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Appendices

Classification Framework for Coastal Systems

U.S. Environmental Protection Agency
Office of Research and Development
National Health and Environmental Effects Research Laboratory
Research Triangle Park, NC 27711

List of Appendices

[1] These appendices are data files (i.e., Excel files); available in a zipped downloadable file with the main document: Appendices are located in the zipped file: A-1.2, A-2.2, A-3.2, A-4.2, A-5.2, B-1.2, C-1.2, C-2.2 at the same weblink as this document.

A-1.1 Estuarine Drainage Area physical and hydrological characteristics: metadata

Database: **EDAPHYSHYDRO.XLS**

Variable: EDA

Label: Estuarine Drainage Area Code
Units:
Format: uppercase alpha-numeric $5.
Source: http://spo.nos.noaa.gov/projects/cads/ftp_data_download.html
NOAA/NOS/Special Projects Office Coastal Assessment & Data Synthesis (CA&DS) system
Metadata: EDA is derived from the variable, EDASUBEDA, which is in the CA&DS dataset, Reference EDA H Data, available from the above download site. 203 EDAs were chosen to be used in classification

Variable: EDANAME

Label: Estuarine Drainage Area Name
Units:
Format: uppercase alpha $43.
Source: http://spo.nos.noaa.gov/projects/cads/ftp_data_download.html
NOAA/NOS/Special Projects Office, Coastal Assessment & Data Synthesis (CA&DS) system
Metadata: EDANAME is derived from the variable, EDA_NAME, which is in the CA&DS dataset, Reference EDA H Data, available from the above download site.

Variable: EDATASQKM

Label: Total Area of EDA
Units: sq km
Format: numeric 12.
Source: http://spo.nos.noaa.gov/projects/cads/ftp_data_download.html
NOAA/NOS/Special Projects Office, Coastal Assessment & Data Synthesis (CA&DS) system, SAS Dataset: cads_surfarea, physhydro, Excel File: cads_surfarea, physhydro
Metadata: EDATASQKM is derived from the variable, EDATSAMI2, which is in the CA&DS dataset, PandH_EDA_h Data, available from the above download site. It represents the Total Area (Land + Water) for the Coastal Watershed (EDA/CDA). This was converted from square miles to square kilometers.

Variable: ESTUARYAREA

Label: Area of estuary in EDA
Units: sq km
Format: numeric 12.
Source: NOAA's Estuarine Eutrophication Survey – Volumes 1-5, NOAA, Office of Ocean Resources Conservation Assessment 1996; SAS

Dataset: cads_pandh, physhydro, Excel File: cads_pandh, physhydro

Metadata: ESTUARYAREA is derived from the variable, WATRE_AREA, which is in the CA&DS dataset, PandH_EDA_h Data, available from the above download site. It represents the Water Area for the Coastal Watershed (EDA/CDA). This was converted from square miles to square kilometers

Variable: MIXZONEAREA

Label: Mixing Zone Surface Area

Units: sq km

Format: numeric 12.

Source: http://spo.nos.noaa.gov/projects/cads/ftp_data_download.html NOAA/NOS/Special Projects Office Coastal Assessment & Data Synthesis (CA&DS) system; SAS Dataset: cads_pandh, physhydro, Excel File: cads_pandh, physhydro

Metadata: MIXZONEAREA is derived from the variable, MIXZSAMI2, which is in the CA&DS dataset, PandH_EDA_h Data, available from the above download site. It represents the Mixing Zone (0.5 - 25.0 ppt) Surface Area. This was converted from square miles to square kilometers.

Variable: SEAZONEAREA

Label: Seawater Zone Surface Area

Units: sq km

Format: numeric 12.

Source: http://spo.nos.noaa.gov/projects/cads/ftp_data_download.html NOAA/NOS/Special Projects Office Coastal Assessment & Data Synthesis (CA&DS) system; SAS Dataset: cads_pandh, physhydro, Excel File: cads_pandh, physhydro

Metadata: SEAZONEAREA is derived from the variable, SEAZSAMI2, which is in the CA&DS dataset, PandH_EDA_h Data, available from the above download site. It represents the Seawater Zone (>25.0 ppt) Surface Area. This was converted from square miles to square kilometers.

Variable: TFZONEAREA

Label: Tidal Freshwater Zone Surface Area

Units: sq km

Format: numeric 12.

Source: http://spo.nos.noaa.gov/projects/cads/ftp_data_download.html NOAA/NOS/Special Projects Office Coastal Assessment & Data Synthesis (CA&DS) system; SAS Dataset: cads_pandh, physhydro; Excel File: cads_pandh, physhydro

Metadata: TFZONEAREA is derived from the variable, TFZSAMI2, which is in the CA&DS dataset, PandH_EDA_h Data, available from the above download site. It represents the Tidal Freshwater Zone (<0.5

ppt) Surface Area. This was converted from square miles to square kilometers.

Variable: TIDEHT

Label: Height of tide

Units: m

Format: numeric 12.

Source: http://spo.nos.noaa.gov/projects/cads/ftp_data_download.html NOAA/NOS/Special Projects Office Coastal Assessment & Data Synthesis (CA&DS) system; SAS Dataset: cads_pandh, physhydro; Excel File: cads_pandh, physhydro

Metadata: TIDEHT is derived from the variable, AESTMTDFT, which is in the CA&DS dataset, PandH_EDA_h Data, available from the above download site. It represents the Average Tidal Height calculated as means of the height differences or ratios measured at NOS tide gauge stations. This was converted from feet to meters.

Variable: RIVERFLOW

Label: Average Monthly River Flow

Units: cu m/day

Format: numeric 12.

Source: http://spo.nos.noaa.gov/projects/cads/ftp_data_download.html, NOAA/NOS/Special Projects Office Coastal Assessment & Data Synthesis (CA&DS) system; NOAA's Estuarine Eutrophication Survey – Volumes 1-5, NOAA, Office of Ocean Resources Conservation Assessment 1996; SAS Dataset: cads_pandh, physhydro, neesdata; Excel File: cads_pandh, physhydro, neesdata

Metadata: RIVERFLOW is derived from the variable, ANNLTFLWAV, which is in the CA&DS dataset, PandH_EDA_h Data, available from the above download site. It represents the Annual Long-Term Flow Average of Gauged Rivers obtained from USGS Gage stations data. If values were missing for RIVERFLOW, the average daily inflow values from NOAA's Estuarine Eutrophication Survey were substituted. Both sets of values were converted from cubic feet per second to cubic meters per day.

Variable: ESTUARYVOL

Label: Estuary Volume

Units: billion cu m

Format: numeric 12.

Source: http://spo.nos.noaa.gov/projects/cads/ftp_data_download.html NOAA/NOS/Special Projects Office Coastal Assessment & Data Synthesis (CA&DS) system; NOAA's Estuarine Eutrophication Survey – Volumes 1-5, NOAA, Office of Ocean Resources Conservation Assessment 1996; SAS Dataset: physhydro, neesdata; Excel File: physhydro, neesdata

Metadata: ESTUARYVOL was typed in from hardcopies of the 5 regional reports of the Estuarine Eutrophication Survey. It comes directly from the bottom left cell, labeled "Volume (billion cu ft)" in the table, titled "Physical and Hydrologic Characteristics" for each EDA. This was converted from billion cubic feet to billion cubic meters. This value represents the volume of the estuary only (water only). If ESTUARYVOL was missing then estimates of estuary volume were calculated as estuaryarea(m2)*depth_m/1000000000.

Variable: TIDALPRISMVOL

Label: Tidal Prism Volume

Units: cu m

Format: numeric 12.

Source: http://spo.nos.noaa.gov/projects/cads/ftp_data_download.html NOAA/NOS/Special Projects Office Coastal Assessment & Data Synthesis (CA&DS) system; SAS Dataset: cads_pandh, physhydro; Excel File: cads_pandh, physhydro

Metadata: TIDALPRISMVOL is derived from the variable, TPVOLBCF, which is in the CA&DS dataset, PandH_EDA_h Data, available from the above download site. It represents the Tidal Prism Volume calculated using the salinity zone mean-range value when available; if not, the salinity mean-tide value multiplied by two was used instead. This salinity zone tide value multiplied by the salinity zone area provided volume for each salinity zone. The sum of all salinity zone volumes provided the tidal prism volume representative for the estuary. If tide information was not available for all three-salinity zones, the estuary mean-range was used when available, if not, the estuary mean-tide value multiplied by two was used instead. This estuary tide-value times the estuary water area provided the tidal prism volume representative for the estuary. This value was converted from billion cubic feet to billion cubic meters.

Variable: BTM_SAL

Label: Salinity at bottom depth

Units: ppt

Format: numeric 10.4

Source: Environmental Monitoring and Assessment Program (EMAP) 1990-1997; National Coastal Assessment (NCA) 2000; SAS datasets: emapwq, physhydro; Excel files: emapwq, physhydro

Metadata: Salinity was measured at surface and bottom depths of stations sampled during the summer through EMAP. This includes stations in the Virginian Province (1990-1993), Carolinian Province (1994-1997), West Indian Province (1995), and Gulf of Mexico (1991-1994). This also includes stations sampled through the National Coastal Assessment (Western Pilot, 1999; NCA, 2000). All EMAP stations were geo-referenced to EDAs and HUCs. BTM_SAL represents the salinity measured at bottom depths averaged across space and time for each EDA.

Variable: SRF_SAL

Label: Salinity at surface depth

Units: ppt

Format: numeric 10.4

Source: Environmental Monitoring and Assessment Program (EMAP) 1990-1997; National Coastal Assessment (NCA) 2000; SAS datasets: emapwq, physhydro; Excel files: emapwq, physhydro

Metadata: Salinity was measured at surface and bottom depths of stations sampled during the summer through EMAP. This includes stations in the Virginian Province (1990-1993), Carolinian Province (1994-1997), West Indian Province (1995), and Gulf of Mexico (1991-1994). This also includes stations sampled through the National Coastal Assessment (Western Pilot, 1999; NCA, 2000). All EMAP stations were geo-referenced to EDAs and HUCs. SRF_SAL represents the salinity measured at surface depths averaged across space and time for each EDA.

Variable: DEPTH_M

Label: Depth at the bottom

Units: m

Format: numeric 10.4

Source: Environmental Monitoring and Assessment Program (EMAP) 1990-1997; National Coastal Assessment (NCA) 2000; SAS datasets: emapdepth, physhydro; Excel files: emapdepth, physhydro

Metadata: Depth was measured at the bottom of stations sampled during the summer through EMAP. This includes stations in the Virginian Province (1990-1993), Carolinian Province (1994-1997), West Indian Province (1995), and Gulf of Mexico (1991-1994). This also includes stations sampled through the National Coastal Assessment (Western Pilot, 1999; NCA, 2000). All EMAP stations were geo-referenced to EDAs and HUCs. DEPTH_M represents the bottom depths averaged across space and time for each EDA. If depth was missing for an EDA, the average depth from NOAA's Estuarine Eutrophication Survey Regional reports was used instead. This is found in the middle left cell labeled, Average Depth (ft) Estuary, in the table titled, Physical and Hydrologic Characteristics, for each EDA. This depth was converted from feet to meters.

Variable: DCP

Label: Dissolved Concentration Potential

Units: mg/L

Format: numeric 10.4

Source: National Oceanic and Atmospheric Administration (NOAA). 1989. Susceptibility and Status of Gulf of Mexico Estuaries to Nutrient Discharges. Silver Spring, MD.Office of Oceanography and Marine Assessment.

Metadata: The variable DCP is a calculated variable estimating the dissolved concentration potential of a pollutant as a function of pollutant load, the volume of freshwater in the estuary, freshwater inflow, and total estuarine volume. The volume of freshwater in the estuary was calculated using the freshwater fraction method, where,

Ffw = (SO-S)/SO), Ffw- Freshwater fraction,
SO= Boundary Salinity and S= Average salinity

The volume of freshwater was calculated using:

Vfw = Ffw*Vtot, where,
Vfw= volume of freshwater in the estuary,
Ffw= Freshwater Fraction, and
Vtot= Estuarine volume

Dissolved concentration potential (DCP) was calculated using the following equation: DCP= L(Vfw/Ifw)(1/Vtot), where,

DCP= Dissolved concentration potential,
L= Pollutant Load,
Vfw=Volume of freshwater in the estuary,
Ifw= Average freshwater inflow (daily average river flow)
Vtot= Estuarine volume.

In order to compare DCP values among EDAs, an estimated pollutant load (L) of 25,000 kg/d was assigned to each EDA and substituted in the DCP equation. Based on the standard pollutant load, DCP values can be used to estimate the concentration of a pollutant expected in an estuary.

Variable: PRE

Label: Particle Retention Efficiency
Units: years
Format: numeric 10.4
Source: National Oceanic and Atmospheric Administration (NOAA). 1989. Susceptibility and Status of Gulf of Mexico Estuaries to Nutrient Discharges. Silver Spring, MD.Office of Oceanography and Marine Assessment.
Metadata: Particle retention efficiency (PRE) is estimates an estuary's ability to trap suspended particles, i.e., the time a particle remains in an estuary. PRE is calculated using the formula: PRE= C/I, where,

C= Volume of the estuary
I= freshwater inflow

Appendix A-2.1 EDA/CDA land-use and land-cover: metadata

Database: **EDALANDCOVER.XLS**

Variable: EDA

Label: Estuarine Drainage Area Code
Units:
Format: uppercase alpha-numeric $5.
Source: http://spo.nos.noaa.gov/projects/cads/ftp_data_download.html NOAA/NOS/Special Projects Office Coastal Assessment & Data Synthesis (CA&DS) system
Metadata: EDA is derived from the variable, EDASUBEDA, which is in the CA&DS dataset, Reference EDA H Data, available from the above download site. 203 EDAs were chosen to be used in classification

Variable: WATER

Label: Area with Land Cover Type = Water
Units: sq km
Format: numeric 8.
Source: Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992, http://www.epa.gov/mrlc/nlcd.html
Metadata: The USGS and the USEPA created a nationwide land cover dataset (National Land Cover Data - NLCD) for the conterminous U.S. based on early to mid-1990s 30-meter Landsat Thematic Mapper (TM) satellite imagery. The NLCD consists of 21 land cover categories classified in a consistent manner across the conterminous U.S. To derive acreage statistics for each spatial referencing unit or EDA, USGS (NWRC – Gulf Breeze Project Office) performed a matrix overlay of our spatial referencing unit dataset with the NLCD dataset.

Variable: URBANCOMM

Label: Area with Land Cover Type = Urban/Commercial
Units: sq km
Format: numeric 8.
Source: Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992, http://www.epa.gov/mrlc/nlcd.html
Metadata: The USGS and the USEPA created a nationwide land cover dataset (National Land Cover Data - NLCD) for the conterminous U.S. based on early to mid-1990s 30-meter Landsat Thematic Mapper (TM) satellite imagery. The NLCD consists of 21 land cover categories classified in a consistent manner across the conterminous U.S. To derive acreage statistics for each spatial referencing unit or EDA, USGS (NWRC – Gulf Breeze Project Office) performed a matrix overlay of our spatial referencing unit dataset with the NLCD dataset. Urban/Commercial was created by summing the area for the

following land cover types: High & Low Intensity Residential and Commercial, Industrial, Transportation.

Variable: BARREN

Label: Area with Land Cover Type = Barren

Units: sq km

Format: numeric 8.

Source: Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992, http://www.epa.gov/mrlc/nlcd.html

Metadata: The USGS and the USEPA created a nationwide land cover dataset (National Land Cover Data - NLCD) for the conterminous U.S. based on early to mid-1990s 30-meter Landsat Thematic Mapper (TM) satellite imagery. The NLCD consists of 21 land cover categories classified in a consistent manner across the conterminous U.S. To derive acreage statistics for each spatial referencing unit or EDA, USGS (NWRC – Gulf Breeze Project Office) performed a matrix overlay of our spatial referencing unit dataset with the NLCD dataset. Barren was created by summing the area for the following land cover types: Bare rock, sand, clay and Quarry, strip mine, gravel pit and Transitional from barren.

Variable: FORESTED

Label: Area with Land Cover Type = Forested

Units: sq km

Format: numeric 8.

Source: Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992, http://www.epa.gov/mrlc/nlcd.html

Metadata: The USGS and the USEPA created a nationwide land cover dataset (National Land Cover Data - NLCD) for the conterminous U.S. based on early to mid-1990s 30-meter Landsat Thematic Mapper (TM) satellite imagery. The NLCD consists of 21 land cover categories classified in a consistent manner across the conterminous U.S. To derive acreage statistics for each spatial referencing unit or EDA, USGS (NWRC – Gulf Breeze Project Office) performed a matrix overlay of our spatial referencing unit dataset with the NLCD dataset. Forested was created by summing the area for the following land cover types: Deciduous, Evergreen, Mixed Forest and Shrubland.

Variable: AGRICULTURE

Label: Area with Land Cover Type = Agriculture

Units: sq km

Format: numeric 8.

Source: Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992, http://www.epa.gov/mrlc/nlcd.html

Metadata: The USGS and the USEPA created a nationwide land cover dataset (National Land Cover Data - NLCD) for the conterminous U.S. based on early to mid-1990s 30-meter Landsat Thematic Mapper

(TM) satellite imagery. The NLCD consists of 21 land cover categories classified in a consistent manner across the conterminous U.S. To derive acreage statistics for each spatial referencing unit or EDA, USGS (NWRC – Gulf Breeze Project Office) performed a matrix overlay of our spatial referencing unit dataset with the NLCD dataset. Agriculture was created by summing the area for the following land cover types: orchard, vineyard, other and grassland, herbaceous, and pasture, hay and row crops and small grains and fallow and urban/recreational grass.

Variable: WETLAND

Label: Area with Land Cover Type = Wetland

Units: sq km

Format: numeric 8.

Source: Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992, http://www.epa.gov/mrlc/nlcd.html

Metadata: The USGS and the USEPA created a nationwide land cover dataset (National Land Cover Data - NLCD) for the conterminous U.S. based on early to mid-1990s 30-meter Landsat Thematic Mapper (TM) satellite imagery. The NLCD consists of 21 land cover categories classified in a consistent manner across the conterminous U.S. To derive acreage statistics for each spatial referencing unit or EDA, USGS (NWRC – Gulf Breeze Project Office) performed a matrix overlay of our spatial referencing unit dataset with the NLCD dataset. Wetland was created by summing the area for the following land cover types: woody wetland and emergent, herbaceous wetland

.

Appendix A-3.1 EDA stressor loadings: metadata

Database: **EDALOADS.XLS**

Variable: EDA

Label: Estuarine Drainage Area Code

Units:

Format: uppercase alpha-numeric $5.

Source: http://spo.nos.noaa.gov/projects/cads/ftp_data_download.html, NOAA/NOS/Special Projects Office Coastal Assessment & Data Synthesis (CA&DS) system

Metadata: EDA is derived from the variable, EDASUBEDA, which is in the CA&DS dataset, Reference EDA H Data, available from the above download site. 203 EDAs were chosen to be used in classification

Variable: TOTALN

Label: Total Nitrogen Load from Point and Non-point Sources

Units: kg/day

Format: numeric 10.4

Source: SPARROW Surface Water Quality Modeling Nutrients in Watersheds of the Conterminous U.S., http://water.usgs.gov/nawqa/sparrow/wrr97/results.html; SAS datasets: nexport, npexport, hucedanpexport; Excel files: nexport, npexport

Metadata: Total N Load was modeled from point and nonpoint source water quality data. The models empirically estimate the delivery of nutrients to streams and the outlets of watersheds from point and nonpoint sources. Estimates of stream transport (dependent variable in the SPARROW models) are adjusted to reflect 1987 nutrient inputs and long-term mean flow conditions (1970-1988), based on records of the concentration and flow for the period 1974 to 1989. Nitrogen nonpoint source data are for 1987. Point source data are for the period 1977-81.

Variable: POINTN

Label: Total Nitrogen Load from Point Sources

Units: kg/day

Format: numeric 10.4

Source: SPARROW Surface Water Quality Modeling Nutrients in Watersheds of the Conterminous U.S., http://water.usgs.gov/nawqa/sparrow/wrr97/results.html; SAS datasets: nexport, npexport, hucedanpexport; Excel files: nexport, npexport

Metadata: Point source N load was modeled from point source water quality data. The models empirically estimate the delivery of nutrients to streams and the outlets of watersheds from point and nonpoint sources. Estimates of stream transport (dependent variable in the

SPARROW models) are adjusted to reflect 1987 nutrient inputs and long-term mean flow conditions (1970-1988), based on records of the concentration and flow for the period 1974 to 1989. Point source data are for the period 1977-81.

Variable: TOTALP

Label: Total Phosphorus Load from Point and Non-point Sources

Units: kg/day

Format: numeric 10.4

Source: SPARROW Surface Water Quality Modeling; Nutrients in Watersheds of the Conterminous U.S.; http://water.usgs.gov/nawqa/sparrow/wrr97/results.html; SAS datasets: pexport, npexport, hucedanpexport; Excel files: pexport, npexport

Metadata: Total P Load was modeled from point and nonpoint source water quality data. The models empirically estimate the delivery of nutrients to streams and the outlets of watersheds from point and nonpoint sources. Estimates of stream transport (dependent variable in the SPARROW models) are adjusted to reflect 1987 nutrient inputs and long-term mean flow conditions (1970-1988), based on records of the concentration and flow for the period 1974 to 1989. Point source data are for the period 1977-81.

Variable: POINTP

Label: Total Phosphorus Load from Point Sources Only

Units: kg/day

Format: numeric 10.4

Source: SPARROW Surface Water Quality Modeling Nutrients in Watersheds of the Conterminous U.S.; http://water.usgs.gov/nawqa/sparrow/wrr97/results.html; SAS datasets: pexport, npexport, hucedanpexport; Excel files: pexport, npexport

Metadata: Point source P load was modeled from point source water quality data. The models empirically estimate the delivery of nutrients to streams and the outlets of watersheds from point and nonpoint sources. Estimates of stream transport (dependent variable in the SPARROW models) are adjusted to reflect 1987 nutrient inputs and long-term mean flow conditions (1970-1988), based on records of the concentration and flow for the period 1974 to 1989. Point source data are for the period 1977-81.

Variable: PAHPC

Label: Principal Component - PAHs

Units:

Format: numeric 10.4

Source: EPA/OW BASINS Water Quality Data by HUC Permit Compliance System Data; http://www.epa.gov/waterscience/ftp/basins/gis_data/huc/; SAS datasets: pcsload, loadpca; Excel files: pcsload

Metadata: Loads of individual chemicals were derived from BASINS data. BASINS data represents average concentrations by HUC. HUCs were geo-referenced to EDAs. Individual loads were calculated for each EDA by averaging over time for each NPDES ID and then summing across all NPDES IDs within a HUC and then summing by EDA. All missing loads were assigned a 0. More information on how pollutant loads are calculated from the Permit Compliance System can be found at http://www.epa.gov/owmitnet/pcsguide.htm. Principal Component Analysis was conducted on the full data set of individual chemical loads. All loads were ln-transformed prior to analysis. Three principal components accounted for 75% of the variance. The first principal component was weighted on PAHs.

Variable: METALPC

Label: Principal Component - Metals

Units:

Format: numeric 10.4

Source: EPA/OW BASINS Water Quality Data by HUC Permit Compliance System Data; http://www.epa.gov/waterscience/ftp/basins/gis_data/huc/SAS datasets: pcsload, loadpca; Excel files: pcsload

Metadata: Loads of individual chemicals were derived from BASINS data. BASINS data represents average concentrations by HUC. HUCs were geo-referenced to EDAs. Individual loads were calculated for each EDA by averaging over time for each NPDES ID and then summing across all NPDES IDs within a HUC and then summing by EDA. All missing loads were assigned a 0. More information on how pollutant loads are calculated from the Permit Compliance System can be found at http://www.epa.gov/owmitnet/pcsguide.htm. Principal Component Analysis was conducted on the full data set of individual chemical loads. All loads were ln-transformed prior to analysis. Three principal components accounted for 75% of the variance. The first principal component was weighted on metals.

Variable: PESTPC

Label: Principal Component - PAHs

Units:

Format: numeric 10.4

Source: EPA/OW BASINS Water Quality Data by HUC Permit Compliance System Data; http://www.epa.gov/waterscience/ftp/basins/gis_data/huc/; SAS datasets: pcsload, loadpca; Excel files: pcsload

Metadata: Loads of individual chemicals were derived from BASINS data. BASINS data represents average concentrations by HUC. HUCs were geo-referenced to EDAs. Individual loads were calculated for each EDA by averaging over time for each NPDES ID and then summing across all NPDES IDs within a HUC and then summing by EDA. All missing loads were assigned a 0. More information on how pollutant loads are calculated from the Permit Compliance System can be found at http://www.epa.gov/owmitnet/pcsguide.htm. Principal Component Analysis was conducted on the full data set of individual chemical loads. All loads were ln-transformed prior to analysis. Three principal components accounted for 75% of the variance. The first principal component was weighted on pesticides.

Variable: SED_RANK

Label: Relative ranking for the potential for sediment delivery

Units:

Format: numeric 10.4

Source: EPA/OW/OWOW Watershed Information Network Index of Watershed Indicators; http://www.epa.gov/wateratlas/geo/maplist.html; SAS datasets: sedranks, hucedasedranks; Excel files: sedranks

Metadata: Full metadata is located at http://www.epa.gov/eims/index.html and found by going to EIMS Search >> Advanced Search >> Entry ID = 1757. SEDIMENT DELIVERY TO RIVERS AND STREAMS FROM CROPLAND AND PASTURELAND 1990-1995 was estimated from two simulation model outputs: Hydrologic Unit Modeling of the United States (HUMUS) and Soil and Water Assessment Tool (SWAT). Soils characteristics for each subarea are taken from the STATSGO soils database. A 30-year weather database is available for each watershed. A process model incorporating hydrology, weather, sedimentation, crop growth, and agricultural management (SWAT--Soil and Water Assessment Tool) is applied to each subarea to simulate the relationships among rainfall, runoff, leaching, groundwater return flow, farm management practices, eros! ion, and surface flow in rivers and streams. One of the outputs of the model is average annual sediment delivery to rivers and streams from sheet and rill erosion from cropland and pastureland, as shown on this map.

Variable: TSSLOADPCS

Label: Total Suspended Solids Load

Units: kg/yr

Format: numeric 10.4

Source: EPA/OW BASINS Water Quality Data by HUC Permit Compliance System Data; http://www.epa.gov/waterscience/ftp/basins/gis_data/huc/; SAS datasets: pcsload; Excel files: pcsload

Metadata: Total Suspended Solids Load (Storet Code=00530) was derived from BASINS data. BASINS data represents average concentrations by HUC. HUCs were geo-referenced to EDAs. The total phosphorus load was calculated for each EDA by averaging over time for each NPDES ID and then summing across all NPDES IDs within a HUC and then summing by EDA. All missing loads were assigned a 0. More information on how pollutant loads are calculated from the Permit Compliance System can be found at http://www.epa.gov/owmitnet/pcsguide.htm

Variable: TPLOADPCS

Label: Total Phosphorus Load

Units: kg/yr

Format: numeric 10.4

Source: EPA/OW BASINS Water Quality Data by HUC Permit Compliance System Data; http://www.epa.gov/waterscience/ftp/basins/gis_data/huc/SAS datasets: pcsload; Excel files: pcsload

Metadata: Total Phosphorus Load (Storet Code=00665) was derived from BASINS data. BASINS data represents average concentrations by HUC. HUCs were geo-referenced to EDAs. The total phosphorus load was calculated for each EDA by averaging over time for each NPDES ID and then summing across all NPDES IDs within a HUC and then summing by EDA. All missing loads were assigned a 0. More information on how pollutant loads are calculated from the Permit Compliance System can be found at http://www.epa.gov/owmitnet/pcsguide.htm

Variable: TNLOADPCS

Label: Total Nitrogen Load

Units: kg/yr

Format: numeric 10.4

Source: EPA/OW BASINS Water Quality Data by HUC Permit Compliance System Data; http://www.epa.gov/waterscience/ftp/basins/gis_data/huc/; SAS datasets: pcsload; Excel files: pcsload

Metadata: Total Nitrogen Load (Storet Code = 00600) was derived from BASINS data. BASINS data represents average concentrations by HUC. HUCs were geo-referenced to EDAs. The total nitrogen load was calculated for each EDA by averaging over time for each NPDES ID and then summing across all NPDES IDs within a HUC and then summing by EDA. All missing loads were assigned a 0. More information on how pollutant loads are calculated from the Permit Compliance System can be found at http://www.epa.gov/owmitnet/pcsguide.htm

Appendix A-4.1 EDA modifying factors: metadata

Database: **EDAEXPOSURE.XLS**

Variable: EDA

Label: Estuarine Drainage Area Code
Units:
Format: uppercase alpha-numeric $5.
Source: http://spo.nos.noaa.gov/projects/cads/ftp_data_download.html; NOAA/NOS/Special Projects Office Coastal Assessment & Data Synthesis (CA&DS) system
Metadata: EDA is derived from the variable, EDASUBEDA, which is in the CA&DS dataset, Reference EDA H Data, available from the above download site. 203 EDAs were chosen to be used in classification

Variable: DIN_MGL

Label: Dissolved Inorganic Nitrogen Concentration
Units: mg/L
Format: numeric 10.4
Source: Environmental Monitoring and Assessment Program EMAP)National Coastal Assessment (NCA) 2000 EPA/OW BASINS Water Quality Data by HUC; http://www.epa.gov/waterscience/ftp/basins/gis_data/huc/; SAS datasets: emapnuts, basinwq; Excel files: emapnuts, basinwq, "edanutrients calculations"
Metadata: Nitrate+Nitrite (NO3+NO2), and Ammonia (NH4) were measured at 888 coastal stations nationwide in the summer of 2000. EMAP/NCA stations were geo-referenced to EDAs and HUCs by USGS/NWRC Gulf Breeze Project Office. DIN was calculated as the sum of NH4 and NO2NO3. The average DIN concentration was calculated for each EDA. When there was no EMAP data for an EDA, BASINS data was used if available. From BASINS, DIN was calculated as the sum of NH4_MGL and NO2NO3_MGL. BASINS data represents average concentrations by HUC. HUCs were geo-referenced to EDAs. The average DIN concentration was calculated for each EDA.

