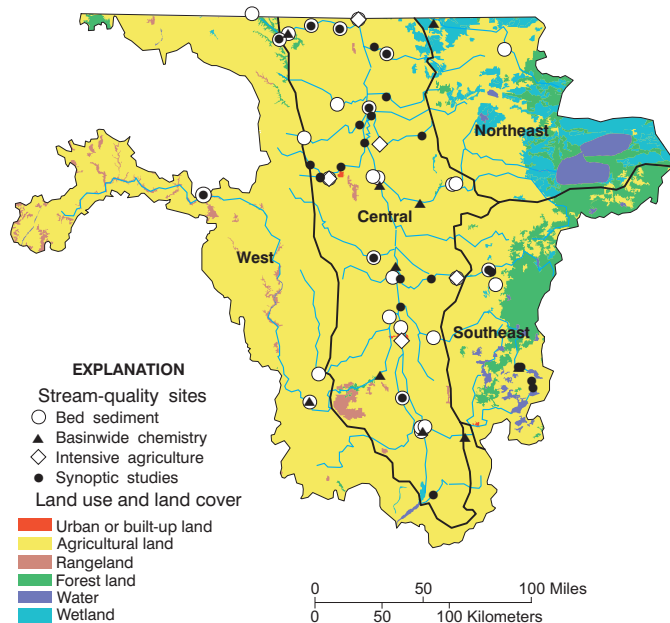
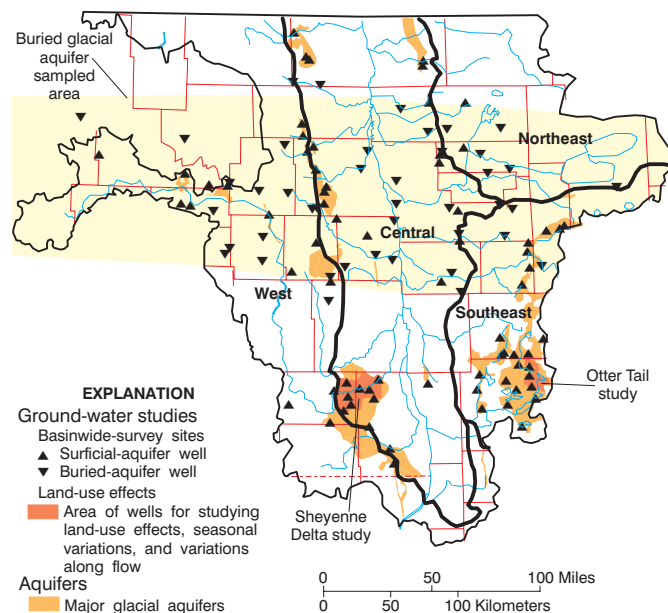


STUDY DESIGN AND DATA COLLECTION In the Red River of the North Basin, 1992-95

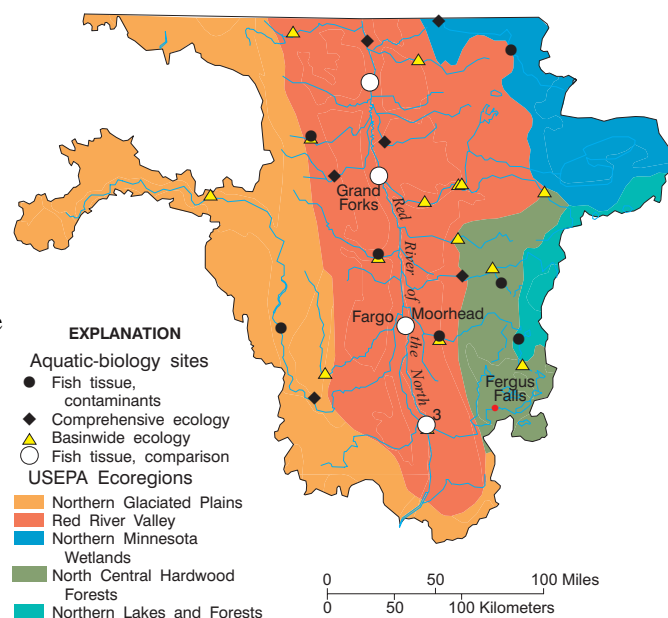
The ground-water studies assessed the overall water quality of surficial aquifers and buried glacial aquifers (table 5). Land-use effects on ground-water quality were also described in two study areas. A special study addressed land-use effects on the Otter Tail outwash aquifer along ground-water flow from areas of recharge beneath the land use to an area of discharge to a stream.



