630/R-96/007A

MIDDLE PLATTE RIVER FLOODPLAIN

Ecological Risk Assessment Planning and Problem Formulation

RISK ASSESSMENT FORUM
U. S. ENVIRONMENTAL PROTECTION AGENCY

DRAFT, June 17, 1996

RAF 024

DRAFT
DO NOT QUOTE, CITE, OR DISTRIBUTE

Review Draft
June 1996

CENTRAL PLATTE RIVER FLOODPLAIN ECOSYSTEM ECOLOGICAL RISK ASSESSMENT CASE STUDY

EXECUTIVE SUMMARY

Prepared for the
Risk Assessment Forum
U.S. Environmental Protection Agency
Washington, D.C.

NOTICE

THIS DOCUMENT IS A PRELIMINARY DRAFT. It has not been released by the U.S. Environmental Protection Agency and should not at this state be construed to represent Agency policy. It is being circulated for comment on its technical accuracy and policy implications.

Risk Assessment Forum
U.S. Environmental Protection Agency
Washington, D.C.

DRAFT--DO NOT QUOTE, CITE, OR DISTRIBUTE

DISCLAIMER

This document is a draft for review purposes only and does not constitute Agency policy. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

MIDDLE PLATTE ECOLOGICAL RISK ASSESSMENT TEAM

Name	Status	Affiliation
Marcy, Suzanne	Chair	EPA/ORD/NCEA
Fenimore, Robert	Associate Chair	EPA/Reg. 7/ENSR
Jelinski, Dennis	Associate Chair	Univ. Nebraska-Lincoln - FFW
Sefton, Donna	Former Assoc. Chair	EPA/Reg. 7/WWPD
Craven, Harry	Team Member	EPA/OPP
Currier, Paul	Team Member	Platte R. Crane Trust
Downing, Marla	Former Assoc. Chair	EPA/Reg. 7/ENSV
Ferguson, Jaci	Team Member	EPA/Reg. 7/ARTX
Foster, Walt	Former Assoc. Chair	EPA/Reg. 7/ENSV
Gardetto, Ed	Team Member	EPA/OAR
Green, Pete	Team Member	EPA/Reg. 7/ENSV
Huber, Annette	Former Assoc. Chair	EPA/OW/OST
Huntsinger, Tom	Team Member	USGS
Jackson, Susan	Team Member	EPA/OW/OST
Schweiger, William	Team Member	EPA/Reg. 7/ENSV
Sidle, John	Team Member	USFWS
Thackray, Gillian	Team Member	EPA/OSW
Welker, Gary	Team Member	EPA/Reg. 7/ENSV
Anderbery, Rick	Participant	Tri-Basin Natural Resource District
Bender, John	Participant	Nebraska Dept. Environmental Quality
Kubicek, Terry	Participant	Nebraska Natural Resources Comm.
Lathrop, Brent	Participant	Nature Conservancy
Miller, Kent	Participant	Twin Platte Natural Resource District
Moravek, Milt	Participant	Central Platte Natural Resource District
Norman, Kenneth	Participant	SCS-Nebraska State Office
Peters, Edward	Participant	Univ. Nebraska-Lincoln - Fisheries
Reiman, Richard	Participant	Nebraska Dept. Agriculture
Rothenberger, Steve	Participant	Univ. Nebraska-Kearney
Volk, Robert	Participant	Univ. Nebraska-Lincoln - Water Center
Wallin, Jerry	Participant	Nebraska Natural Resources Comm.
Whitney, William	Participant	Prairie Plains Res.
Zuerlein, Gene	Participant	Nebraska Game and Parks Comm.