Variable: TKN_MGL

Label: Total Kjeldahl Nitrogen Concentration
Units: mg/L
Format: numeric 10.4
Source: EPA/OW BASINS Water Quality Data by HUC; http://www.epa.gov/waterscience/ftp/basins/gis_data/huc/; SAS datasets: basinwq; Excel files: basinwq,
Metadata: TKN_MGL was derived from BASINS data. BASINS data represents average concentrations by HUC. HUCs were geo-

referenced to EDAs. The average TKN concentration was calculated for each EDA.

Variable: TP_MGL

Label: Total Phosphorus Concentration

Units: mg/L

Format: numeric 10.4

Source: EPA/OW BASINS Water Quality Data by HUC; http://www.epa.gov/waterscience/ftp/basins/gis_data/huc/; SAS datasets: basinwq; Excel files: basinwq, "edanutrients calculations"

Metadata: TP_MGL was derived from BASINS data. BASINS data represents average concentrations by HUC. HUCs were geo-referenced to EDAs. The average TP concentration was calculated for each EDA.

Variable: TSS

Label: Total Suspended Solids Concentration

Units: mg/L

Format: numeric 10.4

Source: EPA/OW BASINS Water Quality Data by HUC; http://www.epa.gov/waterscience/ftp/basins/gis_data/huc/; SAS 7

Metadata: TSS was derived from BASINS data. BASINS data represents average concentrations by HUC. HUCs were geo-referenced to EDAs. The average TSS concentration was calculated for each EDA.

Variable: METALTUSUM

Label: Sediment Metals Toxic Unit Sum

Units: no units

Format: numeric 10.4

Source: Environmental Monitoring and Assessment Program (EMAP); http://www.epa.gov/emap; SAS datasets: emapsedchem; Excel files: emapsedchem

Metadata: Sediment metals were measured from bottom sediments of stations sampled during the summer through EMAP. This includes stations in the Virginian Province (1990-1993), Carolinian Province (1994-1997), West Indian Province (1995), and Gulf of Mexico (1991-1994). This also includes stations sampled through the National Coastal Assessment (Western Pilot, 1999; NCA, 2000). Marine sediment toxicity values were derived from McDonald et al. (2000) and Long et al. (1995) [see table below]. Toxic units for Cd, Cu, Cr, Hg, Ni, and Zn at each EMAP station were calculated by dividing the measured concentration by the appropriate toxicity value (e.g. Cd T.U. = [Cd] / 1.2). Toxic units for all metals were summed for each station. All EMAP stations were geo-referenced to EDAs and HUCs. The average metal toxic unit sum forEDAs and HUCs were calculated by averaging the toxic unit sums for all stations located within the EDA or HUC.

Variable: PESTTUSUM

Label: Sediment Pesticides and Polychlorinated Biphenyls Toxic Unit Sum

Units: no units

Format: numeric 10.4

Source: Environmental Monitoring and Assessment Program (EMAP); http://www.epa.gov/emap; SAS datasets: emapsedchem; Excel files: emapsedchem

Metadata: Sediment pesticides and total PCBs were measured from bottom sediments of stations sampled during the summer through EMAP. This includes stations in the Virginian Province (1990-1993), Carolinian Province (1994-1997), West Indian Province (1995), and Gulf of Mexico (1991-1994). This also includes stations sampled through the National Coastal Assessment (Western Pilot, 1999; NCA, 2000). Marine sediment toxicity values were derived from McDonald et al. (2000) and Long et al. (1995) [see table below]. Because the toxicity values for dieldrin and endrin were in units of organic carbon, concentrations of these pesticides were converted from "ng/g dry weight" to "ug/g OC". Toxic units for total DDTs, Dieldrin, Endrin, and total PCBs at each EMAP station were then calculated by dividing the measured concentration by the appropriate toxicity value (e.g. Dieldrin T.U. = [Cd] / 28). Toxic units for the four contaminants were summed for each station. All EMAP stations were geo-referenced to EDAs and HUCs. The average pesticide/PCB toxic unit sum for EDAs and HUCs was calculated by averaging the toxic unit sums for all stations located within the EDA or HUC.

Variable: PAHTUSUM

Label: Sediment Polycyclic Aromatic Hydrocarbons Toxic Unit Sum

Units: no units

Format: numeric 10.4

Source: Environmental Monitoring and Assessment Program (EMAP); http://www.epa.gov/emap; SAS datasets: emapsedchem; Excel files: emapsedchem

Metadata: Sediment PAHs were measured from bottom sediments of stations sampled during the summer through EMAP. This includes stations in the Virginian Province (1990-1993), Carolinian Province (1994-1997), West Indian Province (1995), and Gulf of Mexico (1991-1994). This also includes stations sampled through the National Coastal Assessment (Western Pilot, 1999; NCA, 2000). Marine sediment toxicity values were derived from McDonald et al. (2000) and Long et al. (1995) [see table below]. Because the toxicity values for all PAHs were in units of organic carbon, PAH concentrations were converted from "ng/g dry weight" to "ug/g OC". Toxic units for 16 PAHs at each EMAP station were calculated by dividing the measured concentration by the appropriate toxicity value (e.g. Acenaphthene T.U. = [Acenaphthene] / 491). Toxic units for all PAHs were summed for each station. All EMAP stations were geo-referenced to

EDAs and HUCs. The average PAH toxic unit sum for EDAs and HUCs were calculated by averaging the toxic unit sums for all stations located within the EDA or HUC.

Variable: METALTUMAX

Label: Sediment Metals Toxic Unit Maximum

Units: no units

Format: numeric 10.4

Source: Environmental Monitoring and Assessment Program (EMAP); http://www.epa.gov/emap; SAS datasets: emapsedchem; Excel files: emapsedchem

Metadata: Sediment metals were measured from bottom sediments of stations sampled during the summer through EMAP. This includes stations in the Virginian Province (1990-1993), Carolinian Province (1994-1997), West Indian Province (1995), and Gulf of Mexico (1991-1994). This also includes stations sampled through the National Coastal Assessment (Western Pilot, 1999; NCA, 2000). Marine sediment toxicity values were derived from McDonald et al. (2000) and Long et al. (1995) [see table below]. Toxic units for Cd, Cu, Cr, Hg, Ni, and Zn at each EMAP station were calculated by dividing the measured concentration by the appropriate toxicity value (e.g. Cd T.U. = [Cd] / 1.2). The maximum toxic unit for all metals was calculated for each station. All EMAP stations were geo-referenced to EDAs and HUCs. The average metal toxic unit maximum for EDAs and HUCs were calculated by averaging the toxic unit maxima for all stations located within the EDA or HUC.

Variable: PESTTUMAX

Label: Sediment Pesticides and Polychlorinated Biphenyls Toxic Unit Maximum

Units: no units

Format: numeric 10.4

Source: Environmental Monitoring and Assessment Program (EMAP); http://www.epa.gov/emap; SAS datasets: emapsedchem; Excel files: emapsedchem

Metadata: Sediment pesticides and total PCBs were measured from bottom sediments of stations sampled during the summer through EMAP. This includes stations in the Virginian Province (1990-1993), Carolinian Province (1994-1997), West Indian Province (1995), and Gulf of Mexico (1991-1994). This also includes stations sampled through the National Coastal Assessment (Western Pilot, 1999; NCA, 2000). Marine sediment toxicity values were derived from McDonald et al. (2000) and Long et al. (1995) [see table below]. Because the toxicity values for dieldrin and endrin were in units of organic carbon, concentrations of these pesticides were converted from "ng/g dry weight" to "ug/g OC". Toxic units for total DDTs, Dieldrin, Endrin, and total PCBs at each EMAP station were then calculated by dividing the measured concentration by the appropriate toxicity value (e.g. Dieldrin T.U. = [Cd] / 28). The maximum toxic unit for the four contaminants was calculated for each station. All EMAP stations were geo-referenced to EDAs and HUCs. The average pesticide/PCB toxic unit maximum for EDAs and HUCs was calculated by averaging the toxic unit maxima for all stations located within the EDA or HUC.

Variable: PAHTUMAX

Label: Sediment Polycyclic Aromatic Hydrocarbons Toxic Unit Maximum

Units: no units

Format: numeric 10.4

Source: Environmental Monitoring and Assessment Program (EMAP); http://www.epa.gov/emap; SAS datasets: emapsedchem; Excel files: emapsedchem

Metadata: Sediment PAHs were measured from bottom sediments of stations sampled during the summer through EMAP. This includes stations in the Virginian Province (1990-1993), Carolinian Province (1994-1997), West Indian Province (1995), and Gulf of Mexico (1991-1994). This also includes stations sampled through the National Coastal Assessment (Western Pilot, 1999; NCA, 2000). Marine sediment toxicity values were derived from McDonald et al. (2000) and Long et al. (1995) [see table below]. Because the toxicity values for all PAHs were in units of organic carbon, PAH concentrations were converted from "ng/g dry weight" to "ug/g OC". Toxic units for 16 PAHs at each EMAP station were calculated by dividing the measured concentration by the appropriate toxicity value (e.g. Acenaphthene T.U. = [Acenaphthene] / 491). The maximum toxic unit for all PAHs was calculated for each station. All EMAP stations were geo-referenced to EDAs and HUCs. The average PAH toxic unit maximum for EDAs and HUCs were calculated by averaging the toxic unit maxima for all stations located within the EDA or HUC.

Variable: PRSKF_LEA

Label: Potential Leaching Concentration at the Bottom of the Root Zone Exceeds at Least One Water Quality Threshold for Fish

Units: % Acres

Format: numeric 10.4

Source: USDA NRCS National Pesticide Loss Database; http://www.nrcs.usda.gov/technical/land/pubs/gosstext.html; SAS datasets: pestlriskfish; Excel files: riskf_lea, pestlriskfish

Metadata: A National Pesticide Loss Database was created for use as a look-up table for estimates of pesticide losses from farm fields in leachate and runoff. Pesticide leaching and runoff losses were estimated using the pesticide fate and transport model GLEAMS 1. Pesticide leaching was movement beyond the bottom of the root-zone. Final pesticide loss results are reported as 1) the percentage of total mass of pesticide applied, and 2) the annual concentration of pesticide leaving the field, expressed as the percentage of total mass of pesticide applied per million parts of water or sediment. Mass loss and annual concentration were calculated for each pesticide at each sample point. Mass loss estimates were then aggregated over acres treated in each watershed to produce national maps. Concentrations were compared to water quality thresholds to derive a measure of environmental risk at each NRI sample point. Maximum Acceptable Toxicant Concentrations (MATCs) were used as "safe" thresholds for fish, which were calculated using toxicity data published by EPA. The extent to which the concentration exceeded the threshold was used as a measure of risk for each pesticide. PRSKF_LEA is an index of the percent of the land in the watershed (nonfederal rural land) where the potential leaching concentration at the bottom of the root zone exceeds at least one water quality threshold for fish.

Variable: PRSKF_RUN

Label: Potential Runoff Concentration at the Edge of the Field Exceeds at Least One Water Quality Threshold for Fish

Units: % Acres

Format: numeric 10.4

Source: USDA NRCS National Pesticide Loss Database; http://www.nrcs.usda.gov/technical/land/pubs/gosstext.html; SAS datasets: pestrriskfish; Excel files: riskf_run, pestrriskfish

Metadata: A National Pesticide Loss Database was created for use as a look-up table for estimates of pesticide losses from farm fields in leachate and runoff. Pesticide leaching and runoff losses were estimated using the pesticide fate and transport model GLEAMS 1. Pesticide leaching was movement beyond the bottom of the root-zone. Final pesticide loss results are reported as 1) the percentage of total mass of pesticide applied, and 2) the annual concentration of pesticide leaving the field, expressed as the percentage of total mass of pesticide applied per million parts of water or sediment. Mass loss and annual concentration were calculated for each pesticide at each sample point. Mass loss estimates were then aggregated over acres treated in each watershed to produce national maps. Concentrations were compared to water quality thresholds to derive a measure of environmental risk at each NRI sample point. Maximum Acceptable Toxicant Concentrations (MATCs) were used as "safe" thresholds for fish, which were calculated using toxicity data published by EPA. The extent to which the concentration exceeded the threshold was used as a measure of risk for each pesticide. PRSKF_RUN is an index of the percent of the land in the watershed (nonfederal rural land) where the potential runoff concentration at the edge of the field exceeds at least one water quality threshold for fish.

Variable: PRSKH_LEA

Label: Potential Leaching Concentration at the Bottom of the Root Zone Exceeds at Least One Water Quality Threshold for Humans

Units: % Acres
Format: numeric 10.4
Source: USDA NRCS National Pesticide Loss Database; http://www.nrcs.usda.gov/technical/land/pubs/gosstext.html; SAS datasets: pestlriskhuman; Excel files: riskh_lea, pestlriskhuman
Metadata: A National Pesticide Loss Database was created for use as a look-up table for estimates of pesticide losses from farm fields in leachate and runoff. Pesticide leaching and runoff losses were estimated using the pesticide fate and transport model GLEAMS 1. Pesticide leaching was movement beyond the bottom of the root-zone. Final pesticide loss results are reported as 1) the percentage of total mass of pesticide applied, and 2) the annual concentration of pesticide leaving the field, expressed as the percentage of total mass of pesticide applied per million parts of water or sediment. Mass loss and annual concentration were calculated for each pesticide at each sample point. Mass loss estimates were then aggregated over acres treated in each watershed to produce national maps. Concentrations were compared to water quality thresholds to derive a measure of environmental risk at each NRI sample point. Health Advisories (HAs) and Maximum Contaminant Levels (MCLs) were used for humans for pesticides that have been assigned drinking water standards by EPA. For other pesticides, "safe" thresholds were estimated from EPA Reference Dose values and cancer slope data. The extent to which the concentration exceeded the threshold was used as a measure of risk for each pesticide. PRSKH_LEA is an index of the percent of the land in the watershed (nonfederal rural land) where the potential leaching concentration at the bottom of the root zone exceeds at least one water quality threshold for humans.

Variable: PRSKH_RUN
Label: Potential Runoff Concentration at the Edge of the Field Exceeds at Least One Water Quality Threshold for Fish
Units: % Acres
Format: numeric 10.4
Source: USDA NRCS National Pesticide Loss Database; http://www.nrcs.usda.gov/technical/land/pubs/gosstext.html; SAS datasets: pestrriskhuman; Excel files: riskh_run, pestrriskhuman

Metadata: A National Pesticide Loss Database was created for use as a look-up table for estimates of pesticide losses from farm fields in leachate and runoff. Pesticide leaching and runoff losses were estimated using the pesticide fate and transport model GLEAMS 1. Pesticide leaching was movement beyond the bottom of the root-zone. Final pesticide loss results are reported as 1) the percentage of total mass of pesticide applied, and 2) the annual concentration of pesticide leaving the field, expressed as the percentage of total mass of pesticide applied per million parts of water or sediment. Mass loss and annual concentration were calculated for each pesticide at each sample point.

Mass loss estimates were then aggregated over acres treated in each watershed to produce national maps. Concentrations were compared to water quality thresholds to derive a measure of environmental risk at each NRI sample point. Health \Advisories (HAs) and Maximum Contaminant Levels (MCLs) were used for humans for pesticides that have been assigned drinking water standards by EPA. For other pesticides, "safe" thresholds were estimated from EPA Reference Dose values and cancer slope data. The extent to which the concentration exceeded the threshold was used as a measure of risk for each pesticide. PRSKH_RUN is an index of the percent of the land in the watershed (nonfederal rural land) where the potential runoff concentration at the edge of the field exceeds at least one water quality threshold for humans.

Appendix A-5.1 EDA modifying factors: metadata

Database: **EDAMODIFIERS.XLS**

Variable: EDA
Label: Estuarine Drainage Area Code
Units:
Format: uppercase alpha-numeric $5.
Source: http://spo.nos.noaa.gov/projects/cads/ftp_data_download.html NOAA/NOS/Special Projects Office Coastal Assessment & Data Synthesis (CA&DS) system
Metadata: EDA is derived from the variable, EDASUBEDA, which is in the CA&DS dataset, Reference EDA H Data, available from the above download site. 203 EDAs were chosen to be used in classification

Variable: TOC
Label: Total Organic Carbon Concentration in Sediment
Units: %
Format: numeric 10.4
Source: Environmental Monitoring and Assessment Program (EMAP) http://www.epa.gov/emap; SAS datasets: emapsedchem; Excel files: emapsedchem
Metadata: Total Organic Carbon (TOC) was measured from bottom sediments of stations sampled during the summer through EMAP. This includes stations in the Virginian Province (1990-1993), Carolinian Province (1994-1997), West Indian Province (1995), and Gulf of Mexico (1991-1994). This also includes stations sampled through the National Coastal Assessment (Western Pilot, 1999; NCA, 2000). All EMAP stations were geo-referenced to EDAs and HUCs. TOC represents the average DO across depth, space and time for each EDA.

Variable: AVS
Label: Acid-Volatile Sulfide Concentration in Sediment
Units: µM
Format: numeric 10.4
Source: Environmental Monitoring and Assessment Program (EMAP), http://www.epa.gov/emap; SAS datasets: emapsedchem; Excel files: emapsedchem
Metadata: Acid-Volatile Sulfide (AVS) was measured from bottom sediments of stations sampled during the summer through EMAP. This includes stations in the Virginian Province (1990-1993), Carolinian Province (1994-1997), West Indian Province (1995), and Gulf of Mexico (1991-1994). This also includes stations sampled through the National Coastal Assessment (Western Pilot, 1999; NCA, 2000). All EMAP stations were geo-referenced to EDAs and HUCs. AVS

represents the average AVS across depth, space and time for each EDA.

Variable: AV_DO
- *Label:* Average Dissolved Oxygen Concentration in Water
- *Units:* mg/L
- *Format:* numeric 10.4
- *Source:* Environmental Monitoring and Assessment Program (EMAP); National Coastal Assessment (NCA) 2000; EPA/OW BASINS Water Quality Data by HUC; http://www.epa.gov/waterscience/ftp/basins/gis_data/huc/; SAS datasets: emapwq, basinwq; Excel files: emapwq, basinwq, "WQ CALCS"
- *Metadata:* Dissolved Oxygen (DO) was measured at surface and bottom depths of stations sampled during the summer through EMAP. This includes stations in the Virginian Province (1990-1993), Carolinian Province (1994-1997), West Indian Province (1995), and Gulf of Mexico (1991-1994). This also includes stations sampled through the National Coastal Assessment (Western Pilot, 1999; NCA, 2000). EMAP/NCA stations were geo-referenced to EDAs and HUCs by USGS/NWRC Gulf Breeze Project Office. The average DO concentration was calculated for each EDA. When there was no EMAP data for an EDA, BASINS data was used if available. From BASINS, DO_MGL was used. BASINS data represents average concentrations by HUC. HUCs were geo-referenced to EDAs. The average DO concentration was calculated for each EDA.

Variable: AV_SAL
- *Label:* Average Salinity in Water
- *Units:* ppt
- *Format:* numeric 10.4
- *Source:* Environmental Monitoring and Assessment Program (EMAP), http://www.epa.gov/emap; SAS datasets: emapwq; Excel files: emapwq
- *Metadata:* Salinity was measured at surface and bottom depths of stations sampled during the summer through EMAP. This includes stations in the Virginian Province (1990-1993), Carolinian Province (1994-1997), West Indian Province (1995), and Gulf of Mexico (1991-1994). This also includes stations sampled through the National Coastal Assessment (Western Pilot, 1999; NCA, 2000). All EMAP stations were geo-referenced to EDAs and HUCs. AV_SAL represents the average salinity across depth, space and time for each EDA.

Variable: AV_PH
- *Label:* Average pH in Water
- *Units:*
- *Format:* numeric 10.4

Source: Environmental Monitoring and Assessment Program (EMAP) National Coastal Assessment (NCA) 2000; EPA/OW BASINS Water Quality Data by HUC; http://www.epa.gov/waterscience/ftp/basins/gis_data/huc/; SAS datasets: emapwq, basinwq; Excel files: emapwq, basinwq, "WQ CALCS"

Metadata: PH was measured at surface and bottom depths of stations sampled during the summer through EMAP. This includes stations in the Virginian Province (1990-1993), Carolinian Province (1994-1997), West Indian Province (1995), and Gulf of Mexico (1991-1994). This also includes stations sampled through the National Coastal Assessment (Western Pilot, 1999; NCA, 2000). EMAP/NCA stations were geo-referenced to EDAs and HUCs by USGS/NWRC Gulf Breeze Project Office. The average pH was calculated for each EDA. When there was no EMAP data for an EDA, BASINS data was used if available. From BASINS, PH was used. BASINS data represents average concentrations by HUC. HUCs were geo-referenced to EDAs. The average pH was calculated for each EDA.

Variable: AV_TEMP

Label: Average Water Temperature

Units: degrees C

Format: numeric 10.4

Source: Environmental Monitoring and Assessment Program (EMAP) National Coastal Assessment (NCA) 2000; EPA/OW BASINS Water Quality Data by HUC; http://www.epa.gov/waterscience/ftp/basins/gis_data/huc/; SAS datasets: emapwq, basinwq; Excel files: emapwq, basinwq, "WQ CALCS"

Metadata: Water Temperature was measured at surface and bottom depths ofstations sampled during the summer through EMAP. This includes stations in the Virginian Province (1990-1993), Carolinian Province (1994-1997), West Indian Province (1995), and Gulf of Mexico (1991-1994). This also includes stations sampled through the National Coastal Assessment (Western Pilot, 1999; NCA, 2000). EMAP/NCA stations were geo-referenced to EDAs and HUCs by USGS/NWRC Gulf Breeze Project Office. The average temperature was calculated for each EDA. When there was no EMAP data for an EDA, BASINS data was used if available. From BASINS, WTRTEMP_C was used. BASINS data represents average concentrations by HUC. HUCs were geo-referenced to EDAs. The average water temperature was calculated for each EDA.

Variable: TSS

Label: Total Suspended Solids Concentration in Water

Units: mg/L

Format: numeric 10.4

Source: EPA/OW BASINS Water Quality Data by HUC; http://www.epa.gov/waterscience/ftp/basins/gis_data/huc/; SAS datasets: basinwq; Excel files: basinwq,
Metadata: TSS was derived from BASINS data. BASINS data represents average concentrations by HUC. HUCs were geo-referenced to EDAs. The average TSS concentration was calculated for each EDA.

Variable: HARDNESS
Label: Hardness as CACO3 in Water
Units: mg/L
Format: numeric 10.4
Source: EPA/OW BASINS Water Quality Data by HUC; http://www.epa.gov/waterscience/ftp/basins/gis_data/huc/; SAS datasets: basinwq; Excel files: basinwq,
Metadata: HARDNESS was derived from BASINS data. BASINS data represents average concentrations by HUC. HUCs were geo-referenced to EDAs. The average HARDNESS was calculated for each EDA.

Variable: ALKALINITY
Label: Total Alkalinity as CACO3 in Water
Units: mg/L
Format: numeric 10.4
Source: EPA/OW BASINS Water Quality Data by HUC; http://www.epa.gov/waterscience/ftp/basins/gis_data/huc/; SAS datasets: basinwq; Excel files: basinwq,
Metadata: ALKALINITY was derived from BASINS data. BASINS data represents average concentrations by HUC. HUCs were geo-referenced to EDAs. The average ALKALINITY was calculated for each EDA.

Variable: CHLORIDE
Label: Total Chloride Concentration in Water
Units: mg/L
Format: numeric 10.4
Source: EPA/OW BASINS Water Quality Data by HUC; http://www.epa.gov/waterscience/ftp/basins/gis_data/huc/; SAS datasets: basinwq; Excel files: basinwq,
Metadata: CHLORIDE was derived from BASINS data. BASINS data represents average concentrations by HUC. HUCs were geo-referenced to EDAs. The average CHLORIDE concentration was calculated for each EDA.

Variable: COND
Label: Specific Conductance in Water
Units: µmhos/cm
Format: numeric 10.4

Source: EPA/OW BASINS Water Quality Data by HUC; http://www.epa.gov/waterscience/ftp/basins/gis_data/huc/; SAS datasets: basinwq; Excel files: basinwq,

Metadata: COND was derived from BASINS data. BASINS data represents average concentrations by HUC. HUCs were geo-referenced to EDAs. The average COND concentration was calculated for each EDA.

Variable: SO4

Label: Sulfate Concentration in Water

Units: mg/L

Format: numeric 10.4

Source: EPA/OW BASINS Water Quality Data by HUC; http://www.epa.gov/waterscience/ftp/basins/gis_data/huc/; SAS datasets: basinwq; Excel files: basinwq,

Metadata: SO4 was derived from BASINS data. BASINS data represents average concentrations by HUC. HUCs were geo-referenced to EDAs. The average SO4 concentration was calculated for each EDA.

Appendix B-1.1. Metadata for Great Lakes R-EMAP Coastal Riverine Wetland Watershed Classification Database

Database: **APPENDIXB1_1.XLS**

Variable: WSHDAREA_KM2
Label: Watershed area
Units: kilometer^2
Format: numeric, 8.2
Source: U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN, REMAP03WSHDS, detenbeck.naomi@epa.gov
Metadata: Watershed boundaries for 155 Great Lakes coastal riverine wetlands sampled for a EPA Region V Regional Assessment and Monitoring Program (R-EMAP) project were digitized in ArcMap using digital raster graphics (DRGs, 1:24,000) as backdrops. Existing watershed boundaries (National Watershed Boundary Database, state watershed boundary databases, and watershed boundaries derived by USGS EROS Data Center through an automated process) were used as a base coverage when available, and modified so that the watershed outlet was consistent with R-EMAP sampling points. Watershed areas were calculated in ArcInfo in meter^2 and converted to square kilometers by dividing by 10^6.