Aquatic biology sites were selected to describe the variation among the USEPA ecological regions (Omernik, 1987) in the Study Unit (table 5). Samples were also taken to determine the presence of contaminants in fish tissue.



The stream-water-quality sampling design (table 5) was established to assess the effects of agricultural land use on water quality and account for differences in the four subregions. A special study addressed the capacity of suspended sediment for transporting nutrients in streams.



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Table 5. Summary of data collected in the Red River of the North Basin reflects the multidisciplinary approach of NAWQA

Study component	What data were collected and why	Types of sites sampled and water-quality measures	Number of sites or studies	Sampling frequency [period]
Ground-Water Quality				
Basinwide survey - surficial aquifers	Describe overall water quality in surficial sand and gravel aquifers which are susceptible to contamination.	Sample 20–30 wells in three of the major subregions for major ions, nutrients, pesticides, organic carbon, and radionuclides.	69	1
Basinwide survey - buried aquifers	Describe the overall water quality and natural chemical patterns in buried aquifers.	Sample wells within a west-east area across the central part of the Study Unit for major ions and trace elements; nutrients and radionuclides collected from 27 wells.	42	1
Land-use effects	Determine the effects of specific land use on the quality of shallow ground water.	For two surficial aquifers lying mostly beneath irrigated cropland, sample wells completed near water table for major ions, nutrients, and pesticides; from one aquifer, sample for volatile-organic compounds and radionuclides.	58	1
Seasonal variations	Determine seasonal variation of concentrations of water-quality indicators in aquifers studied for land-use effects.	Resample selected wells in each aquifer studied for land-use effects for nutrients, major ions, and organic carbon.	16	4-5 per year, [1994–95]
Variations along flow	Describe land-use effects on surficial aquifers along ground-water flow from areas of recharge beneath the land use to area of discharge to a stream.	Sample clusters of wells installed along an approximate line of ground-water flow and at various depths within aquifers studied for land-use effects; analyze for major ions, nutrients, pesticides, and age-dating constituents.	19	1
Stream-Water Quality				
Bed-sediment survey	Determine presence of potentially toxic compounds attached to sediments in major streams.	Sample depositional zones of the Red River and selected tributaries for trace elements, PAHs, and organochlorine compounds.	22	1 [1992]
Bed-sediment distribution survey	Determine distribution of toxic compounds attached to sediment in streams.	Sample sites in addition to bed-sediment survey sites mostly for trace elements.	8	1
Basinwide stream-chemistry sites	Describe concentrations and loads of chemicals, suspended sediment, and nutrients at selected sites basinwide.	Sample for major ions, organic carbon, suspended sediment, and nutrients at or near sites where streamflow is measured continuously.	15	~14 per year, [1993–95]
Intensive agriculture sites	Determine concentration and timing of agriculture related compounds that are transported to streams.	Subset of basinwide stream-chemistry sites where 80 pesticides are sampled at least monthly and during selected runoff events.	5	~20 per year, [1993–95]
Synoptic studies	Describe short-term presence and distribution of contamination over broad areas and how well the stream-chemistry stations represent the entire Red River Basin.	Sample streams during high flow for pesticides and (or) nutrients, suspended sediment, organic carbon, and streamflow; one synoptic sampling for volatile organic compounds.	27	1
Stream sediment	Describe the role of suspended sediment in transporting nutrients in streams.	Map stream-channel geometry and collect sediment samples during spring runoff and storm flows at selected sites along the Pembina River.	1	12
Aquatic Biology				
Fish tissues, contaminants	Determine presence of contaminants that can accumulate in fish tissues.	Collect fish species that live in most streams of the Study Unit; sample composites of whole fish for organic compounds and fish livers for trace elements.	11	1 [1992]
Comprehensive ecology	Assess in detail biological communities and habitat in streams representing primary ecological regions.	Sample and quantify fish, macroinvertebrates, and algae in four of the major ecological regions located at or near a basinwide stream chemistry site; quantitatively describe stream habitat for these organisms; replicate sampling for three consecutive years over three stream reaches.	6	1 per year, [1993–95]
Basinwide ecology	Determine presence and community structure of aquatic species and habitat in representative streams across the Study Unit.	Sample and identify fish, macroinvertebrates and algae at or near stream-chemistry sites and describe habitat.	16	1
Fish tissues, comparison	Determine differences in concentrations of mercury in different fish tissues in the Red River.	Sample two sizes of carp at four sites and catfish at one site in the Red River for mercury concentration in livers, fillets, and whole bodies.	4	1