CENTRAL PLATTE RIVER FLOODPLAIN ECOSYSTEM ECOLOGICAL RISK ASSESSMENT CASE STUDY

EXECUTIVE SUMMARY

The central Platte River valley in Nebraska is an agricultural landscape that has undergone significant transformation over the last century. Most of the native habitats have been extirpated or severely altered. Numerous dams and water diversion projects in the upper Platte River basin have significantly reduced natural flows and sediment discharge on the Platte River and, in consequence, once wide and treeless channels have been transformed to multiple, narrow channels with woody vegetation succeeding on sandbars. Peak discharge has declined nearly 70% over the last century, and the river channel is only 10-70% of its 1865 width. Wetland habitat has been reduced by 75%. There has also been widespread alteration to the upland landscape. Native vegetation now exists only as remnants (patches) within a matrix of agricultural land. Intensive agriculture has replaced the majority of the native grasslands once found in the area. Habitat loss and insularization of the biota have altered considerably the area's biodiversity and threaten many of the remaining native populations and ecological processes.

The central Platte River valley also has hemispherical significance as a staging area for migratory water birds, and offers critical habitat for a variety of migratory and non-migratory birds (Figure 1). The region is best known for the nearly one-half million sandhill cranes (*Grus canadensis*) and several million ducks and geese that migrate annually through the region; however, in total, approximately 50 species of mammals and 300 species of migratory birds use woodlands, grasslands and wet meadows in the Platte River valley. Six endangered or threatened species of birds are found on the Platte.

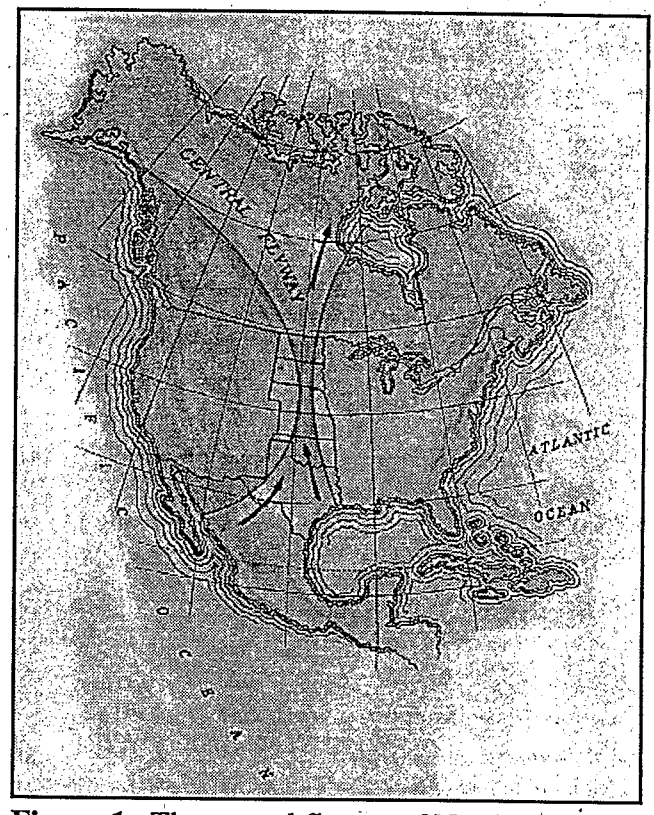

Figure 1. The central flyway of North America. (Source: PRWCMT 1996)

Economic development in the central Platte River valley is essential for local and regional prosperity. Conserving biological resources and maintaining the integrity of ecological processes must be undertaken with consideration for economic activities. A major conflict of economic development on the Platte River revolves around water allocation for irrigation, hydroelectric development, fish and wildlife, and recreation. With more abundant water for irrigation, intense row cropping has changed the land cover of the watershed. Water resources are also critically important for creating and modifying wildlife habitat and for mediating ecological processes such as mineral and nutrient exchange across the floodplain.

Political controversy centers on trade-offs between irrigation and power development, biodiversity of the floodplain ecosystem, and the maintenance of key ecosystem functions. The issues are complex and fraught with emotion.