Variable: FWATER
Label: Fraction open water in watershed
Units: Fraction, unitless
Format: numeric 6.5
Source: Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992 http://www.epa.gov/mrlc/nlcd.html and U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN, derived from US EPA MED-Duluth watershed boundaries
Metadata: The USGS and the USEPA created a nationwide land cover dataset (National Land Cover Data - NLCD) for the conterminous U.S. based on early to mid-1990s 30-meter Landsat Thematic Mapper (TM) satellite imagery. The NLCD consists of 21 land cover categories classified in a consistent manner across the conterminous U.S. To derive area of different land-cover/land-use classes within each wetland watershed, US EPA MED-Duluth intersected watershed boundaries with NLCD coverages. Open water class consists of the sum of areas with grid codes: 10-11

Variable: FURBAN
Label: Fraction urban land in watershed
Units: Fraction, unitless
Format: numeric 6.5

Source: Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992 http://www.epa.gov/mrlc/nlcd.html and U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN, derived from US EPA MED-Duluth watershed boundaries

Metadata: The USGS and the USEPA created a nationwide land cover dataset (National Land Cover Data - NLCD) for the conterminous U.S. based on early to mid-1990s 30-meter Landsat Thematic Mapper (TM) satellite imagery. The NLCD consists of 21 land cover categories classified in a consistent manner across the conterminous U.S. To derive area of different land-cover/land-use classes within each wetland watershed, US EPA MED-Duluth intersected watershed boundaries with NLCD coverages. Urban land-use class consists of the sum of areas with grid codes: 21-23, 84-85

Variable: FBARREN

Label: Fraction barren land in watershed

Units: Fraction, unitless

Format: numeric 6.5

Source: Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992 http://www.epa.gov/mrlc/nlcd.html and U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN, derived from US EPA MED-Duluth watershed boundaries

Metadata: The USGS and the USEPA created a nationwide land cover dataset (National Land Cover Data - NLCD) for the conterminous U.S. based on early to mid-1990s 30-meter Landsat Thematic Mapper (TM) satellite imagery. The NLCD consists of 21 land cover categories classified in a consistent manner across the conterminous U.S. To derive area of different land-cover/land-use classes within each wetland watershed, US EPA MED-Duluth intersected watershed boundaries with NLCD coverages. Barren cover class consists of the sum of areas with grid codes: 31-33

Variable: FFOREST

Label: Fraction forested land in watershed

Units: Fraction, unitless

Format: numeric 6.5

Source: Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992 http://www.epa.gov/mrlc/nlcd.html and U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN, derived from US EPA MED-Duluth watershed boundaries

Metadata: The USGS and the USEPA created a nationwide land cover dataset (National Land Cover Data - NLCD) for the conterminous U.S. based on early to mid-1990s 30-meter Landsat Thematic Mapper (TM) satellite imagery. The NLCD consists of 21 land cover categories classified in a consistent manner across the conterminous

U.S. To derive area of different land-cover/land-use classes within each wetland watershed, US EPA MED-Duluth intersected watershed boundaries with NLCD coverages. Forested land-cover class consists of the sum of areas with grid codes: 41-43

Variable: FSHRUB

Label: Fraction shrubland in watershed

Units: Fraction, unitless

Format: numeric 6.5

Source: Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992 http://www.epa.gov/mrlc/nlcd.html and U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN, derived from US EPA MED-Duluth watershed boundaries

Metadata: The USGS and the USEPA created a nationwide land cover dataset (National Land Cover Data - NLCD) for the conterminous U.S. based on early to mid-1990s 30-meter Landsat Thematic Mapper (TM) satellite imagery. The NLCD consists of 21 land cover categories classified in a consistent manner across the conterminous U.S. To derive area of different land-cover/land-use classes within each wetland watershed, US EPA MED-Duluth intersected watershed boundaries with NLCD coverages. Shrub land-cover class consists of the sum of areas with grid codes: 51

Variable: FGRASS

Label: Fraction nonagricultural grassland in watershed

Units: Fraction, unitless

Format: numeric 6.5

Source: Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992 http://www.epa.gov/mrlc/nlcd.html and U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN, derived from US EPA MED-Duluth watershed boundaries

Metadata: The USGS and the USEPA created a nationwide land cover dataset (National Land Cover Data - NLCD) for the conterminous U.S. based on early to mid-1990s 30-meter Landsat Thematic Mapper (TM) satellite imagery. The NLCD consists of 21 land cover categories classified in a consistent manner across the conterminous U.S. To derive area of different land-cover/land-use classes within each wetland watershed, US EPA MED-Duluth intersected watershed boundaries with NLCD coverages. Non-agricultural grassland-cover class consists of the sum of areas with grid codes: 71

Variable: FAGRIC

Label: Fraction agricultural land in watershed

Units: Fraction, unitless

Format: numeric 6.5

Source: Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992 http://www.epa.gov/mrlc/nlcd.html and U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN, derived from US EPA MED-Duluth watershed boundaries

Metadata: The USGS and the USEPA created a nationwide land cover dataset (National Land Cover Data - NLCD) for the conterminous U.S. based on early to mid-1990s 30-meter Landsat Thematic Mapper (TM) satellite imagery. The NLCD consists of 21 land cover categories classified in a consistent manner across the conterminous U.S. To derive area of different land-cover/land-use classes within each wetland watershed, US EPA MED-Duluth intersected watershed boundaries with NLCD coverages. Agricultural land-use class consisted of the sum of areas with grid codes: 81- 85

Variable: FNLCDWTLD

Label: Fraction wetland area in watershed, NLCD-based

Units: Fraction, unitless

Format: numeric 6.5

Source: Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992 http://www.epa.gov/mrlc/nlcd.html and U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN, derived from US EPA MED-Duluth watershed boundaries

Metadata: The USGS and the USEPA created a nationwide land cover dataset (National Land Cover Data - NLCD) for the conterminous U.S. based on early to mid-1990s 30-meter Landsat Thematic Mapper (TM) satellite imagery. The NLCD consists of 21 land cover categories classified in a consistent manner across the conterminous U.S. To derive area of different land-cover/land-use classes within each wetland watershed, US EPA MED-Duluth intersected watershed boundaries with NLCD coverages. Wetland land-cover class consists of the sum of areas with grid codes: 91-92

Variable: FLWINTRES

Label: Fraction low intensity residential area in watershed

Units: Fraction, unitless

Format: numeric 6.5

Source: Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992 http://www.epa.gov/mrlc/nlcd.html and U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN, derived from US EPA MED-Duluth watershed boundaries

Metadata: The USGS and the USEPA created a nationwide land cover dataset (National Land Cover Data - NLCD) for the conterminous U.S. based on early to mid-1990s 30-meter Landsat Thematic Mapper (TM) satellite imagery. The NLCD consists of 21 land cover categories classified in a consistent manner across the conterminous

U.S. To derive area of different land-cover/land-use classes within each wetland watershed, US EPA MED-Duluth intersected watershed boundaries with NLCD coverages. Low intensity residential land-use class consists of the sum of areas with grid codes: 21

Variable: FHINTRES

Label: Fraction high intensity residential area in watershed
Units: Fraction, unitless
Format: numeric 6.5
Source: Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992 http://www.epa.gov/mrlc/nlcd.html and U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN, derived from US EPA MED-Duluth watershed boundaries
Metadata: The USGS and the USEPA created a nationwide land cover dataset (National Land Cover Data - NLCD) for the conterminous U.S. based on early to mid-1990s 30-meter Landsat Thematic Mapper (TM) satellite imagery. The NLCD consists of 21 land cover categories classified in a consistent manner across the conterminous U.S. To derive area of different land-cover/land-use classes within each wetland watershed, US EPA MED-Duluth intersected watershed boundaries with NLCD coverages. High intensity residential land-use class consists of the sum of areas with grid codes: 22

Variable: FCOMINDTR

Label: Fraction commercial, industrial, and transportation area in watershed
Units: Fraction, unitless
Format: numeric 6.5
Source: Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992 http://www.epa.gov/mrlc/nlcd.html and U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN, derived from US EPA MED-Duluth watershed boundaries
Metadata: The USGS and the USEPA created a nationwide land cover dataset (National Land Cover Data - NLCD) for the conterminous U.S. based on early to mid-1990s 30-meter Landsat Thematic Mapper (TM) satellite imagery. The NLCD consists of 21 land cover categories classified in a consistent manner across the conterminous U.S. To derive area of different land-cover/land-use classes within each wetland watershed, US EPA MED-Duluth intersected watershed boundaries with NLCD coverages. Commercial/industrial/transportation land-use class consists of the sum of areas with grid codes: 23

Variable: FMINING

Label: Fraction mined area in watershed

Units: Fraction, unitless

Format: numeric 6.5

Source: Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992 http://www.epa.gov/mrlc/nlcd.html and U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN, derived from US EPA MED-Duluth watershed boundaries

Metadata: The USGS and the USEPA created a nationwide land cover dataset (National Land Cover Data - NLCD) for the conterminous U.S. based on early to mid-1990s 30-meter Landsat Thematic Mapper (TM) satellite imagery. The NLCD consists of 21 land cover categories classified in a consistent manner across the conterminous U.S. To derive area of different land-cover/land-use classes within each wetland watershed, US EPA MED-Duluth intersected watershed boundaries with NLCD coverages. Mined land-use class consists of the sum of areas with grid codes: 32

Variable: FSTORAGE

Label: Fraction watershed storage area (lakes and wetland area)

Units: Fraction, unitless

Format: numeric 6.5

Source: Derived from following digital wetland inventory databases: National Wetlands Inventory (NWI, http://wetlands.fws.gov/), Wisconsin Wetlands Inventory (WWI, http://www.dnr.state.wi.us/org/water/fhp/wetlands/mapping.shtml, http://wisclinc.state.wi.us/datadisc/wimeta_browser.html see Wetlands of Wisconsin), and Ohio Wetlands Inventory (http://www.dnr.state.oh.us/wetlands/mapping.htm)

Metadata: Calculated from digital wetlands inventory coverages as fraction of area occupied by lacustrine deepwater plus palustrine wetland classes

Variable: FIMPERV

Label: Estimated fraction impervious surface area in watershed

Units: Fraction, unitless

Format: numeric 6.5

Source: Derived from Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992 http://www.epa.gov/mrlc/nlcd.html and U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN, derived from US EPA MED-Duluth watershed boundaries

Metadata: Estimated from NLCD database, using estimates of impervious land in each class for weighting factors. Fraction impervious = (0.55 * fraction low intensity residential) + (0.9 * fraction high intensity residential) + fraction commercial/industrial/transportation. (

Variable: FHYDGA

Label: Fraction soil in hydrologic group A (high infiltration rate) in watershed

Units: Fraction, unitless

Format: numeric, 6.5

Source: Derived from U.S. Department of Agriculture State Soil Geographic Database (STATSGO, http://www.ftw.nrcs.usda.gov/stat_data.html) and from coastal wetland watershed boundaries derived by U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN.

Metadata: Fraction soils in hydrologic group A was estimated from STATSGO by averaging percent soil components in hydrologic soil group A for each Map Unit (MUID) with percent soil components (PCTCOMP) from the COMPLAYER.DBF files as a weighting factor, then averaging percent hydrologic group A across the watershed using MUID area as a weighting factor. Soil components with a hydrologic group of A/D were assumed to be drained (group A) at a frequency proportional to the co-occurrence of agricultural land-use by MUID.

Variable: FHYDGAB

Label: Fraction soil in hydrologic group A (high infiltration rate) or B (moderate infiltration rate) in watershed

Units: Fraction, unitless

Format: numeric, 6.5

Source: Derived from U.S. Department of Agriculture State Soil Geographic Database (STATSGO, http://www.ftw.nrcs.usda.gov/stat_data.html) and from coastal wetland watershed boundaries derived by U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN.

Metadata: Fraction soils in hydrologic groups A and B were estimated from STATSGO by averaging percent soil components in hydrologic soil groups A and B for each Map Unit (MUID) with percent soil components (PCTCOMP) from the COMPLAYER.DBF files as a weighting factor, then averaging percent hydrologic groups A and B across the watershed using MUID area as a weighting factor. Soil components with a hydrologic group of A/D or B/D were assumed to be drained (groups A or B) at a frequency proportional to the co-occurrence of agricultural land-use by MUID.

Variable: AVMNPERM

Label: Average minimum soil permeability in watershed

Units: inches/hour

Format: numeric, 6.2

Source: Derived from U.S. Department of Agriculture State Soil Geographic Database (STATSGO, http://www.ftw.nrcs.usda.gov/stat_data.html) and from coastal wetland watershed boundaries derived by U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN.

Metadata: Minimum soil permeability was calculated for each soil component by selecting the minimum soil permeability across soil layers, then averaging by map unit (MUID) weighting by percent soil component (PCTCOMP), and finally averaging across the watershed weighting by map unit area.

Variable: AVSLOPE

Label: Average watershed slope

Units: percent

Format: numeric, 6.2

Source: Derived from U.S. Department of Agriculture State Soil Geographic Database (STATSGO, http://www.ftw.nrcs.usda.gov/stat_data.html) and from coastal wetland watershed boundaries derived by U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN.

Metadata: Average watershed slope was derived from STATSGO by extracting slope by map unit (MUID), then averaging across watersheds using map unit area as a weighting factor.

Variable: WLVOLUME

Label: Total wetland plus lake storage volume per watershed

Units: $meters^3$

Format: numeric, 12.

Source: Derived from following digital wetland inventory databases: National Wetlands Inventory (NWI, http://wetlands.fws.gov/), Wisconsin Wetlands Inventory (WWI, http://www.dnr.state.wi.us/org/water/fhp/wetlands/mapping.shtml, http://wisclinc.state.wi.us/datadisc/wimeta_browser.html see Wetlands of Wisconsin), and Ohio Wetlands Inventory (http://www.dnr.state.oh.us/wetlands/mapping.htm)

Metadata: Wetland plus lake storage volume was derived by multiplying the area of each wetland type by an appropriate depth, based on descriptions found in wetland inventory metadata.

Variable: I24_2

Label: Average rainfall intensity for 2-year, 24hour event in watershed

Units: water depth, inches/24 hours

Format: numeric, 4.2

Source: U.S. Northeast 2-Year 24-Hour Rain Event (neus2y24hcnt), derived by U.S. Environmental Protection Agency from Wilks and Cember (1993) and U.S. Midwest 2-Year 24-Hour Rain Event (mwus2y24hcnt) derived by U.S. Environmental Protection Agency from Huff and Angel (1992).

Metadata: NEUS2Y24HCNT was georeferenced & vectorized from scanned image of "Map 1, 2-yr return period, 1-day ppt accumulation" from Wilks, D.S. & R.P. Cember, Atlas of Ppt Extremes for the NE U.S. & SE, Northeast Regional Climate Center Research Publ. RR93-5, 40 pp. MWUS2Y24HCNT was georeferenced and vectorized from scanned image of [Figure 6] Spatial distribution of 2-year 24-hour rainfall events (inches). Huff, Floyd A., and James R. Angel. Rainfall Frequency Atlas of the Midwest. Illinois State Water Survey, Champaign, Bulletin 71, 1992.

Variable: I24_2MM

Label: Average rainfall intensity for 2-year, 24hour event in watershed, metric

Units: water depth, millimeters/24 hours

Format: numeric, 4.1

Source: U.S. Northeast 2-Year 24-Hour Rain Event (NEUS2Y24HCNT), derived by U.S. Environmental Protection Agency from Wilks and Cember (1993) and U.S. Midwest 2-Year 24-Hour Rain Event (MWUS2Y24HCNT) derived by U.S. Environmental Protection Agency from Huff and Angel (1992).

Metadata: NEUS2Y24HCNT was georeferenced & vectorized from scanned image of "Map 1, 2-yr return period, 1-day ppt accumulation" from Wilks, D.S. & R.P. Cember, Atlas of Ppt Extremes for the NE U.S. & SE, Northeast Regional Climate Center Research Publ. RR93-5, 40 pp. MWUS2Y24HCNT was georeferenced and vectorized from scanned image of [Figure 6] Spatial distribution of 2-year 24-hour rainfall events (inches). Huff, Floyd A., and James R. Angel. Rainfall Frequency Atlas of the Midwest. Illinois State Water Survey, Champaign, Bulletin 71, 1992. Inches were converted to millimeters using a conversion factor of 25.4.

Variable: SNWTOTL

Label: Average estimated snowfall per year in watershed, water equivalents

Units: depth in mm, water equivalents

Format: numeric, 8.1

Source: **P**arameter-elevation **R**egressions on **I**ndependent **S**lopes **M**odel database (PRISM, Climate Source, Corvallis, OR, http://www.climatesource.com/us/fact_sheets/meta_snowfall_us.html)

Metadata: Average total snowfall was estimated by intersecting PRISM coverage for annual snowfall with coastal wetland watershed boundaries which were derived by US EPA MED-Duluth.

Variable: CN2

Label: Runoff curve number 2 for watershed

Units: Unitless

Format: numeric, 5.1

Source: Derived from Derived from Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992 http://www.epa.gov/mrlc/nlcd.html, from U.S. Department of Agriculture State Soil Geographic Database (STATSGO, http://www.ftw.nrcs.usda.gov/stat_data.html) and from coastal wetland watershed boundaries derived by U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN.

Metadata: Calculated based on USDA Soil Conservation Service curve number method, using curve numbers for combinations of soil hydrologic groups and major land-use classes based on tables in Soil and Water Assessment Tool (SWAT) model (http://www.brc.tamus.edu/swat/swatdoc.html):

CNA = ((77 * FBARREN) + (61.5 * FURBAN) + (50.8 * FAGRIC) + (25 * FFOREST))/TOTCLASS

CNB = ((86 * FBARREN) + (76.5 * FURBAN) + (68 * FAGRIC) + (55 * FFOREST))/TOTCLASS;

CNC = ((91 * FBARREN) + (84.5 * FURBAN) + (78.5 * FAGRIC) + (70 * FFOREST))/TOTCLASS;

CND = ((94 * FBARREN) + (88 * FURBAN) + (83.5 * FAGRIC) + (77 * FFOREST))/TOTCLASS;

then averaging across watershed using map unit area (MUID) as a weighting factor

Variable: CN3

Label: Runoff curve number 3 for watershed

Units: Unitless

Format: numeric, 5.1

Source: Derived from Derived from Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992 http://www.epa.gov/mrlc/nlcd.html, from U.S. Department of Agriculture State Soil Geographic Database (STATSGO, http://www.ftw.nrcs.usda.gov/stat_data.html) and from coastal wetland watershed boundaries derived by U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN.

Metadata: Calculated based on USDA Soil Conservation Service curve number method, based on documentation in Soil and Water Assessment Tool (SWAT) model (http://www.brc.tamus.edu/swat/swatdoc.html):

CN3 = CN2 * exp (0.00673 * (100 _ CN2)

Variable: CN2S

Label: Slope-corrected runoff curve number 2 for watershed

Units: Unitless

Format: numeric, 5.1

Source: Derived from Derived from Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992 http://www.epa.gov/mrlc/nlcd.html, from U.S. Department of Agriculture State Soil Geographic Database (STATSGO, http://www.ftw.nrcs.usda.gov/stat_data.html) and from coastal wetland watershed boundaries derived by U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN.

Metadata: Calculated based on USDA Soil Conservation Service curve number method, based on documentation in Soil and Water Assessment Tool (SWAT) model (http://www.brc.tamus.edu/swat/swatdoc.html): $CN2S = ((1/3) * (CN3-CN2) * (1 - (2 * e^{(-13.86 * avslope/100)}))) + CN2$

Variable: CN3S

Label: Slope-corrected runoff curve number 3 for watershed

Units: Unitless

Format: numeric, 5.1

Source: Derived from Derived from Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992 http://www.epa.gov/mrlc/nlcd.html, from U.S. Department of Agriculture State Soil Geographic Database (STATSGO, http://www.ftw.nrcs.usda.gov/stat_data.html) and from coastal wetland watershed boundaries derived by U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN.

Metadata: Calculated based on USDA Soil Conservation Service curve number method, based on documentation in Soil and Water Assessment Tool (SWAT) model (http://www.brc.tamus.edu/swat/swatdoc.html): $CN3S = CN2S * e^{(0.00673 * (100 - CN2S))}$

Variable: S

Label: Estimated soil storage compartment associated with 2-year, 24hour rainfall event

Units: depth in millimeters

Format: 4.1

Source: Derived from Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992 http://www.epa.gov/mrlc/nlcd.html, from U.S. Department of Agriculture State Soil Geographic Database (STATSGO, http://www.ftw.nrcs.usda.gov/stat_data.html), 2-year 24-hour rainfall intensity (Wilks and Cember, 1993; Huff and Angel, 1992) and from coastal wetland watershed boundaries derived by U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN.

Metadata: Calculated based on USDA Soil Conservation Service curve number method, based on documentation in Soil and Water Assessment Tool (SWAT) model (http://www.brc.tamus.edu/swat/swatdoc.html): $S = 254 * ((100/CN3S) - 1)$,

where S = soil storage component

CN3S = curve number for average soil moisture conditions, corrected for watershed slope

Variable: Q2_24

Label: Estimated runoff associated with 2-year, 24hour rainfall event per watershed

Units: depth in millimeters

Format: 4.1

Source: Derived from Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992 http://www.epa.gov/mrlc/nlcd.html, from U.S. Department of Agriculture State Soil Geographic Database (STATSGO, http://www.ftw.nrcs.usda.gov/stat_data.html), 2-year 24-hour rainfall intensity (Wilks and Cember, 1993; Huff and Angel, 1992) and from coastal wetland watershed boundaries derived by U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN.

Metadata: Calculated based on USDA Soil Conservation Service curve number method, based on documentation in Soil and Water Assessment Tool (SWAT) model (http://www.brc.tamus.edu/swat/swatdoc.html):

S = 254 * ((100/CN3S) - 1)

if Rmm > (0.2 * S) then Q = ((Rmm - (0.2*S))**2)/(Rmm + (0.8*S))

if Rmm le (0.2 * S) then Q = 0,

where Rmm = rainfall from 2-year, 24-hour event (mm)

S = soil storage component (mm), and

Q = runoff (mm) associated with 2-year, 24-hour event

Variable: RVcum

Label: Estimated runoff volume associated with 2-year, 24hour rainfall event per watershed

Units: depth in millimeters

Format: 12.

Source: Derived from Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992 http://www.epa.gov/mrlc/nlcd.html, from U.S. Department of Agriculture State Soil Geographic Database (STATSGO, http://www.ftw.nrcs.usda.gov/stat_data.html), 2-year 24-hour rainfall intensity (Wilks and Cember, 1993; Huff and Angel, 1992) and from coastal wetland watershed boundaries derived by U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN.

Metadata: Calculated based on USDA Soil Conservation Service curve number method, based on documentation in Soil and Water Assessment Tool (SWAT) model (http://www.brc.tamus.edu/swat/swatdoc.html):

RVcum = (Q/1000) * WSHDAREA

where Q = runoff depth associated with 2-year, 24-hour precipitation even

RVcum = cumulative runoff volume

Variable: RDFLINDX

Label: Watershed index of flow responsiveness, rain events

Units: Unitless

Format: numeric, 6.2

Source: Derived from Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992 http://www.epa.gov/mrlc/nlcd.html, U.S. Department of Agriculture State Soil Geographic Database (STATSGO, http://www.ftw.nrcs.usda.gov/stat_data.html), 2-year 24-hour rainfall intensity (Wilks and Cember, 1993; Huff and Angel, 1992) and from wetland volumes based on digital wetland inventory databases: National Wetlands Inventory (NWI, http://wetlands.fws.gov/), Wisconsin Wetlands Inventory (WWI, http://www.dnr.state.wi.us/org/water/fhp/wetlands/mapping.shtml, http://wisclinc.state.wi.us/datadisc/wimeta_browser.html see Wetlands of Wisconsin), and Ohio Wetlands Inventory (http://www.dnr.state.oh.us/wetlands/mapping.htm) and coastal wetland watershed boundaries, derived by U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN.

Metadata: The watershed index of flow responsiveness for rainfall events is calculated as the ratio of potential runoff volume from a 2-year, 24-hour event to watershed depressional storage volume.

Variable: SNFLINDX

Label: Watershed index of flow responsiveness, snowmelt

Units: Unitless

Format: 6.2

Source: Derived from Multi-Resolution Land Characteristics Consortium National Land Cover Data – 1992 http://www.epa.gov/mrlc/nlcd.html, U.S. Department of Agriculture State Soil Geographic Database (STATSGO, http://www.ftw.nrcs.usda.gov/stat_data.html), estimated annual snowfall (**P**arameter-elevation **R**egressions on **I**ndependent **S**lopes **M**odel, PRISM, Climate Source, Corvallis, OR, http://www.climatesource.com/us/fact_sheets/meta_snowfall_us.html) from wetland volumes estimated from digital wetland inventory databases: National Wetlands Inventory (NWI, http://wetlands.fws.gov/), Wisconsin Wetlands Inventory (WWI, http://www.dnr.state.wi.us/org/water/fhp/wetlands/mapping.shtml, http://wisclinc.state.wi.us/datadisc/wimeta_browser.html see Wetlands of Wisconsin), and Ohio Wetlands Inventory (http://www.dnr.state.oh.us/wetlands/mapping.htm), and from coastal wetland watershed boundaries, derived by U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN.

Metadata: The watershed index of flow responsiveness for snowmelt events is calculated as the ratio of potential maximum runoff volume from snowmelt to watershed depressional storage volume.

Appendix C-1.1. Marine and Great Lakes coastal watersheds: equations for peak flow predictions: Metadata for summary of state regression equations to predict peak flows

Database: **NFF_COASTAL.XLS**

Variable: State

Label: State-City
Units: AAAnn-X, where AA = two digit state abbreviation or URB (all urban areas combined), nn = year of report if more than two are included for a given state, X = U (urban), W (west), P (Portland), H (Houston)
Format: alphanumeric, uppercase $ 7.
Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)
Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Typically, analyses are performed separately for urban versus rural areas, as urbanized watersheds often have artificial flow regulation and impervious surface areas, which greatly influence peak flows.

Variable: Region

Label: Hydrologic region within state
Units: N/A
Format: alphanumeric, uppercase $ 5.
Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)
Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Typically, regression analyses are performed separately for different hydrologic regions of each state, based on examination of spatial distribution of regression residuals, as well as for urban areas.

Variable: Transformations

Label: Description of transformations applied to variables in USGS peak flow prediction equations
Units: N/A
Format: alphanumeric description, $34.
Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)
Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics.

Variable: Mult_factor

Label: Multiplication factor in nonlinear regression equation
Units: Unitless
Format: numeric, 10.4.

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: DAREA

Label: Exponent for drainage area term in USGS equation

Units: Unitless

Format: numeric, 5.3.

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2 for all states except ME, km^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: CDA

Label: Exponent for contributing drainage area term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: S

Label: Exponent for main channel slope term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: BR

Label: Exponent for basin relief term in USGS equation
Units: Unitless
Format: numeric, 5.3
Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)
Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: ST

Label: Exponent for watershed storage term in USGS equation
Units: Unitless
Format: numeric, 5.3
Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)
Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: LAKES

Label: Exponent for percent lakes term in USGS equation
Units: Unitless
Format: numeric, 5.3
Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)
Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed

characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: WETLANDS

Label: Exponent for percent wetlands term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: CHSWAMP

Label: Exponent for percent channel swamp term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: CONTRA

Label: Exponent for regulated contributing drainage area term in USGS equation

Units: Unitless

Format: numeric, 6.4

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: CORSD

Label: Exponent for percent coarse glacial drift term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: $Q2 = MF * A^aB^b$… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: HYD_A

Label: Exponent for percent hydrologic soil group A term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: $Q2 = MF * A^aB^b$… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: HYD_D

Label: Exponent for percent hydrologic soil group D term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: $Q2 = MF * A^aB^b$… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed

characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: CARB

Label: Exponent for percent area with carbonate bedrock term in USGS equation

Units: Unitless

Format: numeric, 6.4

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: OUTWASH

Label: Exponent for percent outwash surficial deposits term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: FINEM

Label: Exponent for percent fine-grained glacial surface deposits term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed

characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: MEDTILL

Label: Exponent for percent medium-grained glacial till term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mi^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: MUCK

Label: Exponent for percent muck surficial deposits term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mi^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: CLAY

Label: Exponent for percent clay surficial deposits term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mi^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: TILROCK

Label: Exponent for percent bare rock/thin till term in USGS equation
Units: Unitless
Format: numeric, 5.3
Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)
Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: CORGT

Label: Exponent for coarse-grained glacial till term in USGS equation
Units: Unitless
Format: numeric, 5.3
Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)
Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: SP

Label: Exponent for minimum soil permeability term in USGS equation
Units: Unitless
Format: numeric, 5.3
Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)
Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: IA

Label: Exponent for impervious surface area term in USGS equation

Units: Unitless
Format: numeric, 5.3
Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)
Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: BDF
Label: Exponent for basin development factor term in USGS equation
Units: Unitless
Format: numeric, 5.3
Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)
Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: UI
Label: Exponent for urbanization intensity term in USGS equation
Units: Unitless
Format: numeric, 5.3
Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)
Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: URBAN
Label: Exponent for percent urban area term in USGS equation
Units: Unitless
Format: numeric, 6.4

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: LU12

Label: Exponent for percent land-use 12 area term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: GUTR

Label: Exponent for percent area with gutters/storm drainage term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: FOREST

Label: Exponent for percent forested area term in USGS equation

Units: Unitless

Format: numeric, 6.4

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: PREC

Label: Exponent for annual precipitation term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: SNOFALL

Label: Exponent for snowfall term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: I2_24

Label: Exponent for rainfall intensity, 2-yr, 24-hour storm term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: I24_100

Label: Exponent for rainfall intensity, 100 yr, 24-hour storm term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: I2_2

Label: Exponent for rainfall intensity, 2-yr, 2-hour storm term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: RC

Label: Exponent for runoff coefficient term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: $Q2 = MF * A^aB^b\ldots$ where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: RO

Label: Exponent for annual runoff term in USGS equation
Units: Unitless
Format: numeric, 5.3
Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)
Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: $Q2 = MF * A^aB^b\ldots$ where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: JANMIN

Label Exponent for minimum January temperature term in USGS equation
Units: Unitless
Format: numeric, 5.3
Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)
Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: $Q2 = MF * A^aB^b\ldots$ where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: ELEV

Label: Exponent for basin elevation term in USGS equation
Units: Unitless
Format: numeric, 5.3
Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)
Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: $Q2 = MF * A^aB^b\ldots$ where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed

characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: H

Label: Exponent for average main channel elevation, 15%ile and 85%ile term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: BSF

Label: Exponent for basin shape factor term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: L

Label: Exponent for main channel length term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: SLENRAT

Label: Exponent for basin slenderness ratio term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: RQ2

Label: Exponent for rural 2-year peak flow term in USGS equation

Units: Unitless

Format: numeric, 5.3

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Variable: SEE

Label: Standard error of estimate for USGS equation

Units: Percent

Format: numeric, 3.

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Equations are typically in the form: Q2 = MF * A^aB^b… where Q2 = 2-year peak discharge (cfs), MF = multiplication factor, A = watershed area (mil^2), B = other watershed characteristic(s), and a and b are exponents derived through nonlinear regression analysis.

Appendix C1.3. Flood frequency equation references (Study abbreviation).

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Appendix C-2.1 Marine and Great Lakes coastal watersheds: peak flow classes identified by CART analysis: metadata

Database: **CART_RESULTS.XLS**

Variable: U/R

Label: Urbanized or rural watersheds
Units: U = urban, R = rural
Format: alphanumeric, uppercase $ 1.
Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)
Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Typically, analyses are performed separately for urban versus rural areas, as urbanized watersheds often have artificial flow regulation and impervious surface areas, which greatly influence peak flows.

Variable: State

Label: State-City
Units: AAAnn-X, where AA = two digit state abbreviation or URB (all urban areas combined), nn = year of report if more than two are included for a given state, X = U (urban), W (west), P (Portland), H (Houston)
Format: alphanumeric, uppercase $ 7.
Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)
Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Typically, analyses are performed separately for urban versus rural areas, as urbanized watersheds often have artificial flow regulation and impervious surface areas, which greatly influence peak flows.

Variable: Region

Label: Hydrologic region within state
Units: Unitless, coding varies by state
Format: alphanumeric, uppercase $ 6.
Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)
Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Typically, regression analyses are performed

separately for different hydrologic regions of each state, based on examination of spatial distribution of regression residuals.

Variable: Group

Label: CART classification group

Units: Unitless

Format: numeric, 2.

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html) provided the raw data on 2-year peak flows and watershed characteristics for the Classification and Regression Tree analyses

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Typically, regression analyses are performed separately for different hydrologic regions of each state, based on examination of spatial distribution of regression residuals. US EPA performed an analysis of each of the state or urban area data sets from these reports, using a Classification and Regression Tree approach with 2-year peak flows normalized to watershed area as the dependent variable and watershed variables included in state reports as independent variables.

Variable: n

Label: Number of USGS gaging station watersheds

Units: Number of watersheds

Format: numeric, 3.

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Typically, regression analyses are performed separately for different hydrologic regions of each state, based on examination of spatial distribution of regression residuals. US EPA performed an analysis of each of the state or urban area data sets from these reports, using a Classification and Regression Tree approach with 2-year peak flows normalized to watershed area as the dependent variable and watershed variables included in state reports as independent variables. The variable n represents the number of observations included in each CART analysis.

Variable: Criteria

Label: Criteria for separation of peak flow classes

Units: N/A, description

Format: alphanumeric, $18.

Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)

Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Typically, regression analyses are performed separately for different hydrologic regions of each state, based on examination of spatial distribution of regression residuals. US EPA performed an analysis of each of the state or urban area data sets from these reports, using a Classification and Regression Tree approach with 2-year peak flows normalized to watershed area as the dependent variable and watershed variables included in state reports as independent variables. This column reports the identity and cutoff points associated with divisions among flow classes (2-year peak flow normalized to watershed area). Variable names are defined in Appendix X of US EPA (2003).

Variable: Mean

Label: Class average 2-year peak discharge normalized to watershed area
Units: cfs/mil^2
Format: numeric, 4.1
Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)
Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Typically, regression analyses are performed separately for different hydrologic regions of each state, based on examination of spatial distribution of regression residuals. US EPA performed an analysis of each of the state or urban area data sets from these reports, using a Classification and Regression Tree approach with 2-year peak flows normalized to watershed area as the dependent variable and watershed variables included in state reports as independent variables. This column reports the mean value for each flow class identified by CART analysis.

Variable: SD

Label: Class standard deviation 2-year peak discharge normalized to watershed area
Units: cfs/mil^2
Format: numeric, 5.1
Source: U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)
Metadata: U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Typically, regression analyses are performed separately for different hydrologic regions of each state, based on examination of spatial distribution of regression residuals. US EPA performed an analysis of each of the state or urban area data sets

from these reports, using a Classification and Regression Tree approach with 2-year peak flows normalized to watershed area as the dependent variable and watershed variables included in state reports as independent variables. This column reports the standard deviation for each flow class identified by CART analysis.

Variable: PRE

Label:	Percent reduction in error
Units:	Fraction, unitless
Format:	numeric, 4.3
Source:	U.S. Geological Survey, National Flood Frequency Program Reports (http://water.usgs.gov/software/nff.html)
Metadata:	U.S. Geological Survey state offices, in cooperation with state agencies, have produced a series of reports containing flood frequency data and predictive equations derived using watershed characteristics. Typically, regression analyses are performed separately for different hydrologic regions of each state, based on examination of spatial distribution of regression residuals. US EPA performed an analysis of each of the state or urban area data sets from these reports, using a Classification and Regression Tree approach with 2-year peak flows normalized to watershed area as the dependent variable and watershed variables included in state reports as independent variables. This column contains the total percent reduction in error associated with each CART analysis, roughly analogous to the r^2 value for a regression analysis.

Appendix C.3. **Hydrologic regions by state**

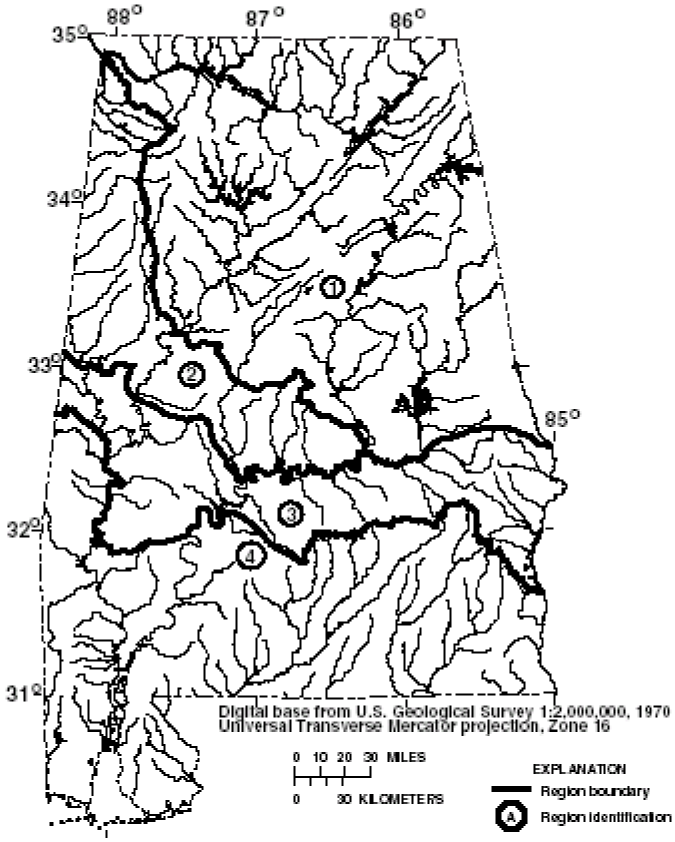


Figure C-3.1. Hydrologic regions for Alabama.

Figure C-3.2. Hydrologic regions for California.

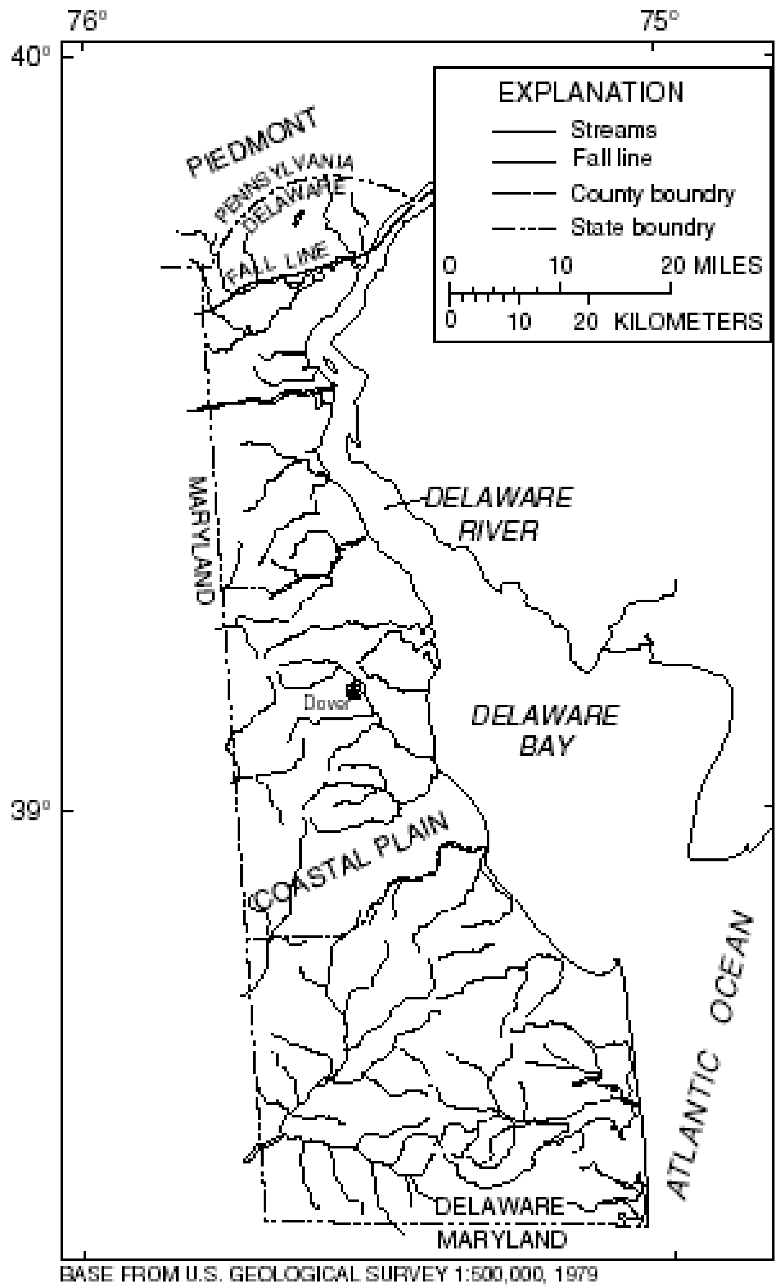


Figure C-3.3 Hydrologic regions for Delaware.

Figure C-3.4. Hydrologic regions for Florida.

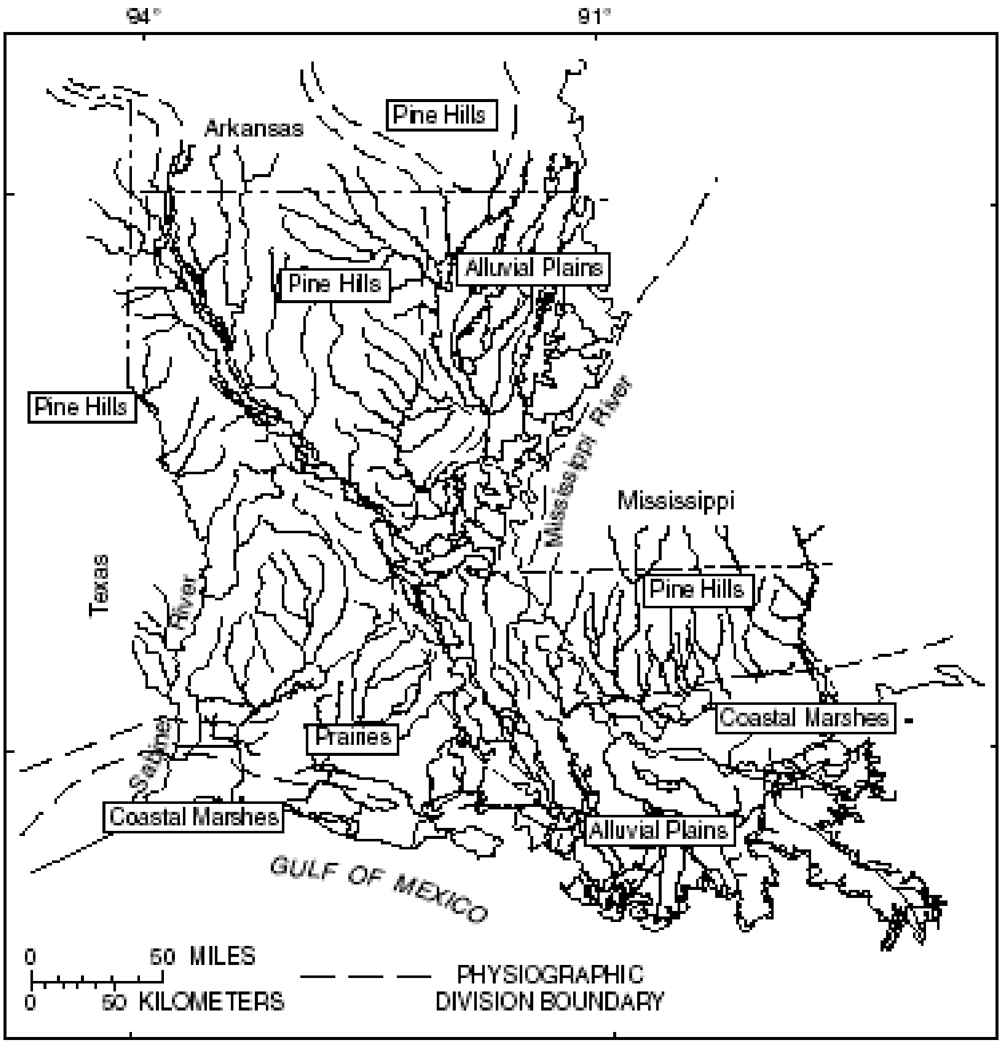


Figure C-3.5. Hydrologic regions for Georgia.

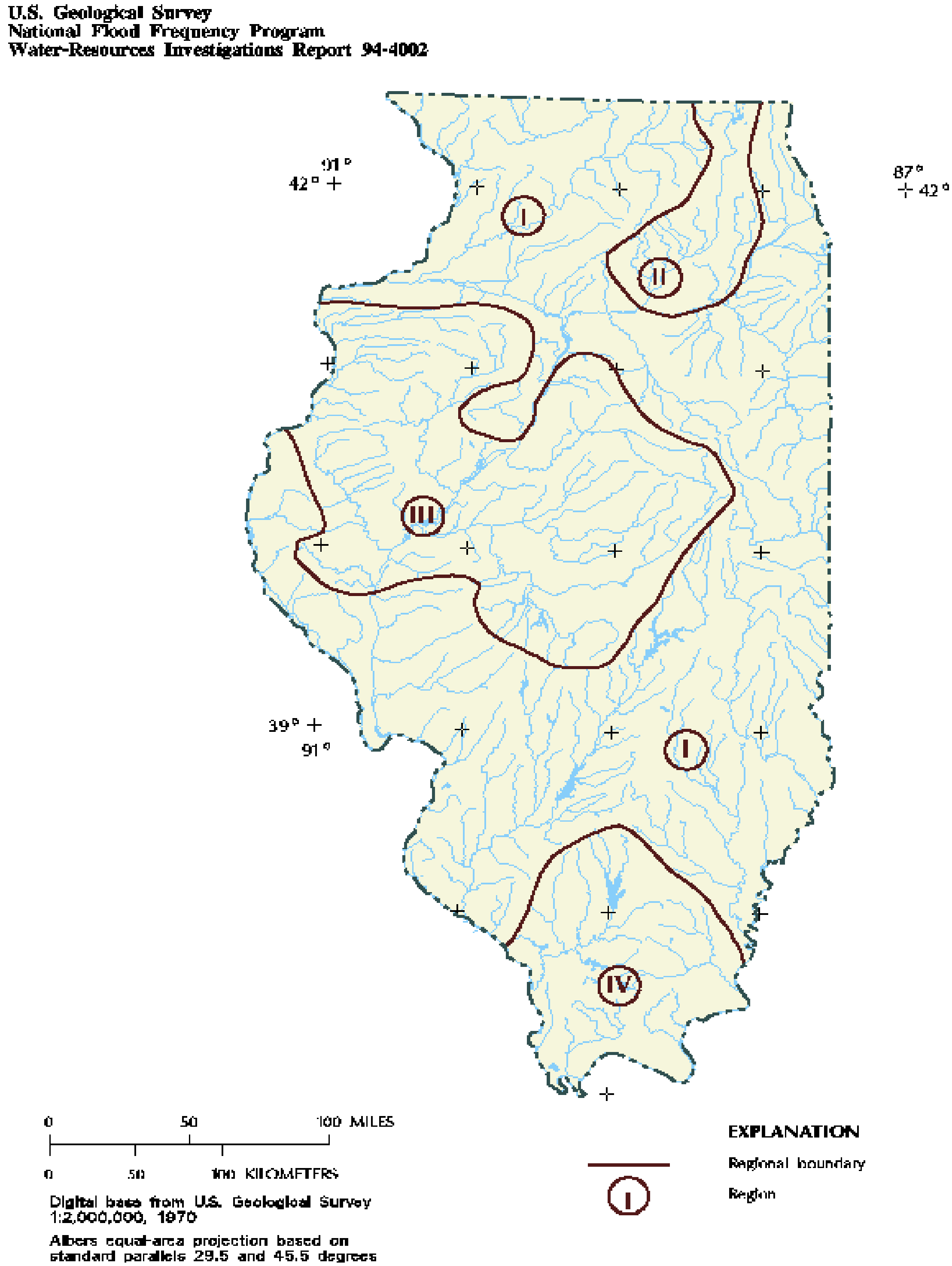


Figure C-3.6. Hydrologic regions for Illinois.

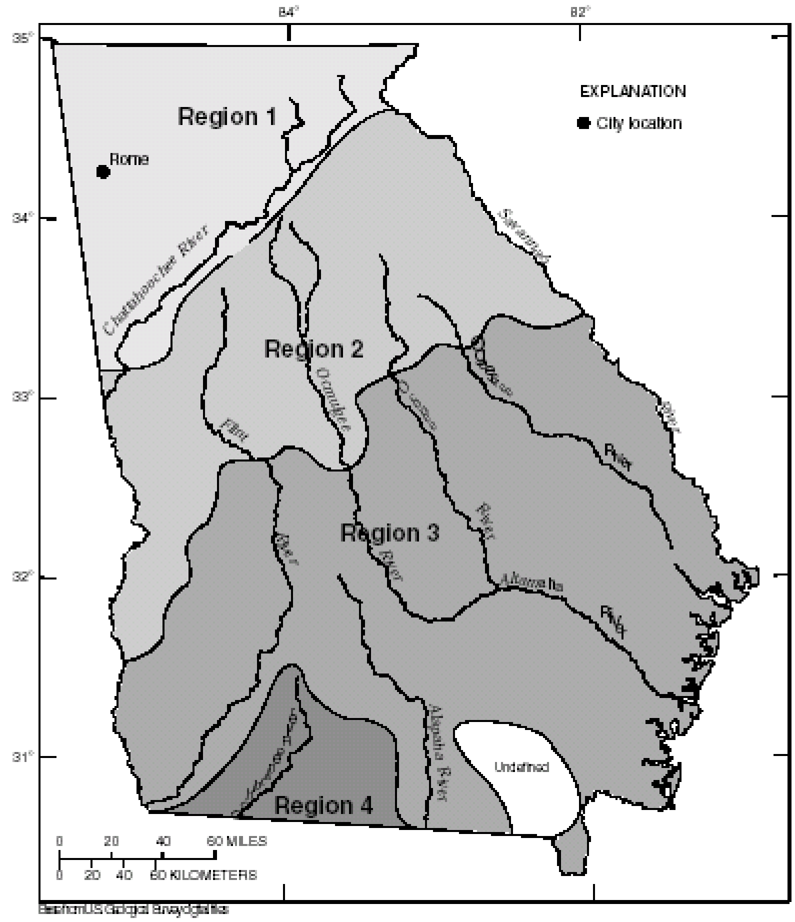


Figure C-3.7. Hydrologic regions for Indiana.

U.S. Geological Survey
National Flood Frequency Program
Water-Resources Investigations Report 94-4002

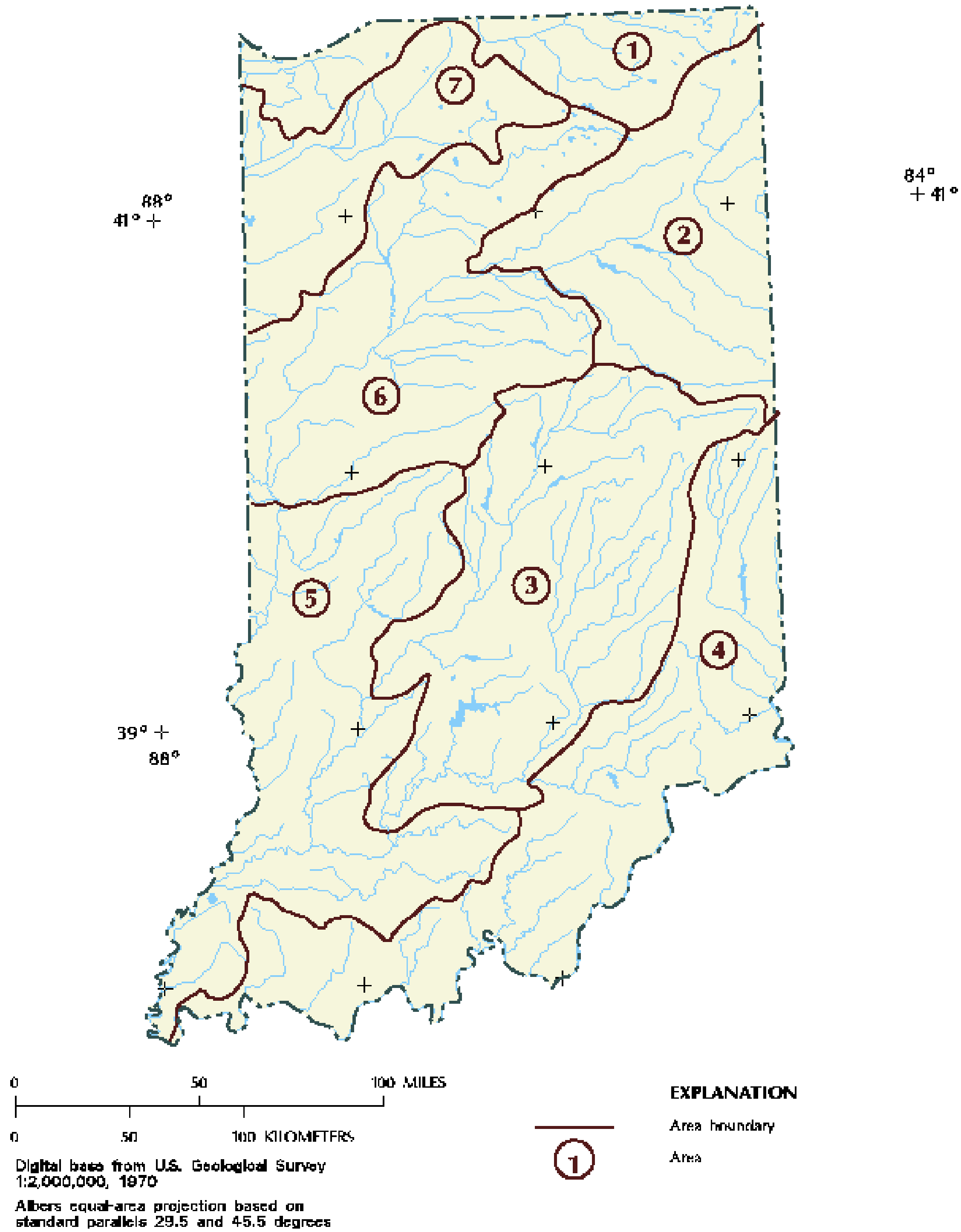


Figure C-3.8. Hydrologic regions for Louisiana.

U.S. Geological Survey
National Flood Frequency Program
Water-Resources Investigations Report 94-4002

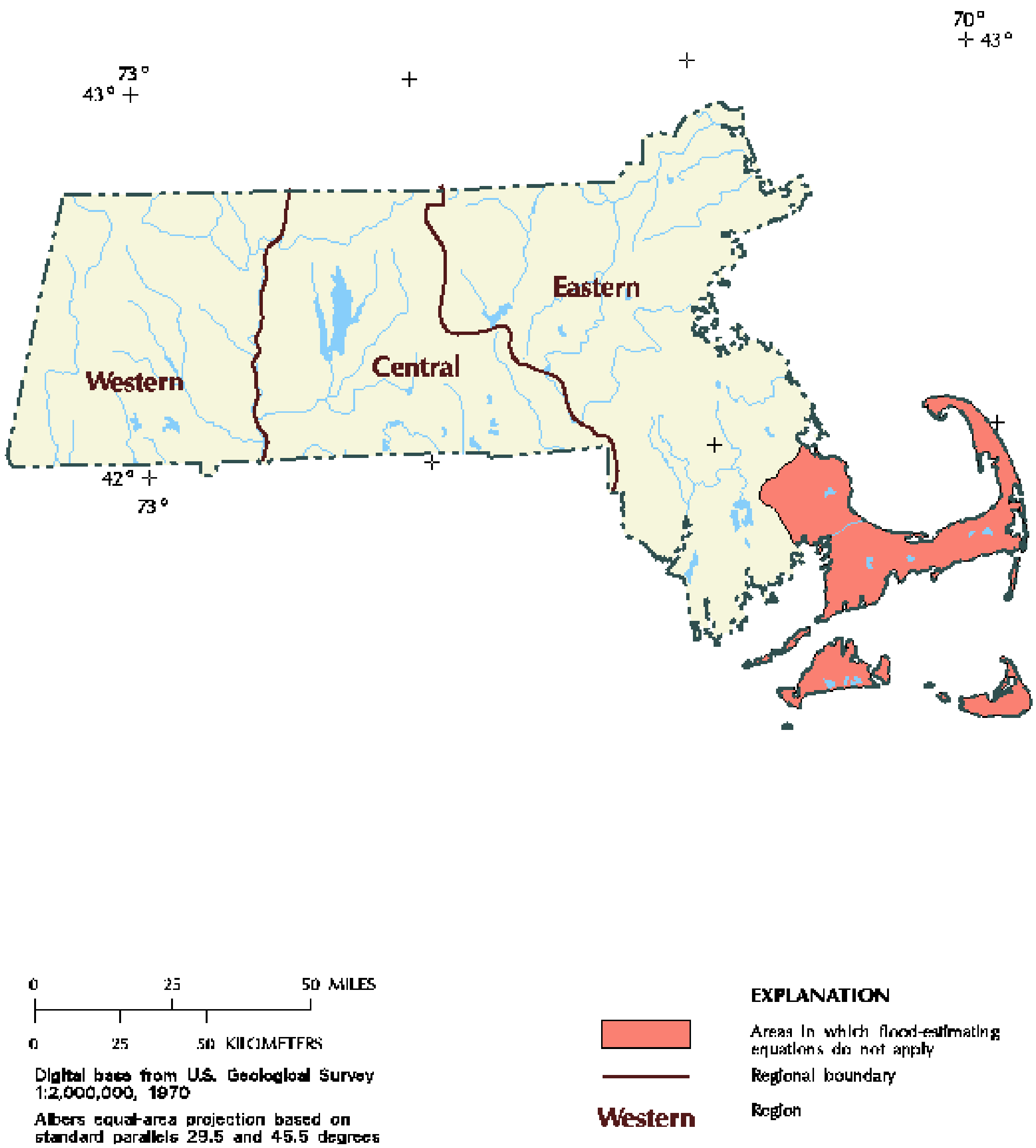


Figure C-3.9. Hydrologic regions in Massachusetts.

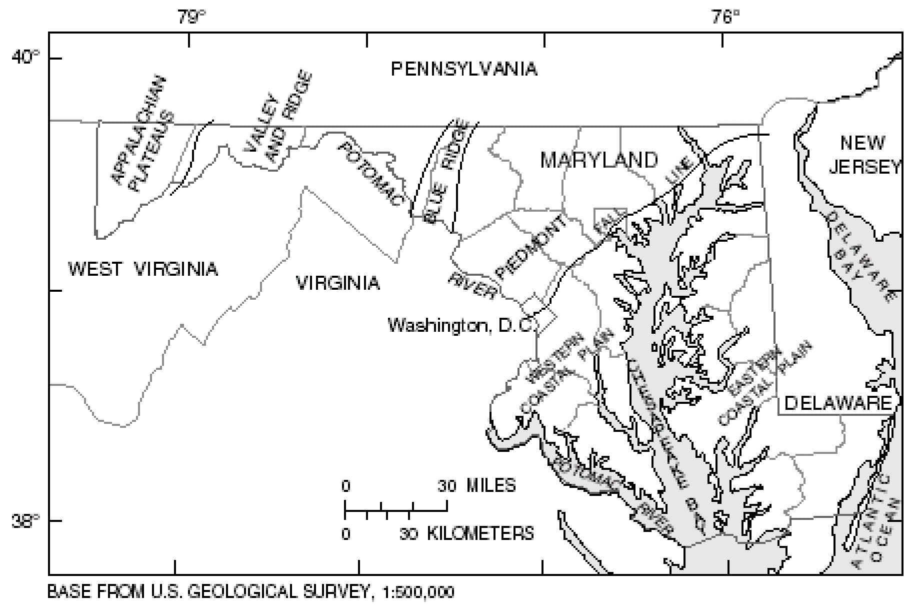


Figure C-3.10. Hydrologic regions for Maryland.