EPA Region VII formally nominated the central Platte River watershed in 1993 for inclusion in an EPA sponsored project to develop watershed-scale ecological risk assessment case studies. Ecological risk assessment provides a framework for conveying scientific information about ecological risks to managers making environmental decisions. The risk assessment process is designed to ensure that assessment results are both relevant to managers and scientifically sound. Cultural and ecological characteristics of the central Platte River floodplain ecosystem have made attainment of these dual requirements particularly challenging. As a consequence, the problem formulation phase of this risk assessment has undergone repeated, extensive revision, and a substantial amount of work remains to be done. Conceptual models and the analysis plan have received considerable thought; however, they are still under development and are not included in this summary.

PLANNING THE RISK ASSESSMENT

The objectives of the planning were to establish clear and agreed-upon goals for the watershed resources, to determine the purpose for the risk assessment within the context of those goals, and to agree on the scope and complexity of the risk assessment. One of the principal challenges for meeting planning objectives for this risk assessment was to develop a management goal for watershed resources that diverse members of the community could support.

The Platte River drainage basin encompasses three states (Figure 2). The geographic scope of this risk assessment includes the river reach extending from the dam at Lake McConaughy near North Platte, Nebraska to the confluence with the Loup River near Columbus, Nebraska. The study area extends laterally from the river channel to the edge of the historical floodplain at the Platte Valley escarpment.

Establishing the Environmental Management Goal

The management goal was formulated through an iterative process involving risk managers and risk assessors, scientific advisors, and interested parties concerned about watershed resources. The process included:

- Watershed Tours/Visits with Interested Parties
- Focus Group Meetings
- Symposia and Public Forums

Early in the process meetings with interested parties focused on gathering information on management goals, valued ecological resources, stressors, and ecological effects. Focus groups were organized around agriculture, irrigation, and industry concerns; environmental and natural resource interests; and government and university interests. Symposia and public forums were held at several stages in the process to explain ecological risk assessment and exchange information relevant to the process. An equally important function of these symposia and public forums was to obtain feedback on the proposed

management goal, stressors, assessment endpoints, measures of effect, and proposed analysis plan, recognizing that all these components were still in the development stage. Formulation of the management goal has been an iterative process in which the goal has been continually refined based on feedback from interested parties, managers, and scientists.