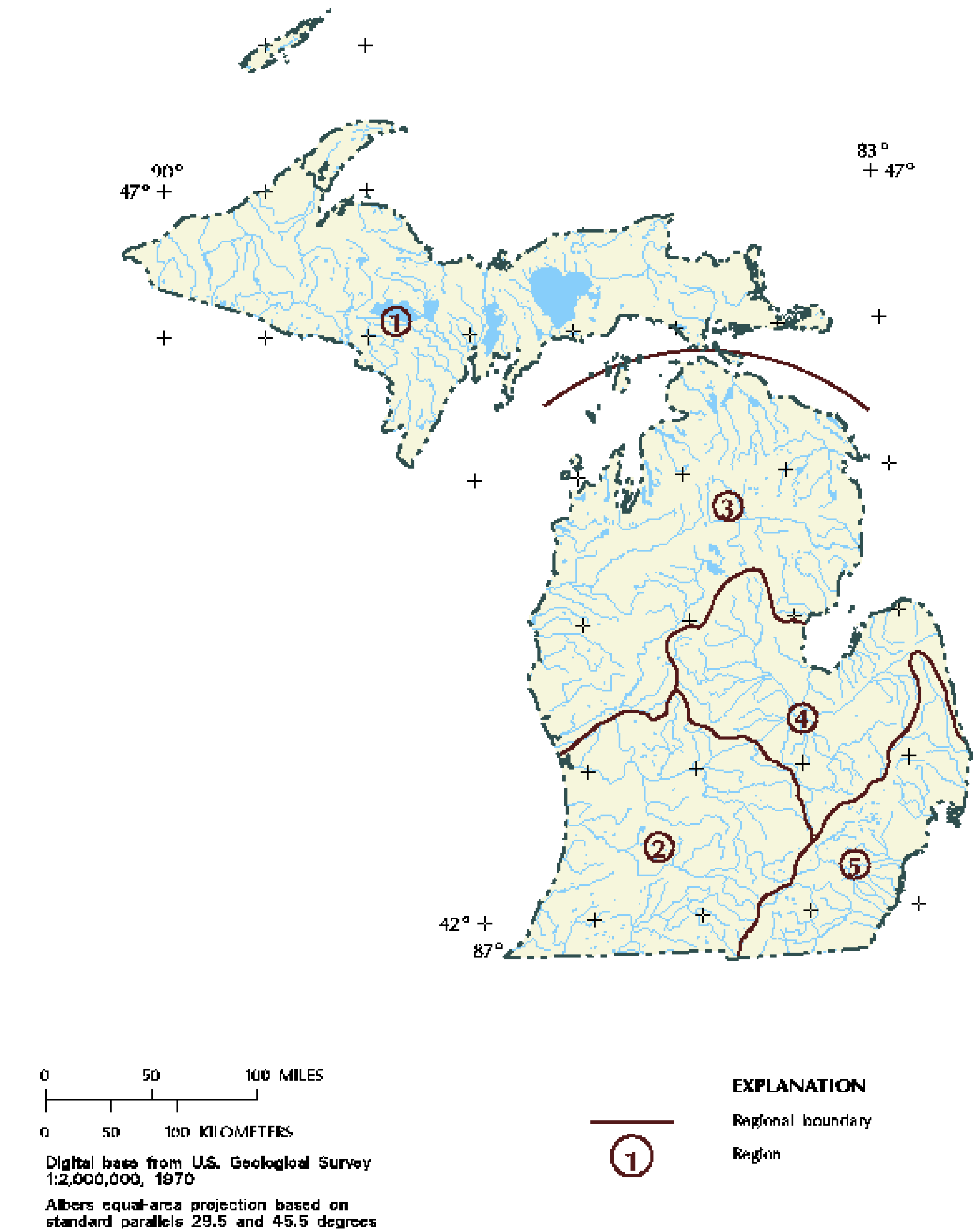


Figure C-3.11. Hydrologic regions for Michigan.

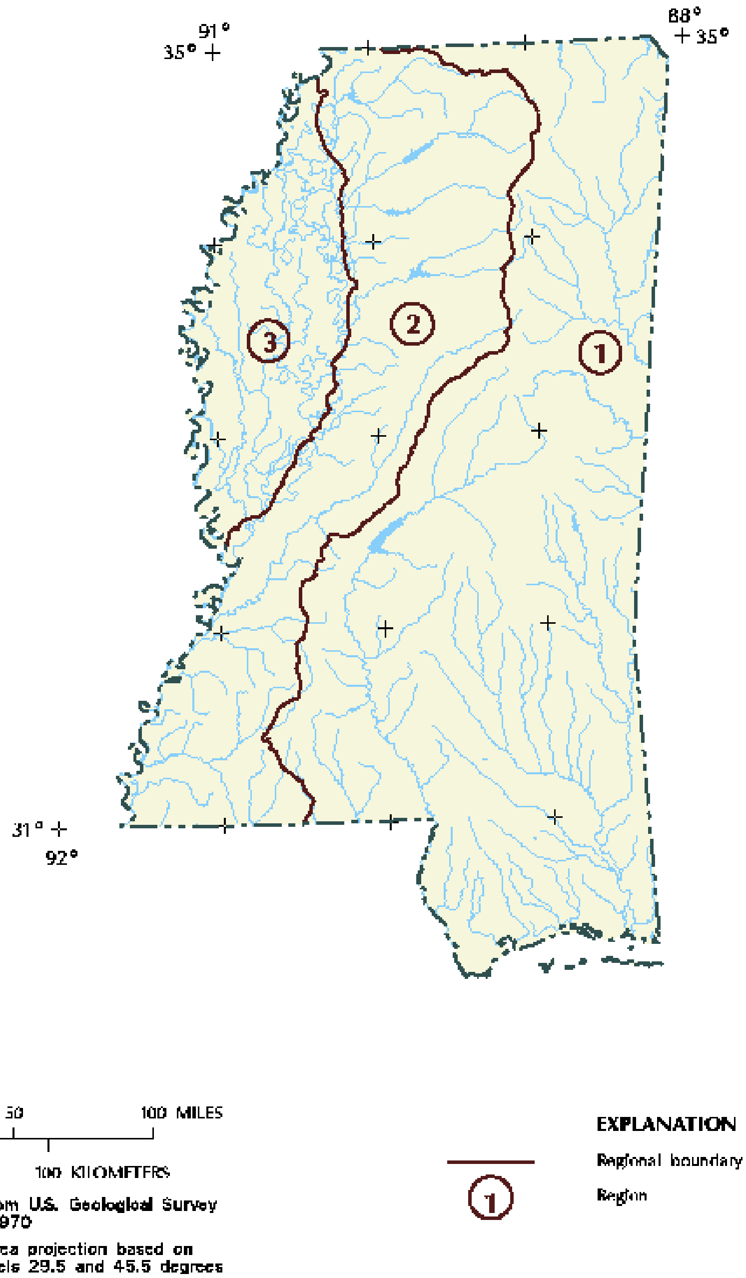


Figure C-3.12. Hydrologic regions for Mississippi.

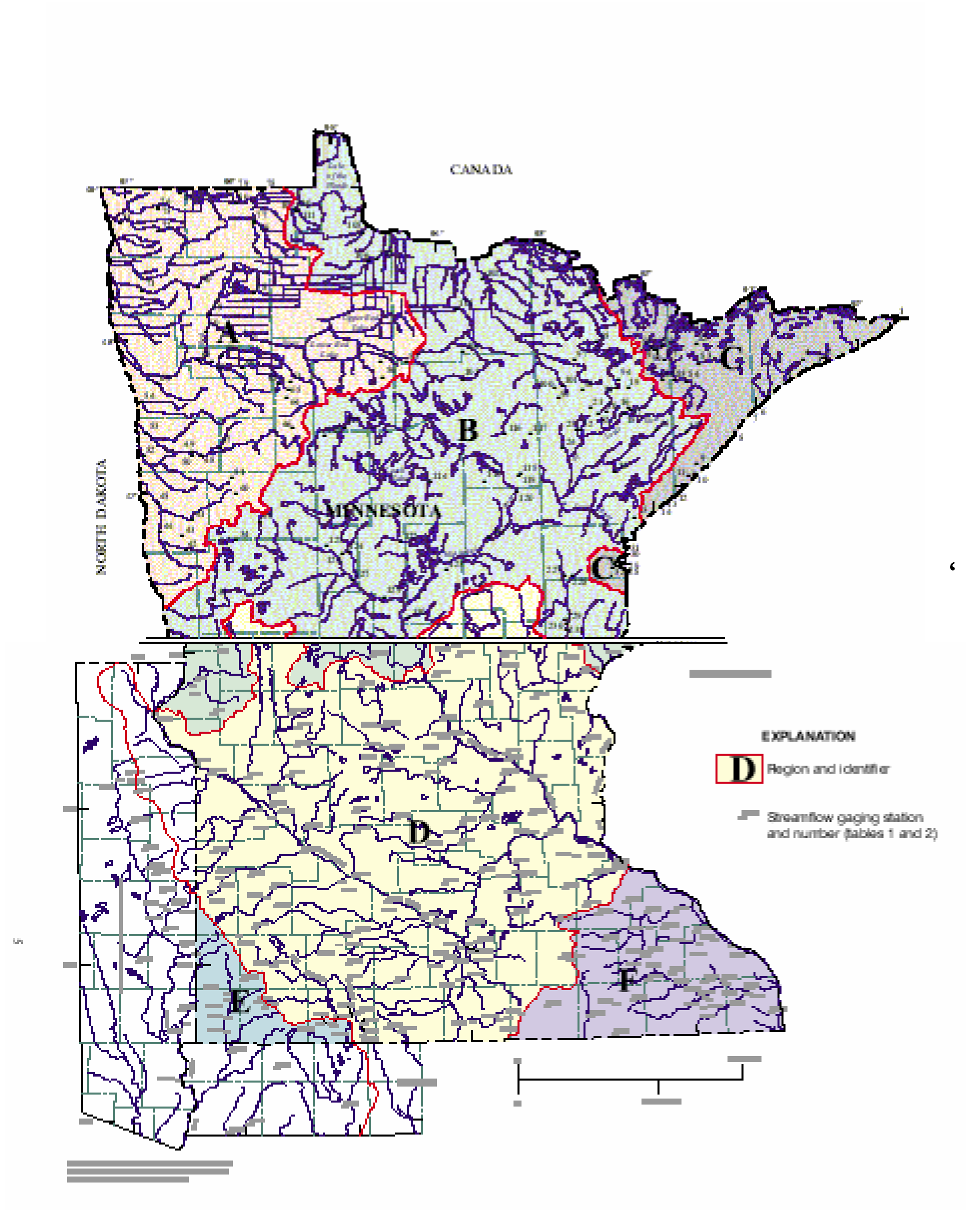


Figure C-3.13. Hydrologic regions for Minnesota.

U.S. Geological Survey
National Flood Frequency Program
Water-Resources Investigations Report 94-4002

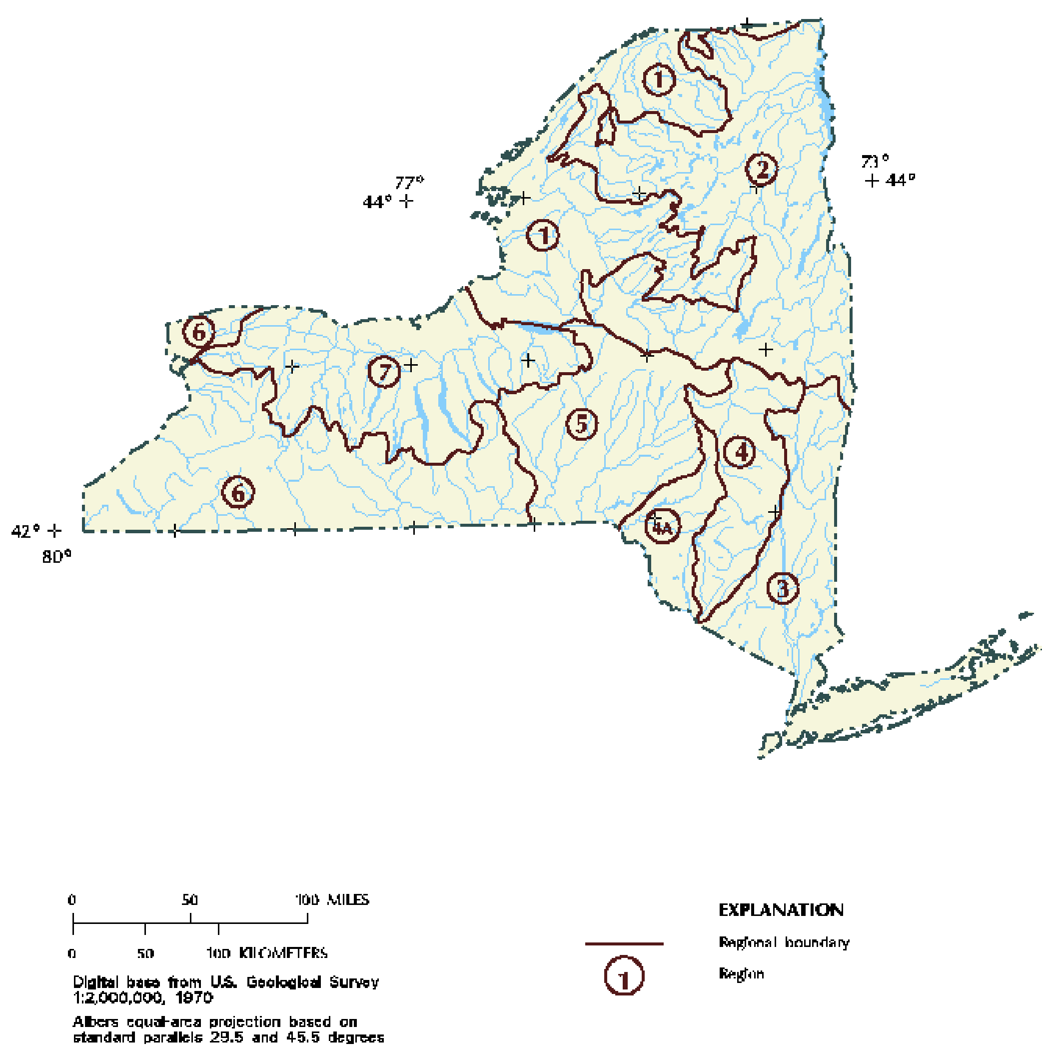


Figure C-3.14. Hydrologic regions for New York.

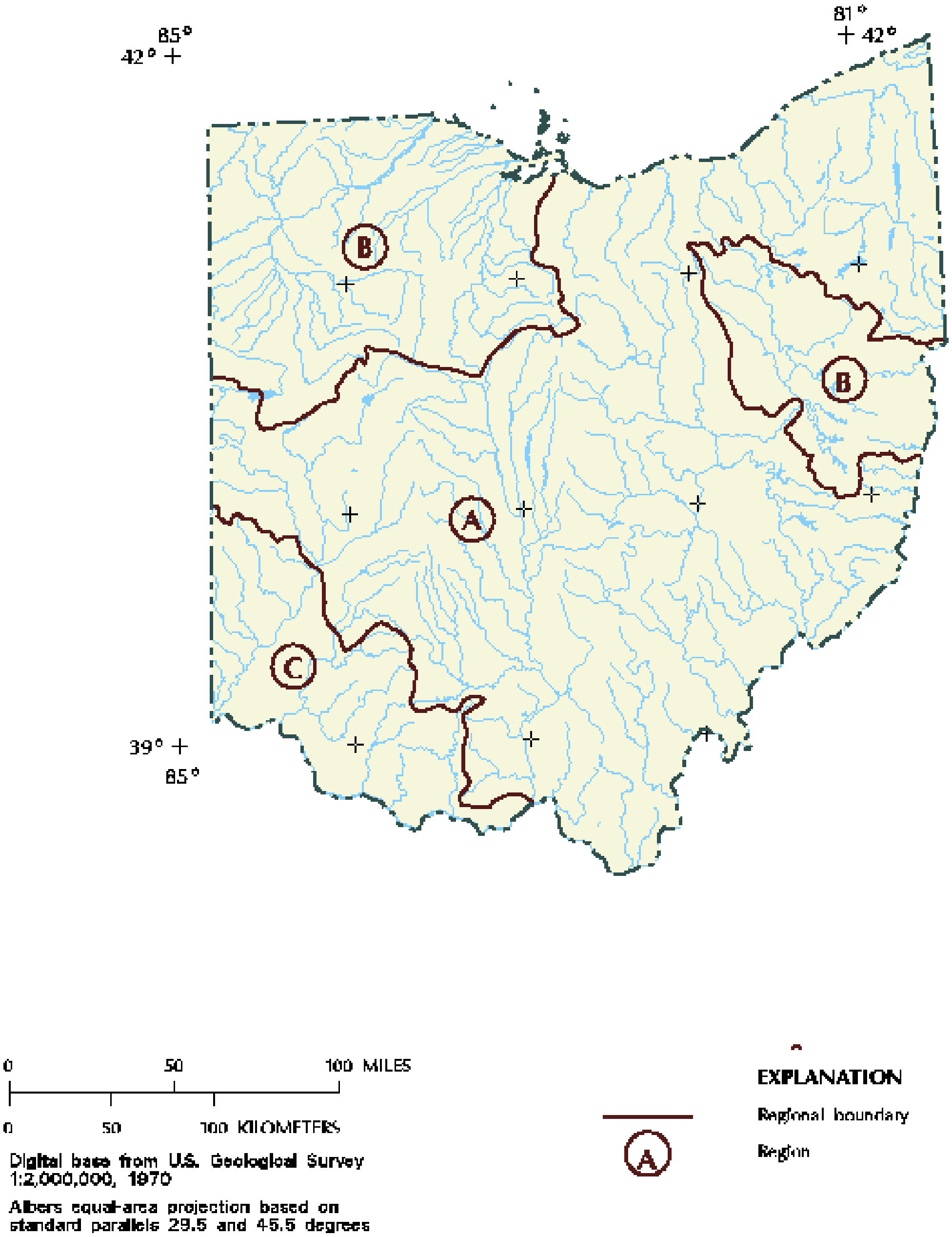


Figure C-3-15. Hydrologic regions for Ohio.

U.S. Geological Survey
National Flood Frequency Program
Water-Resources Investigations Report 94-4002

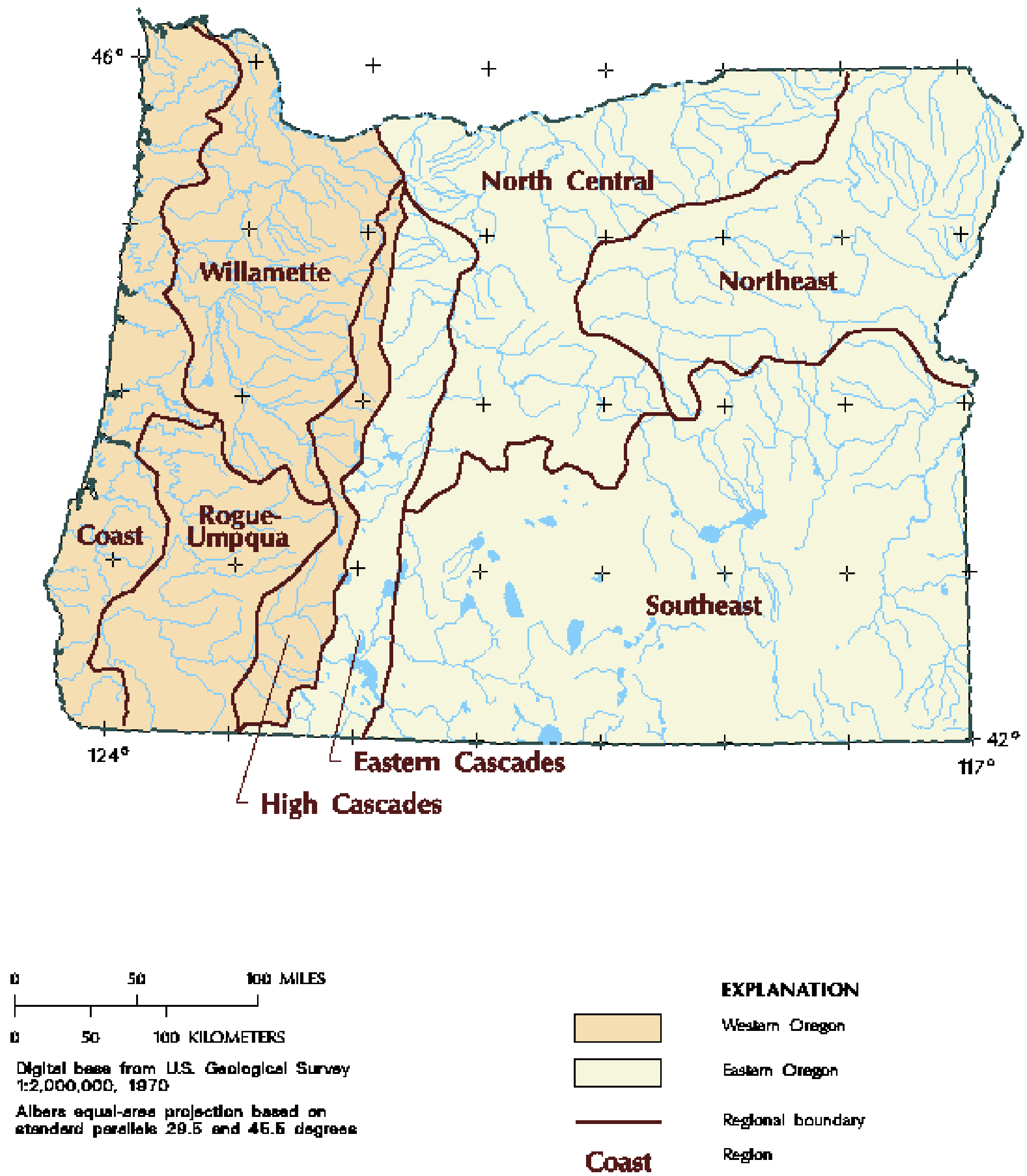


Figure C-3.16. Hydrologic regions for Oregon.

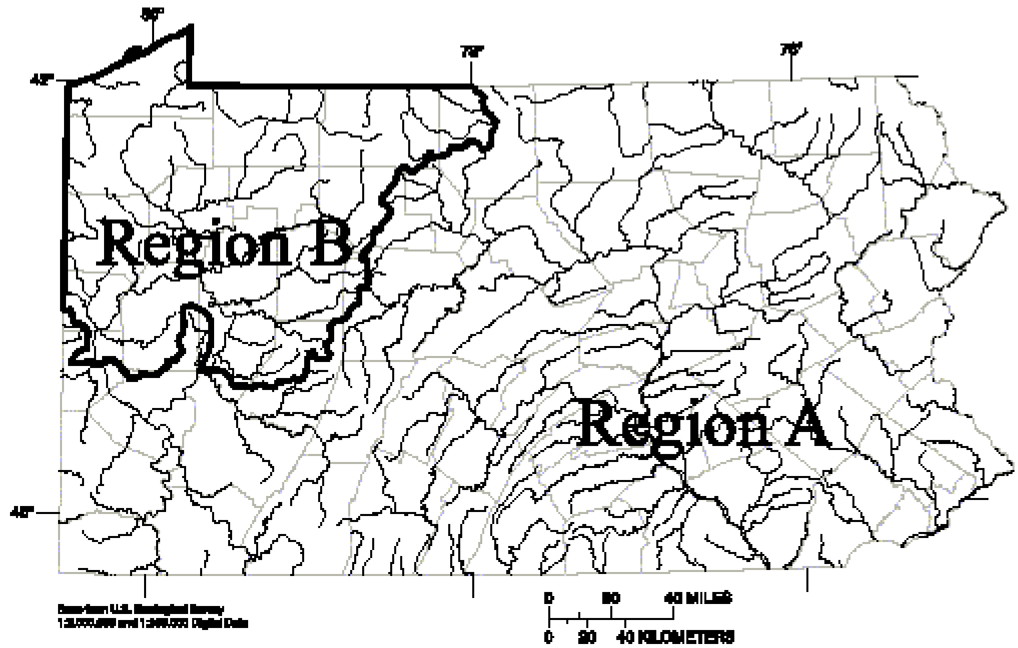


Figure C-3.17. Hydrologic regions in Pennsylvania.

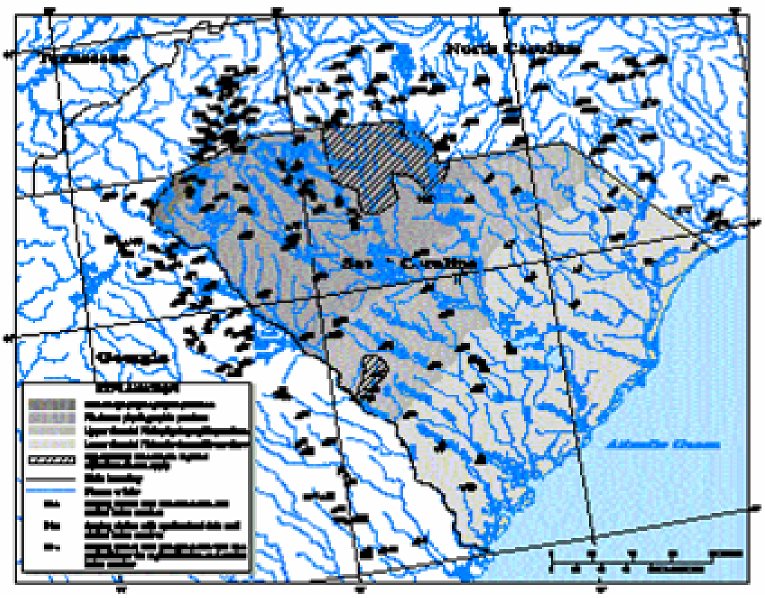
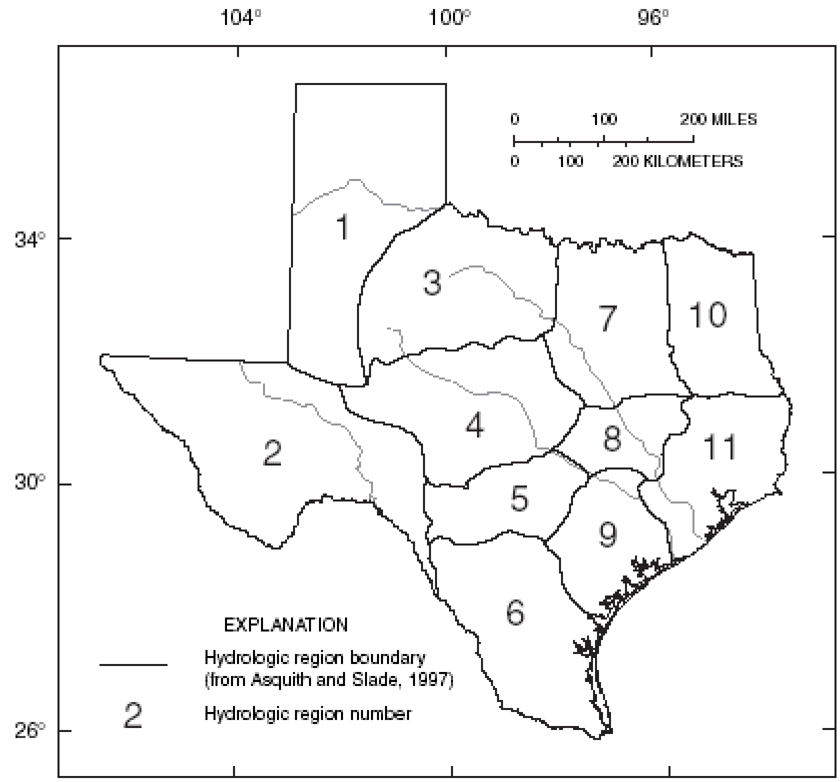
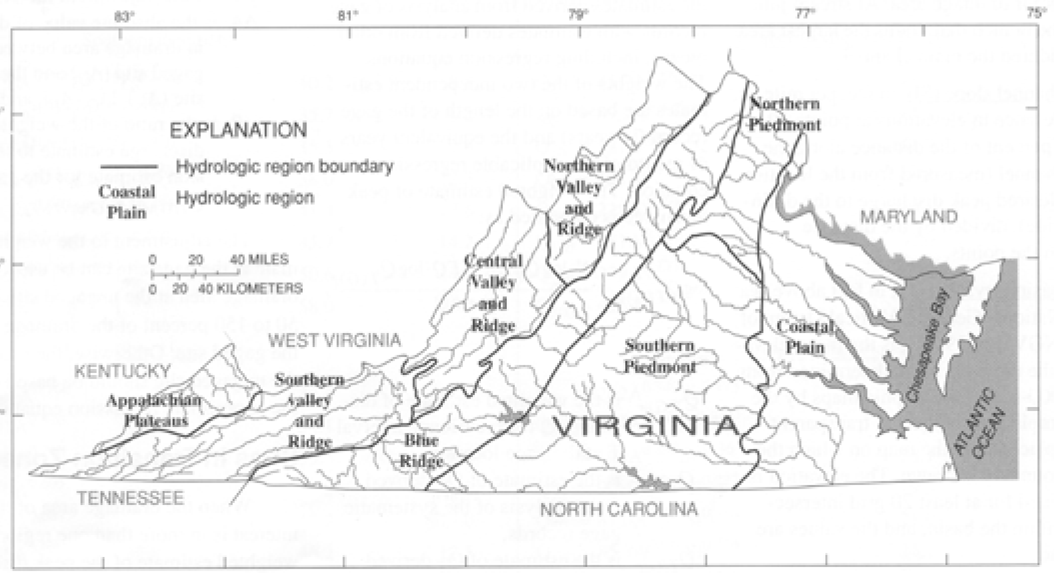


Figure C-3.18. Hydrologic regions for South Carolina.

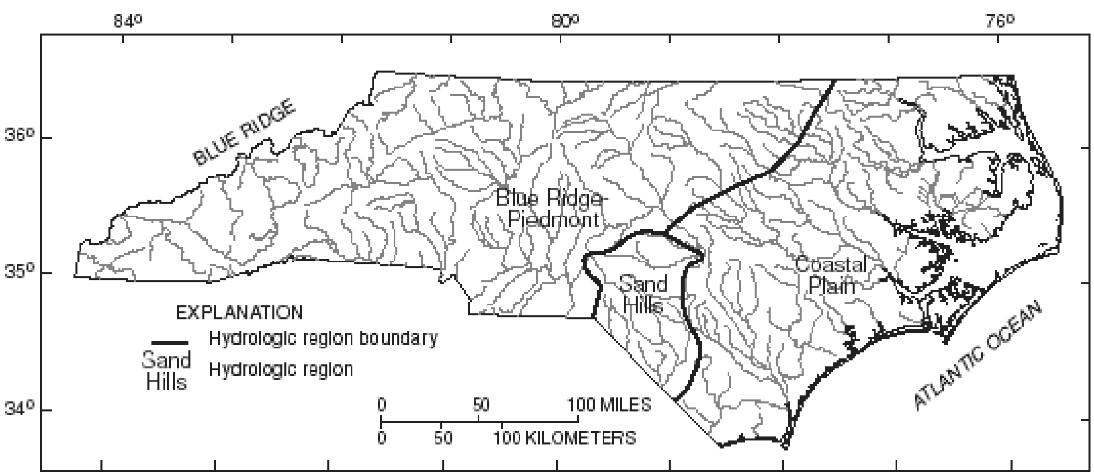


Albers Equal-Area Conic Projection based on
standard parallels at 45.5° and 29.5°
Scale 1:7,250,000

Figure C-3.19. Hydrologic regions for Texas.



Digital base from U.S. Geological Survey
1:2,000,000, 1970



Digital base from U.S. Geological Survey
1:2,000,000, 1970

Figure C-3.20. Hydrologic regions for Virginia.

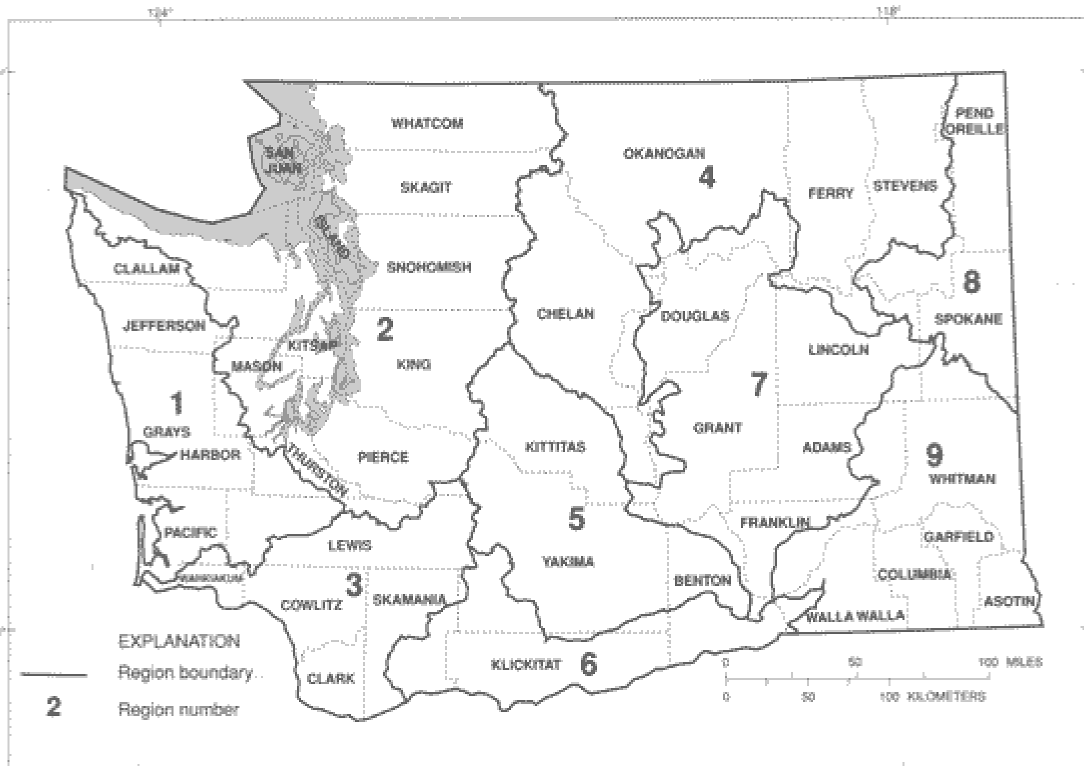


Figure C-3.21. Hydrologic regions for Washington.

U.S. Geological Survey
National Flood Frequency Program
Water-Resources Investigations Report 94-4002

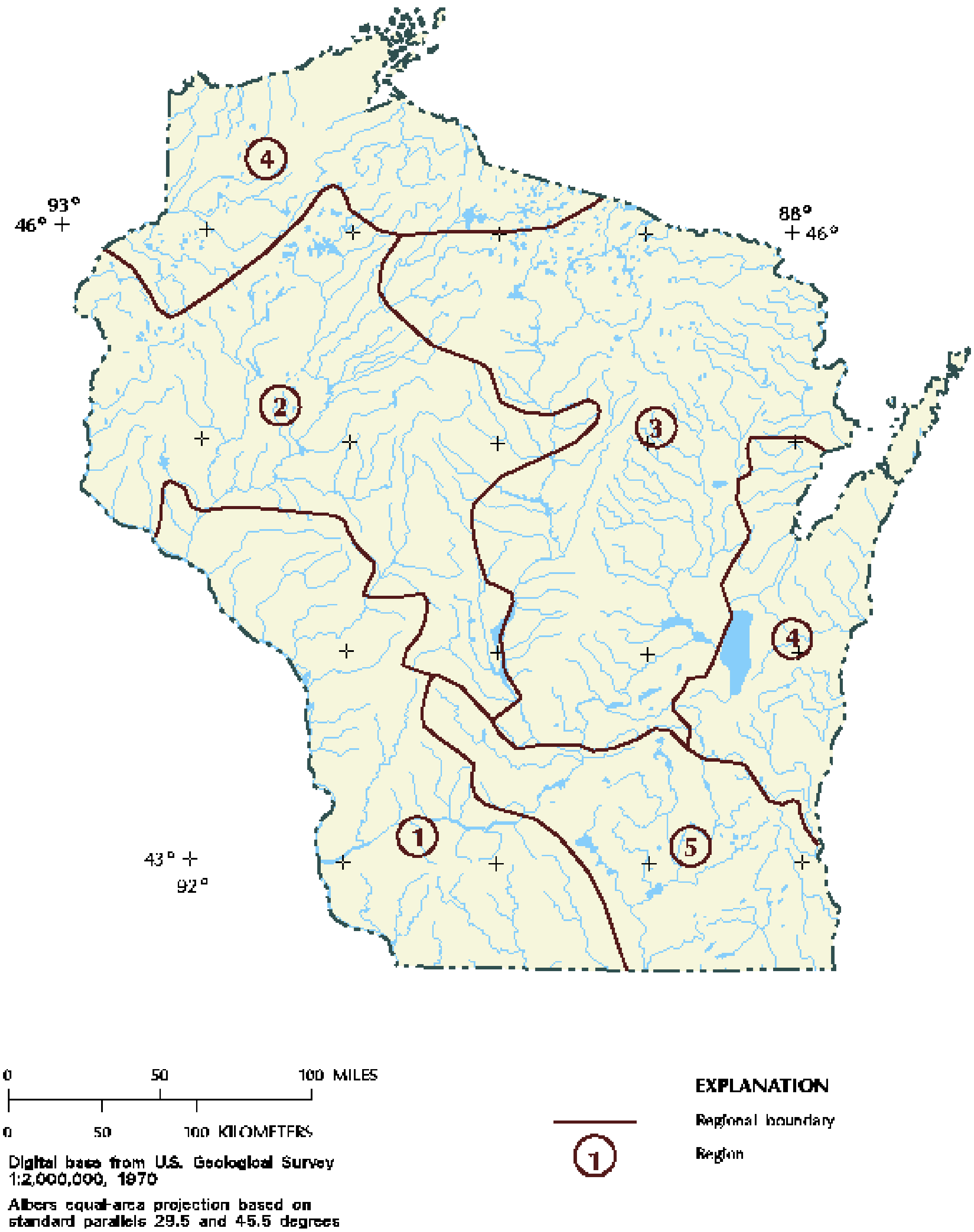


Figure C-9. Hydrologic regions for Wisconsin.

Appendix D. Classification of EDAs by cluster analysis: Classes of Estuarine/Coastal Drainage Areas based on Physical and Hydrologic Characteristics.

Large, Very High Flow, Shallow, Low Salinity

- Lake Pontchartrain
- Mississippi River
- Atchafalaya-Vermilion Bays
- Potomac River
- Chesapeake Bay Mainstem
- Mattole
- Columbia River
- Queets-Quinault
- Albemarle Sound

Large, High Volume, Deep, High Salinity

- Long Island Sound
- Southern Long Island
- Eastern Lower Delmarva
- Maine Coastal
- Penobscot Bay
- Cape Cod Bay
- Cape Cod
- San Pedro Channel Islands
- Santa Barbara Channel
- Central Coastal
- Hoh-Quillayute
- Hood Canal
- Skagit Bay - Whidbey Bn.
- Puget Sound
- Northeast Cape Fear
- Daytona-St. Augustine

Small EDA/Large % Estuary, Low Volume, Low Flow, High Salinity

- Damariscotta River
- New

Medium EDA/Small % Estuary, Low Volume, High Flow, Low Salinity

- Mermentau River
- Connecticut River
- Susquehanna River
- Russian
- Klamath River
- Nooksack

Medium EDA/Small % Estuary, Low Volume, Low Flow, High Salinity

- Passamaquoddy Bay
- South Puget Sound

Medium, Low Volume, Shallow, Mixed Salinity

- Florida Bay
- Big Cypress Swamp
- Sarasota Bay
- Waccasassa River
- Econfina-Steinhatchee River
- St. Andrew Bay
- Austin-Oyster
- Aransas Bay
- Corpus Christi Bay
- Baffin Bay
- Upper Laguna Madre
- Lower Laguna Madre
- Great South Bay
- Barnegat Bay
- New Jersey Inland Bays
- Delaware Inland Bays
- Chincoteague Bay
- Saco Bay
- Plum Island Sound
- San Diego Bay
- San Diego
- Santa Margarita
- Santa Ana
- San Pedro Bay
- Calleguas
- Santa Clara
- Santa Maria River
- Tomales Bay
- Humboldt Bay
- Coquille River
- Coos Bay
- Yaquina Bay
- Fraser
- Bogue Sound
- New River
- St Marys River-Cumberland Sound
- Indian River

Medium Area & Volume, High Salinity

- Buzzards Bay
- Narragansett Bay
- Pawcatuck-Wood
- Gardiners Bay
- Englishman-Machias Bay
- Narraguagus Bay
- Blue Hill Bay
- Muscongus Bay
- Sheepscot Bay

Casco Bay
Boston Harbor
Massachusetts Bay
San Louis Rey-Escondido
Aliso-San Onofre
Santa Monica Bay
Santa Ynez
Central Coastal
Carmel
Monterey Bay
San Francisco Coastal South
San Francisco Bay
Tomales-Drakes Bay
Bodega Bay
Gualala-Salmon
Chetco
Siltcoos
Necanicum
Crescent-Hoko
Dungeness-Elwha
Port Orchard Sound
San Juan Islands
Strait of Georgia
South Carolina Coast
Broad River
Ogeechee Coastal
St. Catherines-Sapelo Sounds
Nassau

Large, High Flow, Shallow, Mixed Salinity

Charlotte Harbor
Tampa Bay
Crystal-Pithlachascotee
Apalachee Bay
Apalachicola Bay
Mobile Bay
East Mississippi Sound
West Mississippi Sound
Breton-Chandeleur Sound
Galveston Bay
San Antonio Bay
Hudson River-Raritan Bay
Delaware Bay
James River
Central San Francisco-San Pablo-Suisun Bays
Big Navaro-Garcia
Mad-Redwood
Smith
Wilson-Trusk-Nestuccu
Pamlico Sound

St. Johns River
Cape Canaveral
Biscayne Bay

Medium EDA/Small % Estuary, Low Volume, High Flow, Mixed Salinity

Suwannee River
Brazos River
Kennebec-Androscoggin
Great Bay
Merrimack River
Eel River
Rogue River
Umpqua River
Siuslaw River
Alsea River
Siletz Bay
Tillamook Bay
Nehalem River
Willapa Bay
Grays Harbor
Cape Fear River
North-South Santee Rivers
Charleston Harbor
Stono-North Edisto Rivers
St. Helena Sound
Savannah River
Ossabaw Sound
Altamaha River
St. Andrew-St. Simons Sounds

Large EDA/Small % Estuary, Low Volume

South Ten Thousand Islands
North Ten Thousand Islands
Caloosahatchee River
Charlotte Harbor
Withlacoochee
Choctawhatchee Bay
Pensacola Bay
Perdido Bay
Lake Borgne
Barataria Bay
Calcasieu Lake
Sabine Lake
Matagorda Bay
Patuxent River
Rappahannock River
York River
Choptank River
Tangier-Pocomoke Sound
Piankatank River-Mobjack Bay

Patapsco-Gunpowder Rivers
Pamlico-Pungo Rivers
Neuse River
Winyah Bay

Small, Low Volume, Low Flow, Shallow, Mixed Salinity

Rookery Bay
Terrebonne-Timbalier Bays
Rio Grande
Maryland Inland Bays
Chester River
Lynnhaven River
Poquoson-Back Rivers
Ingram-Fleets Bays
Elk-Sassafras Rivers
Eastern Bay
Wells Bay
Hampton Harbor
Waquoit Bay
Tijuana Estuary
Mission Bay
Newport Bay
Anaheim Bay
Alamitos Bay
Ventura
San Antonio
Morro Bay
Elkhorn Slough
Drakes Estero
Netarts Bay

Appendix E. Matrix of properties of existing classification schemes.

Classification system	Objective	Classification Factors Considered	Stressor Pertinence	Extent, Spatial Temporal Variability	Data Availability, Gaps	Limitations/ Status of Testing/ Modifications
Ecoregions of the US (Bailey, 1976)	Map / develop hierarchical framework of terrestrial habitats	Land use Soil types Landform Climax Vegetation Temperature	Habitat alteration	US Spatial	Nationwide	Terrestrial focus does not include hydrology. Used by the Nature Conservancy, but not tested for wetlands
Ecological units of the Eastern US (Keys et al., 1995; Maxwell et al., 1995)	Map ecological units: based on physical and biological components that influence ecological relationships, processes and potential	Geomorphology Geology Human use Soil types Climate Surface water characteristics Growing season Vegetation potential Temperature	Habitat alteration Nutrients Suspended sediments Thermal regime	US Spatial	Eastern US, digital Gaps include areas other than eastern US and some portions of west	Terrestrial focus does not include hydrology. Case studies have demonstrated watersheds to group by these ecological units (Jensen, 2001, Detenbeck, 2000)
Ecoregions of the conterminous US (Omernik, 1987)	Map ecosystem regionalities: define regions and explore the processes and effects of human activities	Land use Geology Climate Physiography Soil types Hydrology Vegetation	Habitat alteration Nutrients Suspended sediments Flow regime	US Spatial	Maps, local databases are available to support some reference condition locations	Terrestrial focus. Utilized by a number of states to develop biological criteria, set water quality standards and lake management goals but not tested for most wetlands

Classification system	Objective	Classification Factors Considered	Stressor Pertinence	Extent, Spatial Temporal Variability	Data Availability, Gaps	Limitations/ Status of Testing/ Modifications
Circular 39 (Shaw and Fredine, 1956)	Wetlands: Inventory the distribution, extent and quality of wetlands along with their value as wildlife Habitat	Water depth Flooding regime Salinity Vegetation type	Habitat alteration Hydrologic regime	US Spatial	Nationwide Gaps in mapping	Served as a simple but effective basis for later efforts
Classification of wetlands and deepwater habitats of the US (Cowardin et al, 1979)	Wetlands: Inventory status and trends in coverage and deepwater habitat types	Ecosystem type[a] Relative elevation Substrate type pH and soil type Flooding regime Water regime Water chemistry Vegetation	Habitat alteration	US Spatial	Nationwide Gaps in digitization	Widely used, extensive number of classes may be impractical. Gibbs, 1993 case study, but stressor sensitivity aspects (density, spatial configuration, temporal variability) need to be tested. Modified by McKee, 1992, and for marine systems (Detier, 1992).
Riverine Marsh Disturbance Gradients (Day et al., 1988)	Wetlands: Identify vegetation community response types	Hydrologic regime Disturbance regime Vegetative composition	Nutrients Habitat alteration	Coastal and riverine wetlands	NWI, state inventories, extension to other regions necessary based on species composition/traits	Untested for stressor sensitivity applications

Classification system	Objective	Classification Factors Considered	Stressor Pertinence	Extent, Spatial Temporal Variability	Data Availability, Gaps	Limitations/ Status of Testing/ Modifications
Coastal Wetland Ecosystems (Chow-Fraser and Albert, 1998)	Wetlands: identify habitats of biodiversity for conservation	Geomorphology Vegetation types	Not directly linked with stressor susceptibility	Great Lakes	NWI inventoried wetlands only	Extensive number of classes may be impractical
Coastal Wetlands of the Great Lakes (Keough et al, 1999)	Wetlands: classify by functional groups	Hydrogeomorphic types: open coast, drowned-river mouth, flooded delta and protected	Not directly linked with stressor susceptibility, but hydrogeo-morphic types may differ in retention time, settling efficiency	Great Lakes	Existing NWI state inventories, GLEI	Some difficulty with separation of classes in practice
Great Lakes Wetlands Consortium (Great Lakes Commission, 2003)	Wetland habitats: refine of inventories for tracking a real status and trends, stratify types for monitoring programs	Hydrology Geomorphology Shoreline processes Resuspension Residence time	Nutrients Suspended sediments Toxics Hydrologic regime	Great Lakes	NWI, state wetlands inventories under assessment, point and areal coverages need matching	Untested for stressor sensitivity applications
Fluvial Classification (Montgomery and Buffington, 1993)	Fluvial: apply hierarchical geomorphic classification to predict risk of sediment input, transport	Geology Climate Hydrology Sediment transport	Not linked with stressor susceptibility *per se* but influenced by sediment loading	Fluvial systems	State inventories	Modified by Jay et al, 1999 for estuaries

Classification system	Objective	Classification Factors Considered	Stressor Pertinence	Extent, Spatial Temporal Variability	Data Availability, Gaps	Limitations/ Status of Testing/ Modifications
Channel Types, (Rosgen, 1994)	Streams: predict direction and magnitude of changes due to natural and human disturbances	Geomorphology Channel slope Substrate type Instream Sediment - sources/sinks Climate	Suspended sediments, sediment-associated pollutants	Fluvial systems Temporal Spatial	Not mapped	Riverine only, instream channel form focus. See also, Hawkins et al, 1993
Flow Regimes (Poff and Allan, 1995)	Fluvial: classify hydrologic regime by flooding/drought magnitude, frequency, and predictability and relate to biological community types	Hydrology	Nutrients Suspended sediments Toxics Hydrologic regime	US Temporal	Nationwide	Untested for stressor sensitivity applications
Hydrologic landscape Regions of the US (USGS, 2003)	Watersheds: group according to similarities n landscape and climate characteristics to assist with water quality assessments	Land-surface form Geologic texture (Soil and bedrock permeability) Climate variables	Not linked with stressor susceptibility	43,931 small watersheds (200 sq km) in the US	STATSGO USGS National Atlas, data bases	Parameters are assumed to affect hydrologic processes and so may relate to retention time predictions

Classification system	Objective	Classification Factors Considered	Stressor Pertinence	Extent, Spatial Temporal Variability	Data Availability, Gaps	Limitations/ Status of Testing/ Modifications
Comparative Watershed Framework (Detenbeck et al, 2000)	Freshwater Lotic Systems: predict susceptibility of biota, habitat and water quality to nonpoint stressors mediated by changes in hydrology	Hydrogeomorphic region Watershed storage (retention time) Land use Thresholds relative to hydrologic regime	Habitat alteration Nutrients Suspended and bedded sediments Toxics Thermal regime Hydrologic regime	US: Humid regions, runoff-dominated urban regions Temporal	MRLC, NWI, NWSD, USFS-EU, USGS Gaps in NWI-digital coverage (storage calculations) and NWBD, flow thresholds	Arid regions, groundwater-dominated systems not covered. Tested in Lake Superior and Michigan Basins
Hydrodynamic, single parameter, (Strommel and Farmer, 1952)	Estuarine: describe types based on stratification	Hydrology River flow Stratification Tidal currents	Nutrients Toxics Suspended sediments	Narrow estuaries	NOAA CA&DS	Does not consider estuarine types, focus on narrow estuaries. Modified by Ippen and Harlemann, 1961; Prandle, 1986; Fischer, 1976; Simpson and Hunter, 1974; Nunes Vax and Lennon, 1991

Classification system	Objective	Classification Factors Considered	Stressor Pertinence	Extent, Spatial Temporal Variability	Data Availability, Gaps	Limitations/ Status of Testing/ Modifications
Hydrodynamic, two parameter (Hansen and Rattray, 1966)	Estuarine: describe types based on stratification and circulation	Hydrology Geomorphology Freshwater, Tidal influences Stratification	Nutrients Toxics Suspended sediments	Narrow estuaries, fjords, and river dominated estuaries; Worldwide	NOAA CA&DS	Unsuitable for broad shallow embayments and systems subject to wind forcing or temporal variability. Modified by Fischer, 1976; Officer, 1976; Oey, 1984; Jay and Smith, 1988; Friederichs and Madsen, 1992; Hearn, 1998; Geyer et al, 1999
Ecological Perspective on Estuarine Classification (Jay et al., 1999)	Estuarine: identify environments found in different estuaries and describe their sediment transport processes	River Flow Tidal Flow Residence Time Forcing Processes: wind, waves, sea ice	Suspended and bedded sediments Hydrologic regime	Estuaries Spatial Temporal	LMER	Effectively oriented towards susceptibility to suspended and bedded sediments as a stressor, but untested for other aquatic stressors, i.e. does not address eutrophication

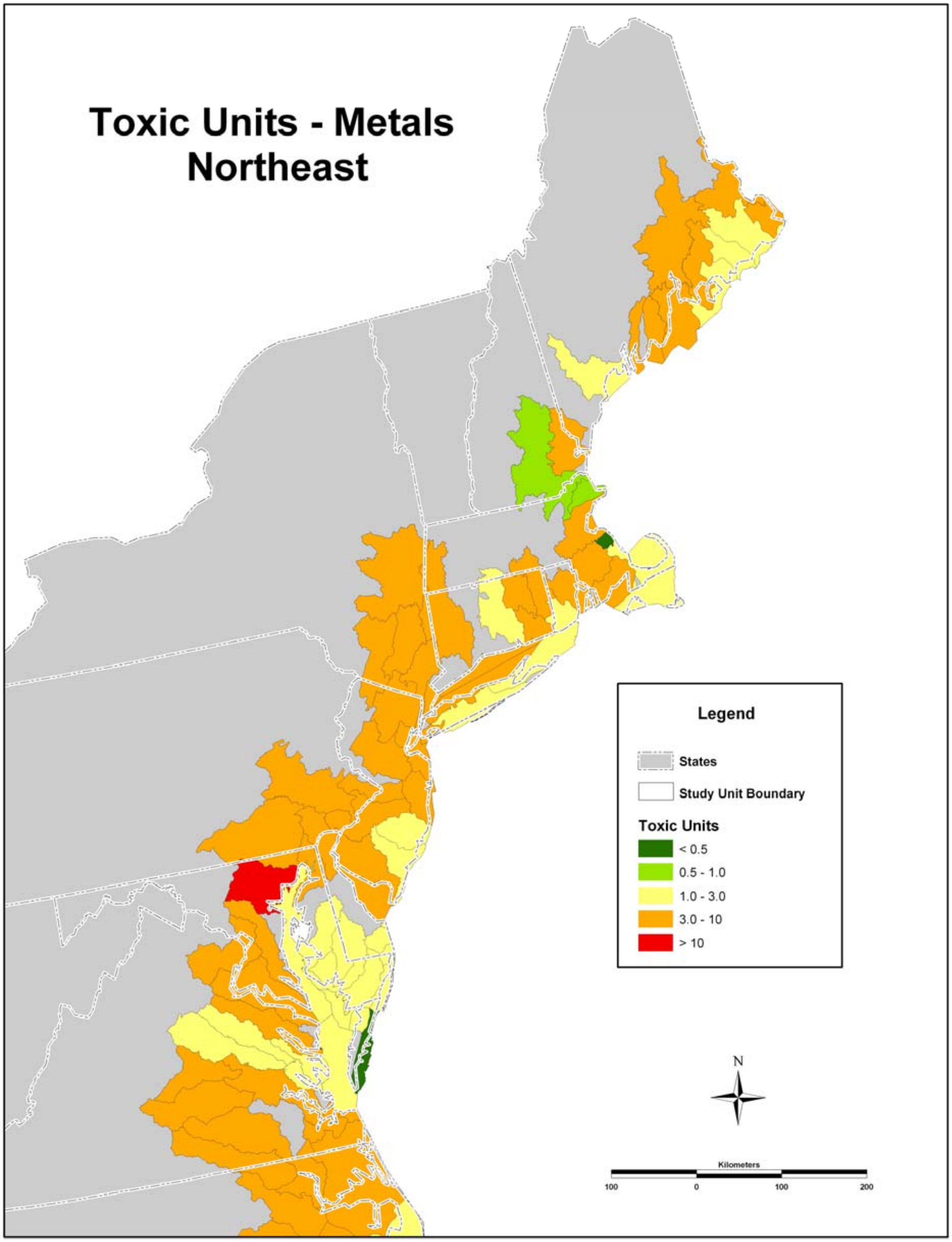
Classification system	Objective	Classification Factors Considered	Stressor Pertinence	Extent, Spatial Temporal Variability	Data Availability, Gaps	Limitations/ Status of Testing/ Modifications
Physical Classification of Australian estuaries (Digby et al., 1999)	Estuarine: Develop a framework for 780 Australian estuaries based on quantifiable, biologically important physical characteristics and transfer knowledge between estuaries with similar characteristics	Geomorphology Climactic zones Tidal range Shoreline Intertidal proportion	Nutrients Toxics Suspended and bedded sediments	Australia Spatial	Data available for 623 of 780 estuaries Gaps in seagrass coverage, and in accounting for temporal variability of this and other parameters	Temperate estuaries become a large category that may be amenable to subdivision based on a biological parameter, ie. seagrass coverage or diversity of fish or macrobenthic communities
NOAA Estuarine Classification (Allee et al., 2000)	Marine and Estuarine: describe the spatial heterogeneity of marine and estuarine landscapes and link to underlying mechanisms structuring the ecosystem and biotic communities	Hydrology Geomorphology Topology Ecosystem type Substratum Climate Zones Wave/wind Energy Temperature Salinity, alkalinity Extreme events Biological interactions	Habitat alteration Nutrients	US: Marine and Estuarine Spatial	NOAA CADS Bathymetry Topography	Leads to a large number of classes, reduction strategies may include system response factors Freshwater systems require modification
Coastal Provinces (Briggs, 1974)	Near Coastal and Marine: Outline zoogeographic regions	Coastal ocean currents Distribution of marine organisms, indigenous species	Not directly linked with stressor susceptibility	Near coastal		Untested for stressor sensitivity assessment

Classification system	Objective	Classification Factors Considered	Stressor Pertinence	Extent, Spatial Temporal Variability	Data Availability, Gaps	Limitations/ Status of Testing/ Modifications
The Nature Conservancy, (e.g. Beck and Odaya, 2001)	Aquatic Systems: map and inventory community and ecosystem habitats for conservation of biodiversity and target species	Physicochemical - Geologic factors System attributes Target species Habitat type Land use Road, Dam density Point source density	Habitat alteration Point sources: Toxins, Nutrients Suspended and bedded sediments Hydrologic regime	US, Central and South America Spatial	Species Aquatic system targets Conservation areas Gaps in aquatic insect species coverage, snails, crayfish, fish and mussels, and in tidal marsh habitats	Used to select priority areas for conservation action, not tested for stressor susceptibility applications
Coastal Impacts from Freshwater Flow Alterations (Sklar and Browder, 1998)	Near Coastal: identify potential impacts of alterations to freshwater flow to the Gulf of Mexico	Freshwater Flow Salinity, isohaline zone Dissolved Oxygen System Geometry Discharge component Vegetative habitat	Habitat alteration Nutrients Suspended and bedded sediments Toxics Hydrologic regime Compares individual stressor effects with multiple stressor effects	Gulf of Mexico Spatial Temporal	Data for individual systems	Currently used for in-depth examination of individual systems, not tested for extrapolating across systems.

Classification system	Objective	Classification Factors Considered	Stressor Pertinence	Extent, Spatial Temporal Variability	Data Availability, Gaps	Limitations/ Status of Testing/ Modifications
Geomorphic Modeling Approach (Stefan et al., 1995, 1996)	Lakes: Predict susceptibility of fish habitat to global climate change	Stratification (as a function of mean depth, area) Trophic status Latitudinal gradient Thermal regime	Habitat alteration Nutrients Suspended and bedded sediments Thermal regime Interacting stressors	Potential for US applicability Temporal Spatial	Lake morphometry and trophic status	Predictions have applicability to multiple stressors. Currently limited regional (MN lakes)
Estuarine Qualilty Index (Ferreira, J.G., 2000)	Estuarine; design a decision support system to provide an index or score based on estuarine condition to facilitate classification	Vulnerability Water Quality Sediment Quality Trophodynamics	Nutrients Toxics Suspended and bedded sediments	US and Europe	NOAA CADS BASINS	Benthic community, sediment quality, and fish diversity data may not be widely available.
Estuarine Susceptibility, (NOAA 1989; Bricker et al., 1999)	Estuaries: classify by susceptibility to nutrient over-enrichment	Nutrient Load Dilution Flushing Dissolved concentration potential (DCP) Particle retention efficiency (PRE) Estuarine Eport potential (EXP)	Nutrients	138 US estuaries or Estuarine drainage units (EDUs)	NOAA CADS Gaps in considering temperature, wind mixing, inlet configuration, estuarine plume exchange with nearshore oceanic water, ratio of shoreline length to estuarine surface area	Effectively oriented towards nutrient susceptibility, but untested for other aquatic stressors. Prediction less useful for estuaries in Maine, small estuaries in southern California, and Puget Sound estuaries

BASINS- Better Assessment Science Integrating Point and Nonpoint Sources
GLEI = Great Lakes Environmental Indicators Project
LMER - Land Margin Ecosystem Research Program
MRLC - National Land-use database
NGDC - www.ngdc.noaa.gov.mgg/mggd.html
NWSD-National Watershed Boundary Database
NOAA CADS - National Oceanic and Atmospheric Administration, Coastal Assessment and Data Synthesis System
NWI- National Wetlands Inventory
STATSGO database (U.S. Department of Agriculture, 1994)
USFS-EU - USFS- Ecological Units
USGS- Regional USGS peak flow prediction equations; water.usgs.gov/GIS/metadata/usgswrd/hlrus.htm
Ecosystem type: Marine, Estuarine, Riverine, Lacustrine, and Palustrine

Appendix F-1: Regional maps of sediment toxic units by chemical class (metals, pesticides, PAHs), for estuaries.



Toxic Units - Metals
Northeast
Legend
States
Study Unit Boundary
Toxic Units
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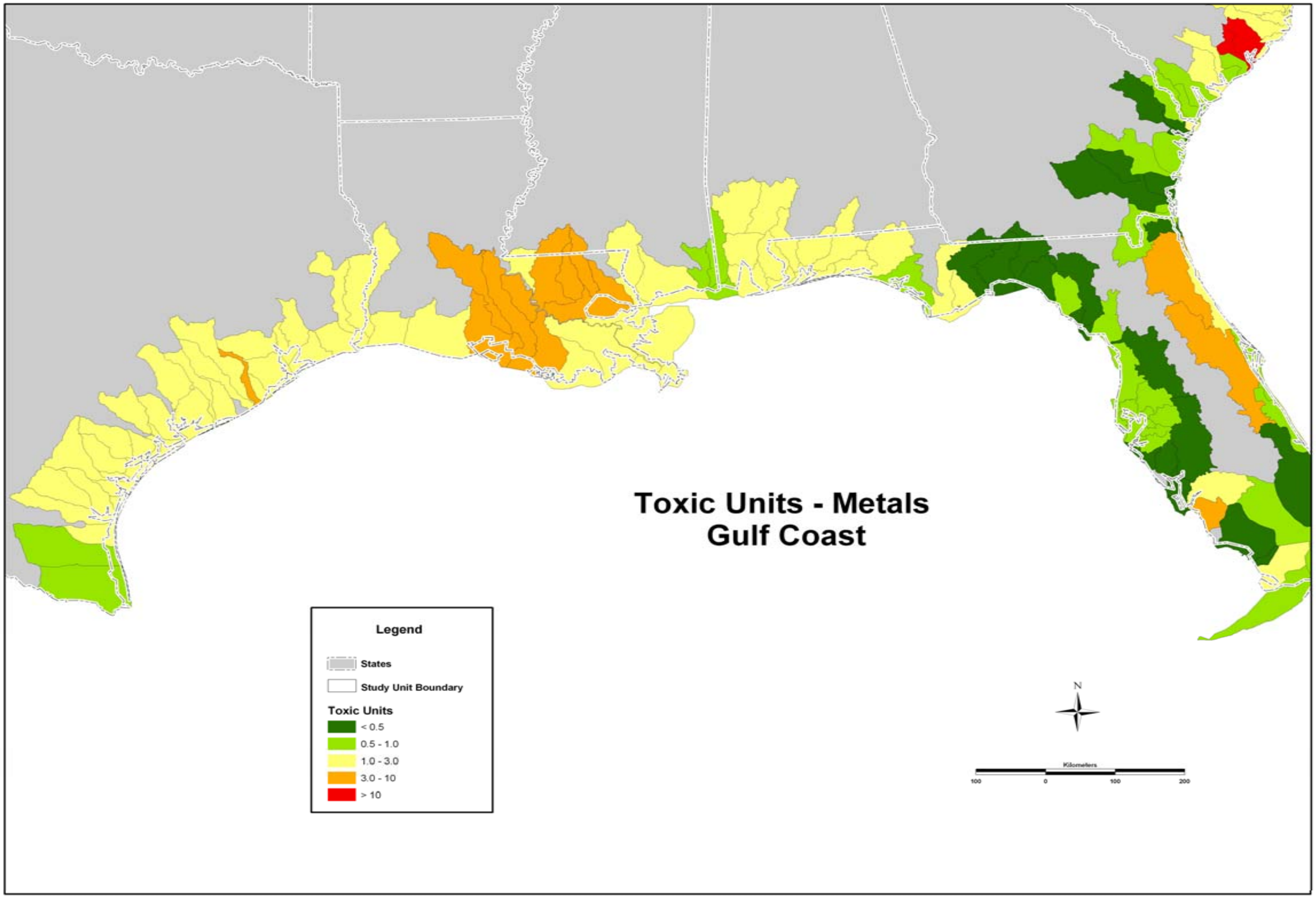
0.5 - 1.0
1.0 - 3.0
3.0 - 10
> 10
N
Kilometers
100
0
100
200


Toxic Units - Metals
Gulf Coast
Legend
States
Study Unit Boundary
Toxic Units
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3.0 - 10
> 10
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Kilometers
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100
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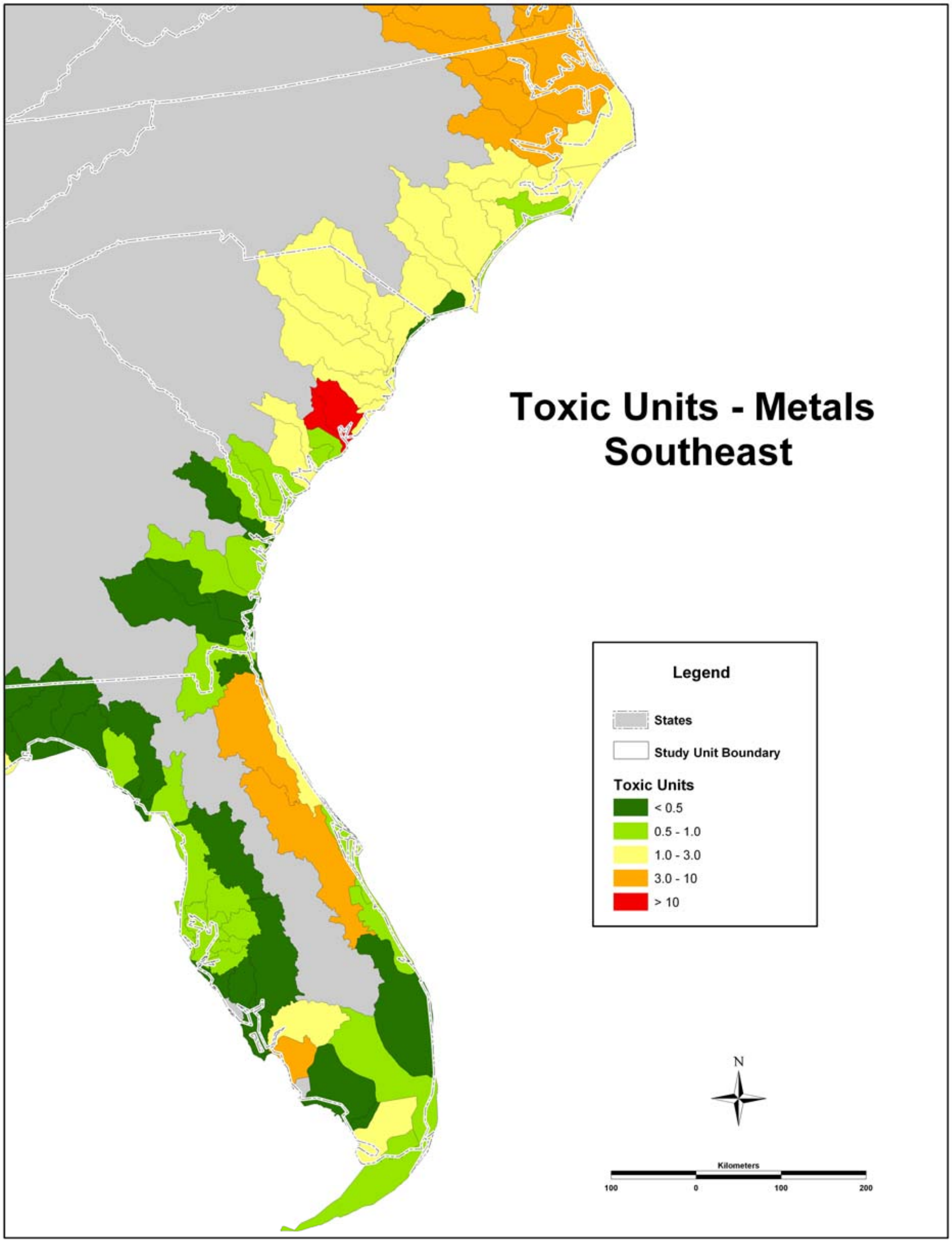

Toxic Units - Metals
Southeast
Legend
States
Study Unit Boundary
Toxic Units
< 0.5
0.5 - 1.0
1.0 - 3.0
3.0 - 10
> 10
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Kilometers
100
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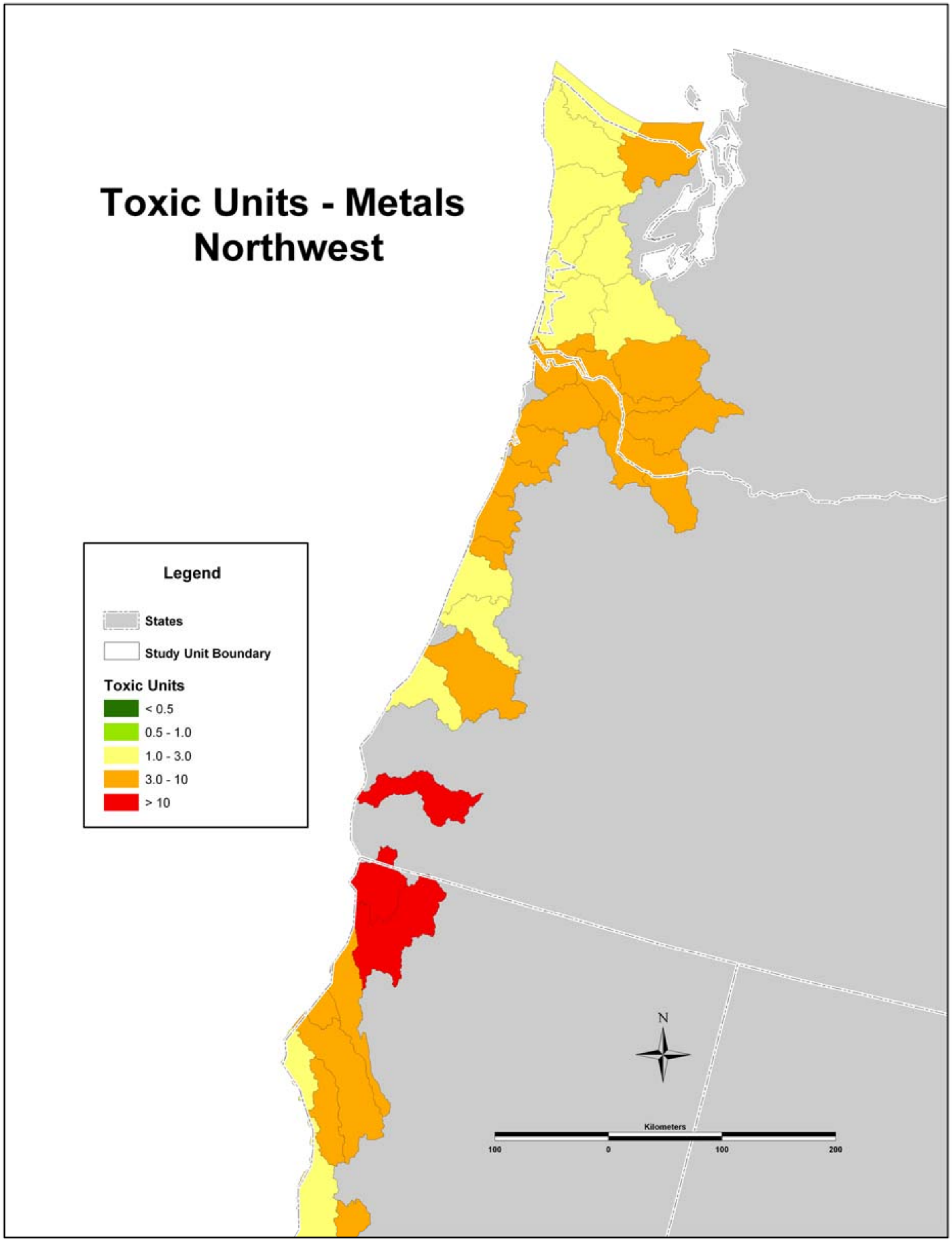
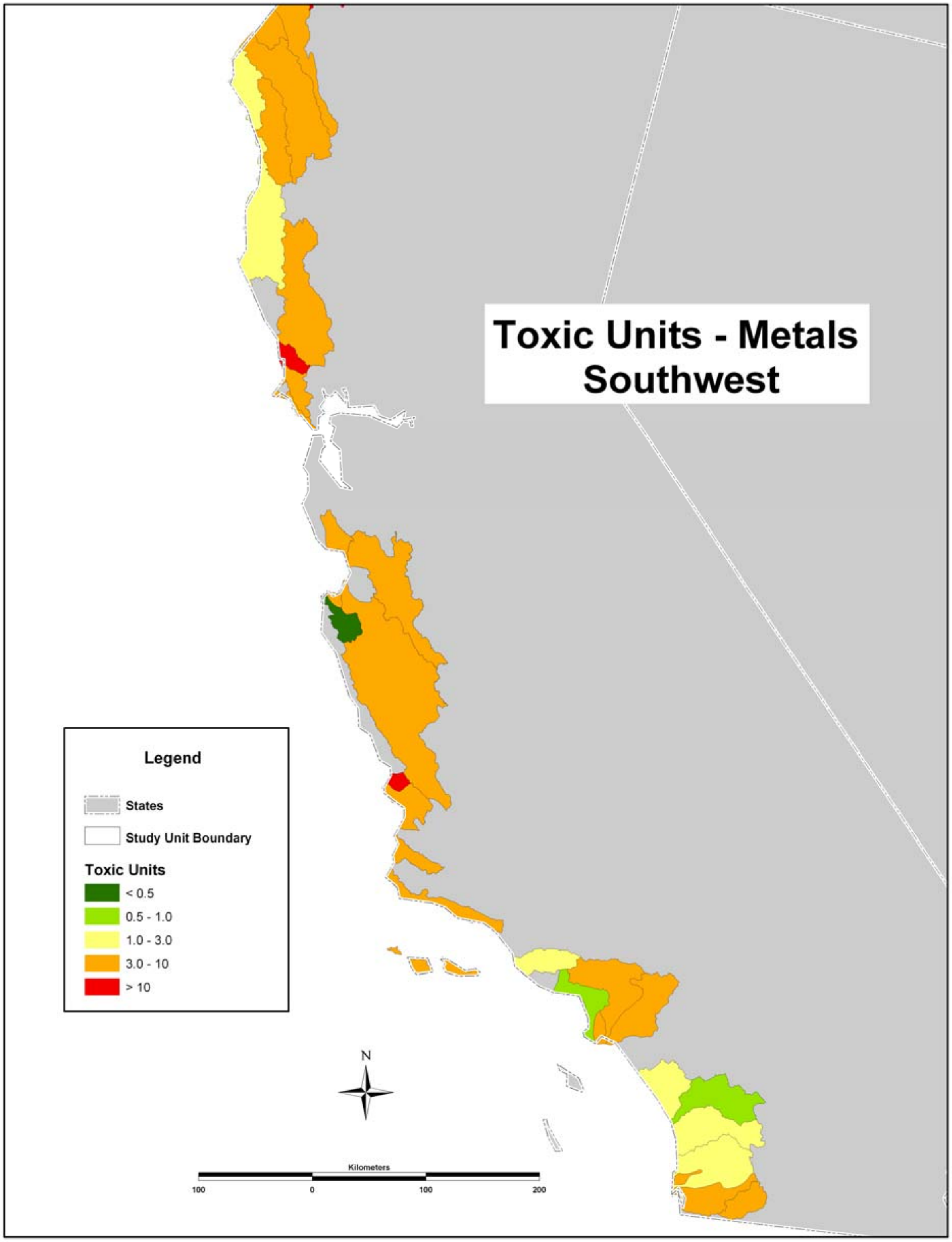
100
200

Toxic Units - Metals
Northwest

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Southwest
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Study Unit Boundary
Toxic Units
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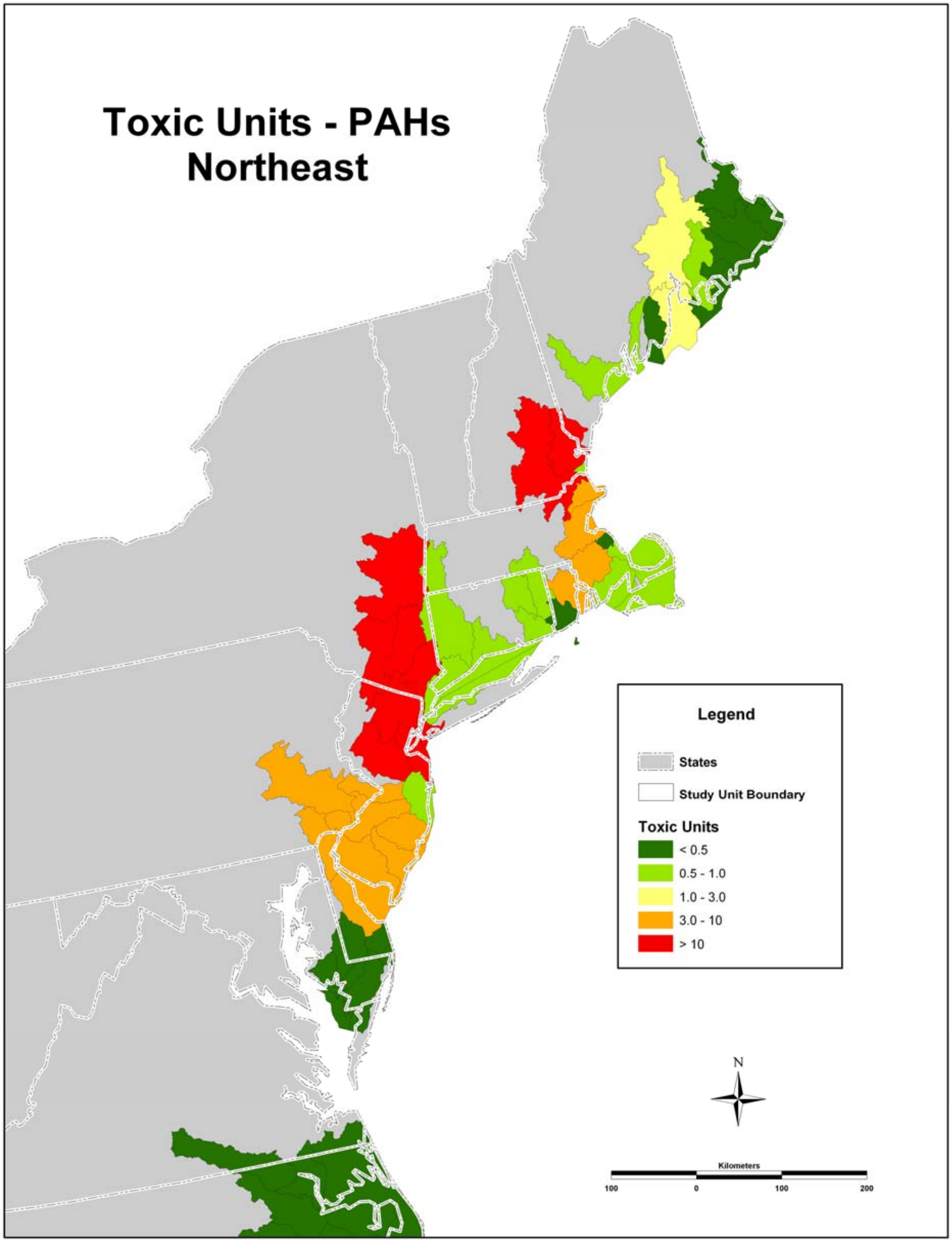

Toxic Units - PAHs
Northeast
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Study Unit Boundary
Toxic Units
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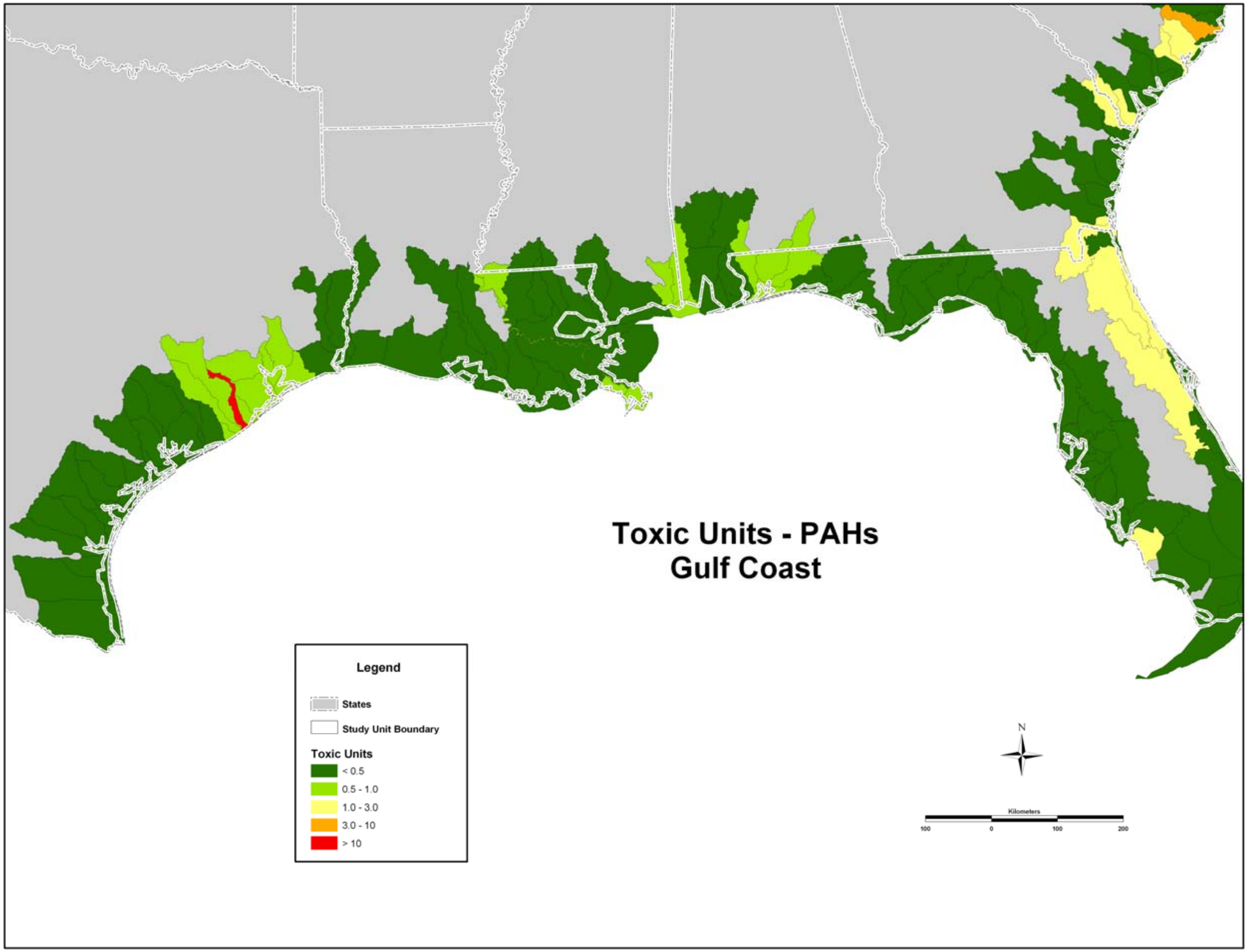
Toxic Units - PAHs
Gulf Coast
Legend
States
Study Unit Boundary
Toxic Units
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Kilometers
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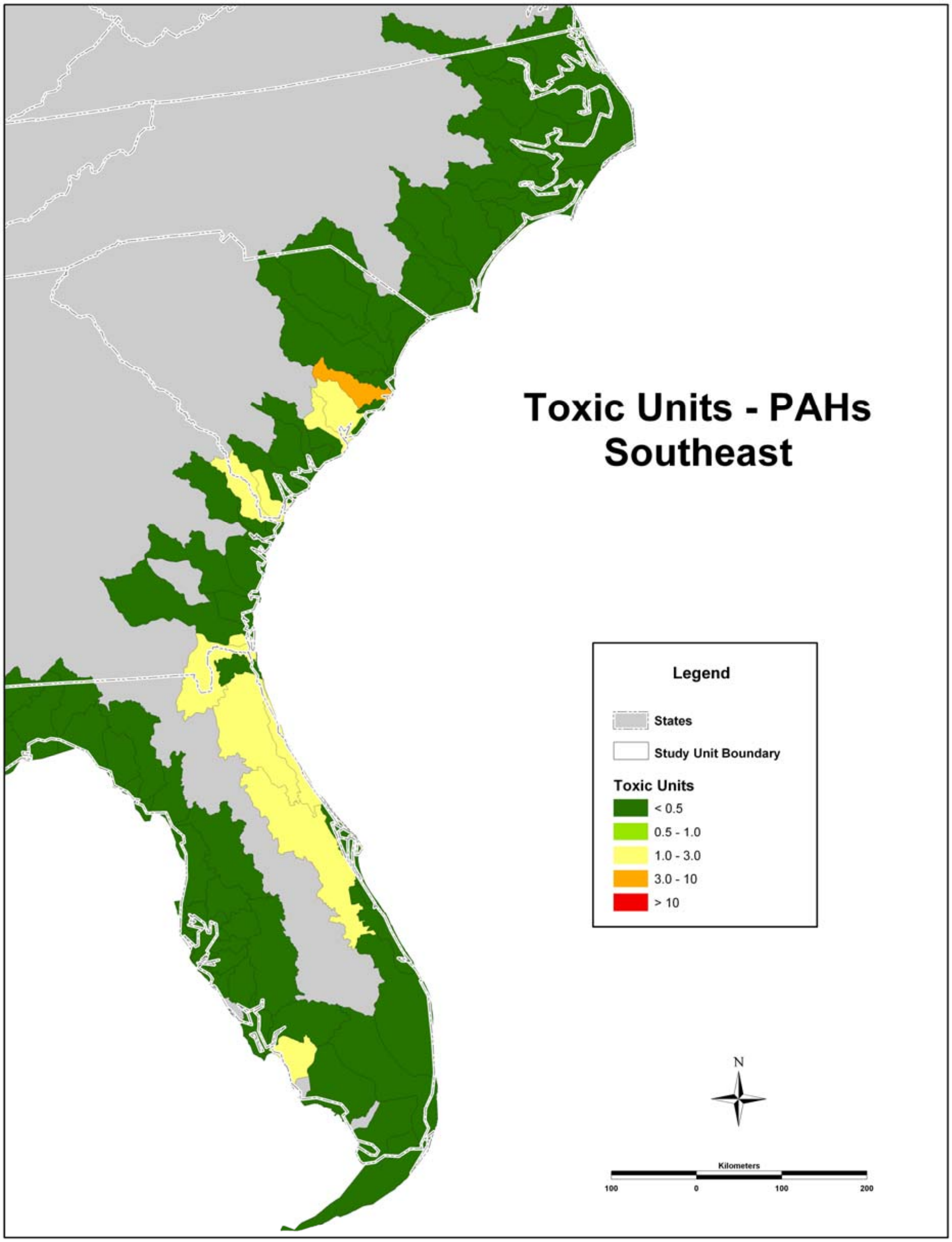
Toxic Units - PAHs
Southeast
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States
Study Unit Boundary
Toxic Units
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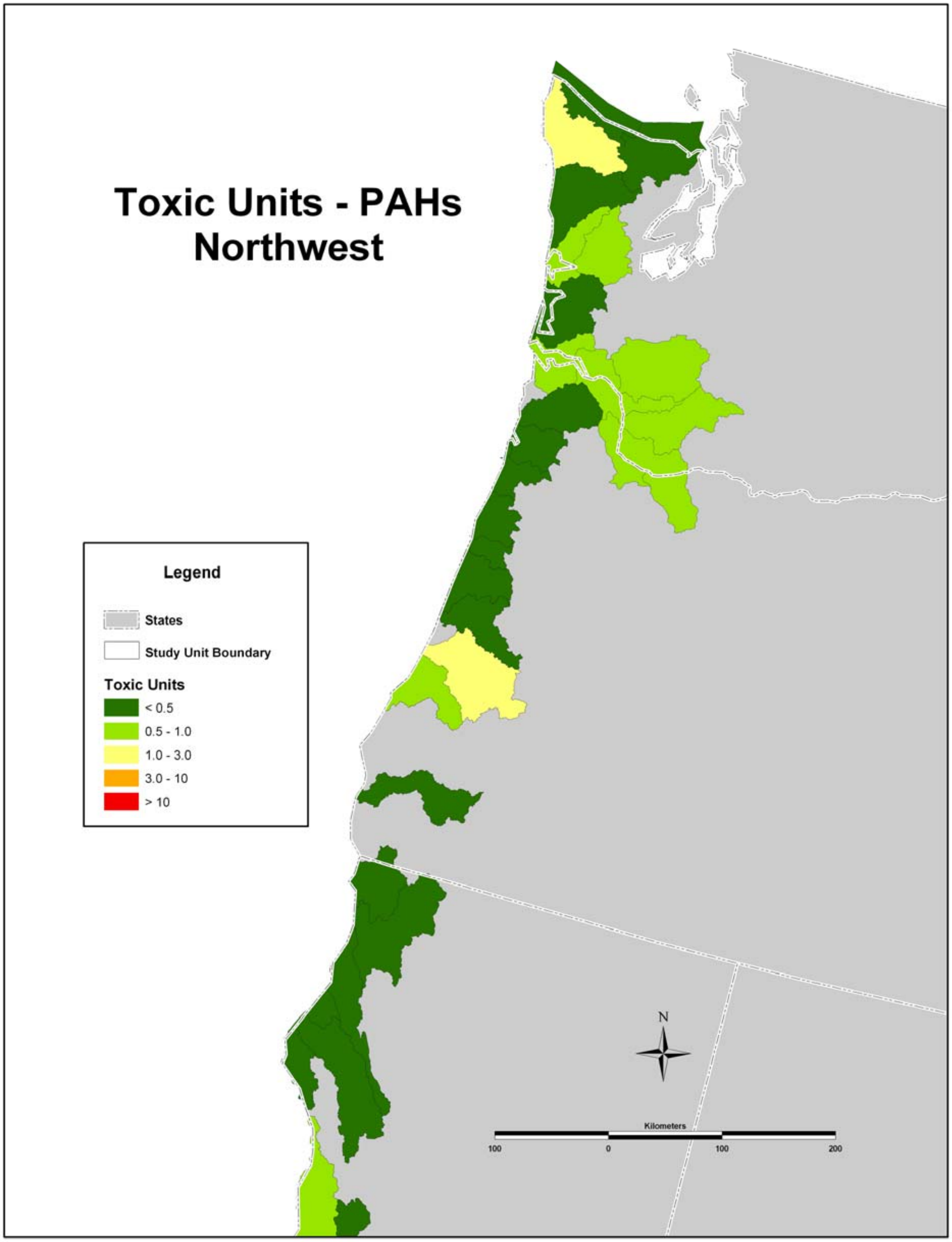

Toxic Units - PAHs
Northwest
Legend
States
Study Unit Boundary
Toxic Units
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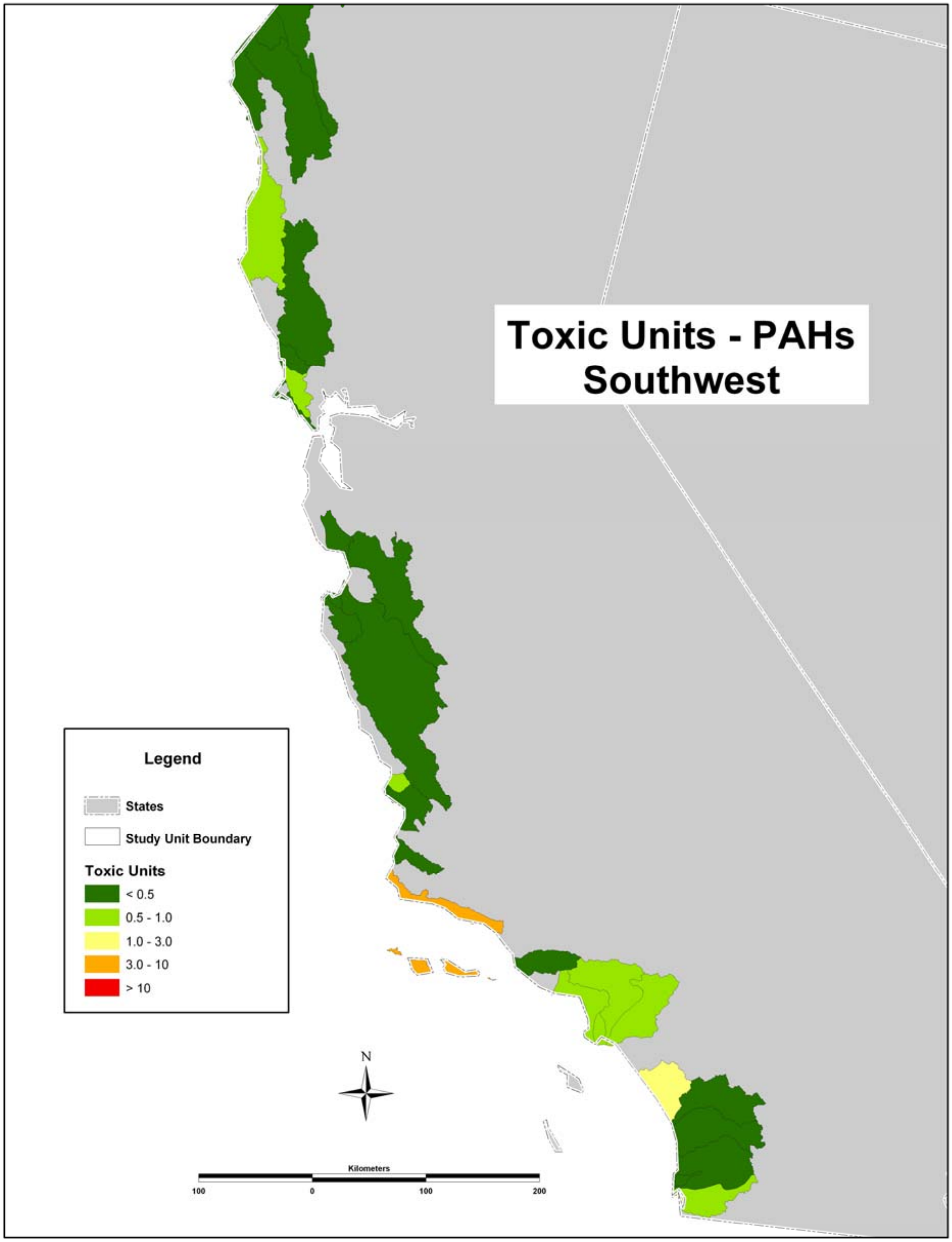

Toxic Units - PAHs
Southwest
Legend
States
Study Unit Boundary
Toxic Units
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0.5 - 1.0
1.0 - 3.0
3.0 - 10
> 10
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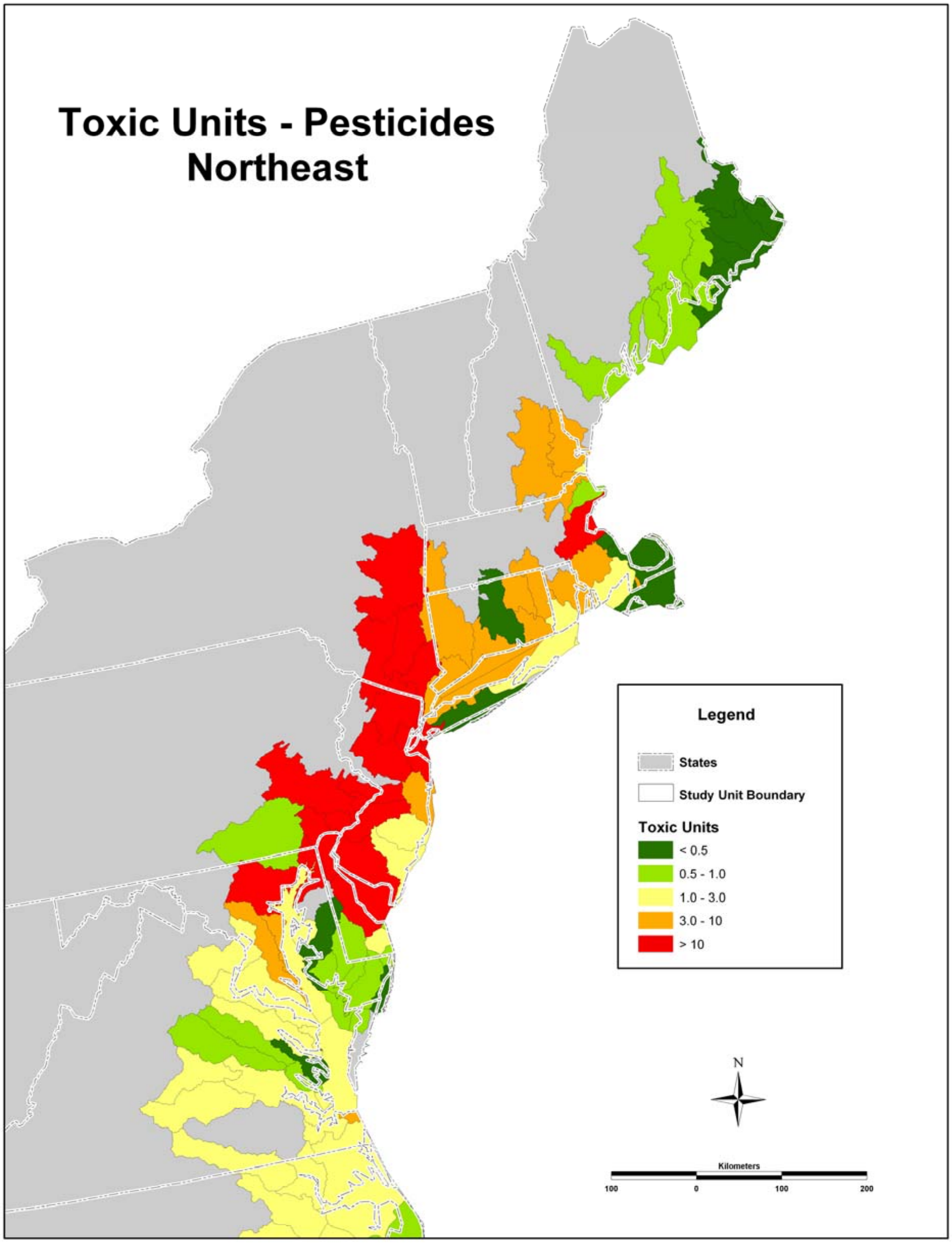
Toxic Units - Pesticides
Northeast
Legend
States
Study Unit Boundary
Toxic Units
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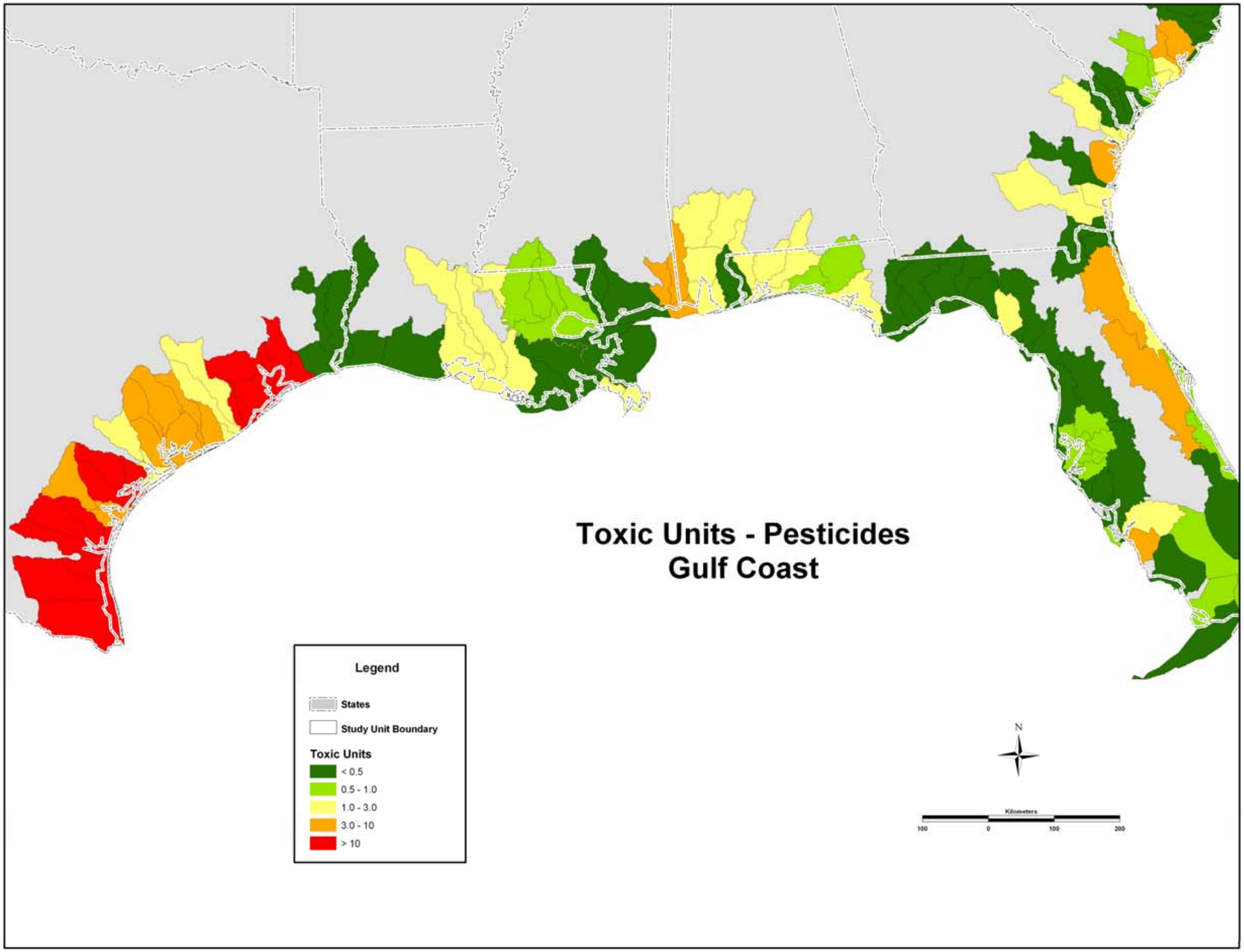
Toxic Units - Pesticides
Gulf Coast
Legend
States
Study Unit Boundary
Toxic Units
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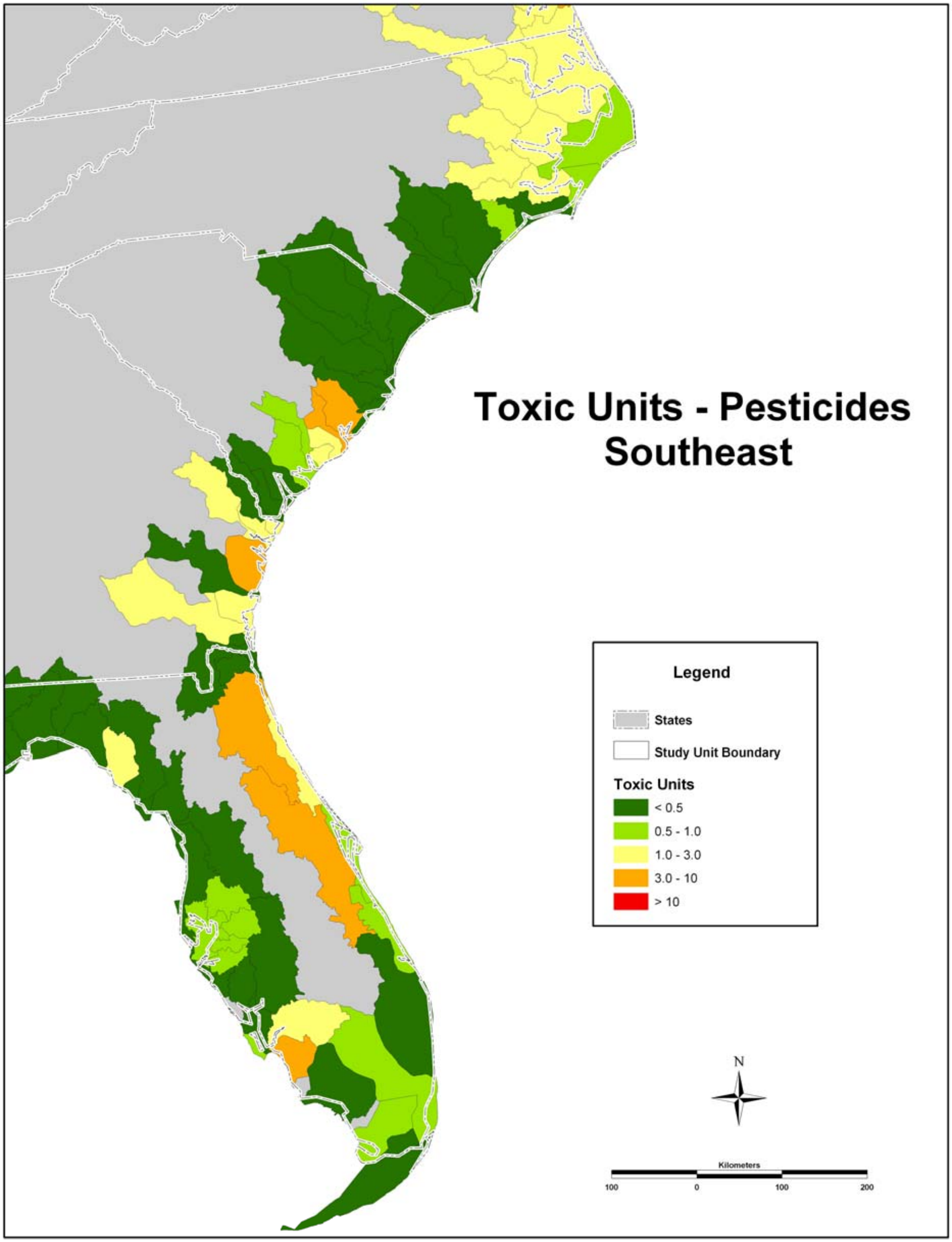
Toxic Units - Pesticides
Southeast
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Study Unit Boundary
Toxic Units
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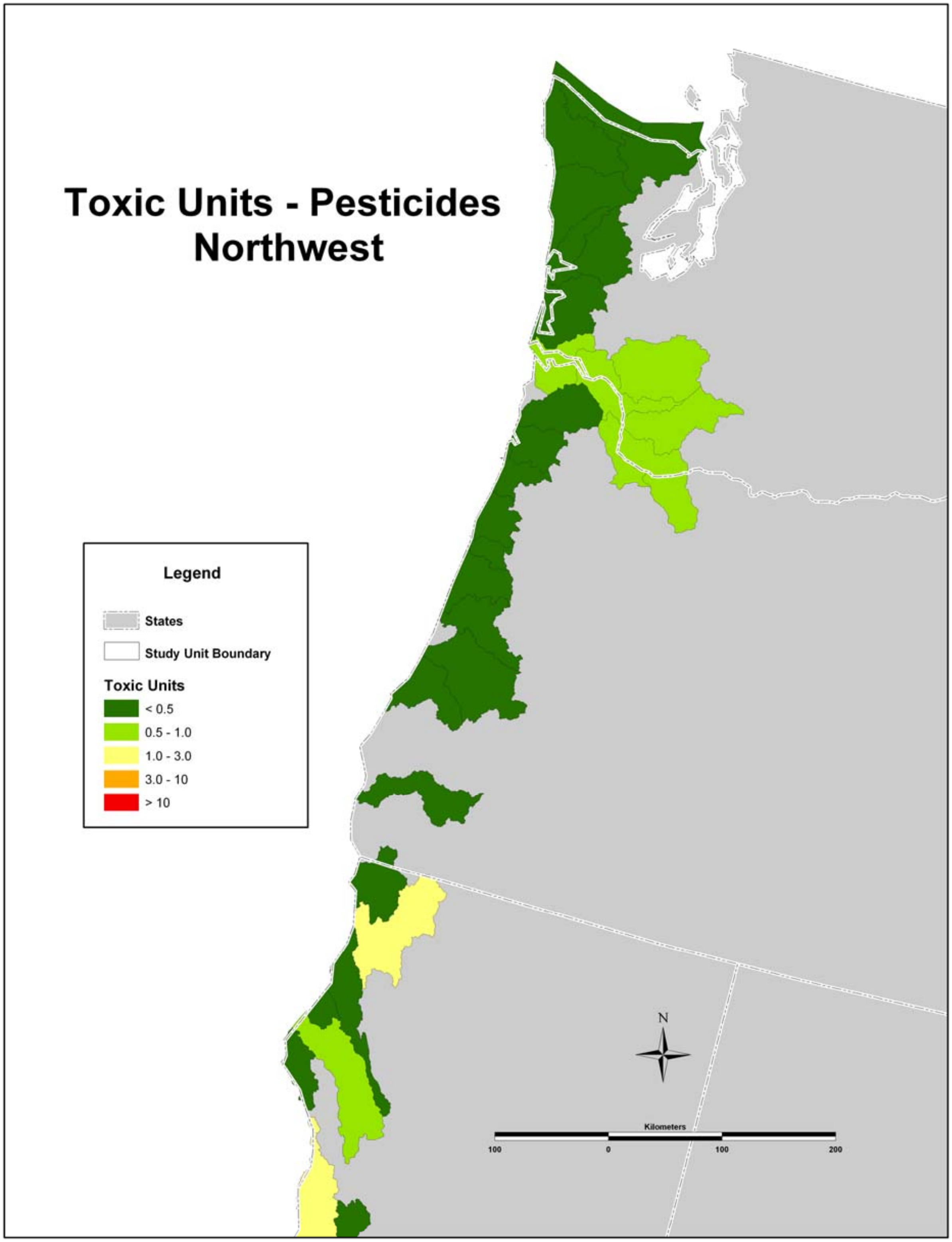

Toxic Units - Pesticides
Northwest
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States
Study Unit Boundary
Toxic Units
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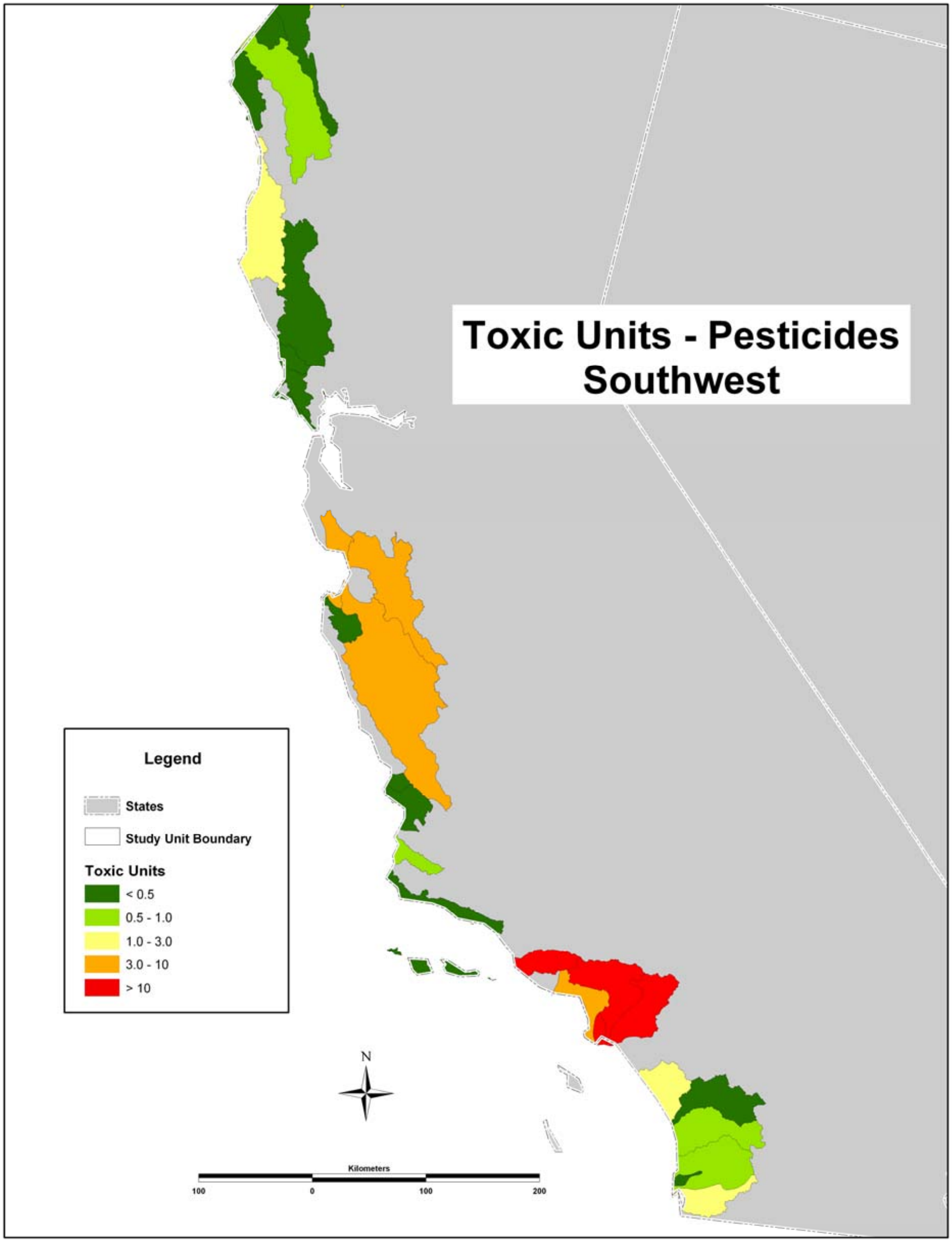
Toxic Units - Pesticides
Southwest
Legend
States
Study Unit Boundary
Toxic Units
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Kilometers
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