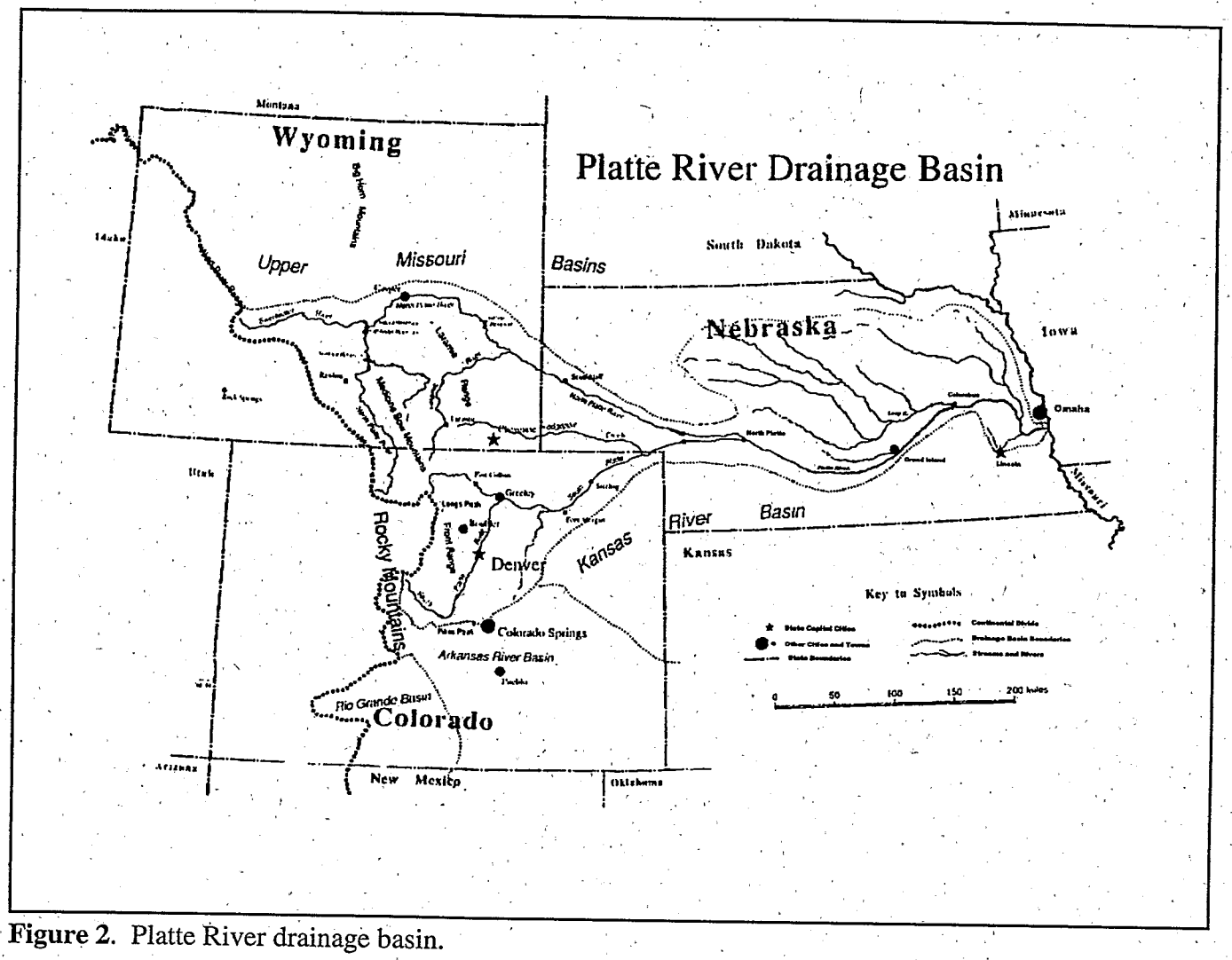

Figure 2. Platte River drainage basin.

The Environmental Management Goal

Protect, maintain, and where feasible, restore biodiversity and ecological processes in the middle Platte River floodplain to sustain and balance ecological values with human uses.

Interpreting the Management Goal for Risk Assessment

The management goal is a qualitative statement that addresses concerns expressed by different management organizations and the public in the central Platte River floodplain. The management goal expressed herein defines the ecological values to be protected, but also recognizes the need to balance these objectives with socio-economic concerns. Biodiversity is a prominent feature of the management goal. The U.S. Office of Technology Assessment (1987) defines biodiversity as "the variety and variability among living organisms, and the ecological complexes in which they occur". There are three scales over which biodiversity can be measured: (1) genetic diversity among individuals of a species, (2) species diversity, and (3) community and landscape diversity. For the purposes of this risk assessment concern is with species, community, and landscape diversity. Our definition of biodiversity also addresses the role of the floodplain landscape mosaic (i.e., spatial configuration) in affecting ecological patterns and processes.

In order for the management goal to support an ecological risk assessment, the goal was evaluated by the Team and interpreted as 11 management objectives (see Table 1). These objectives provide the basis for interpreting the goal in the risk assessment, selecting assessment endpoints, and measuring the degree of success in achieving the goal. These objectives are intended to state the specific ecological characteristics of principal interest to achieve the general management goal. Furthermore, the ecological values as embodied in the management objectives provide a framework for logical development of assessment endpoints that can be directly linked to the management goal.

The management objectives are stated in Table 1, organized in relation to landscape elements (ecosystems), and recognizing that the middle Platte River floodplain is a three-dimensional, volumetric unit composed of river channel, sandbar, backwater, riparian forest and grassland ecosystems. The

Table 1. The environmental management goal for the middle Platte River floodplain interpreted as 11 environmental management objectives that are implicit in and required to achieve the management goal.

Affected Area	Objective	Environmental Management Objective
Channel	1	Restore and maintain stream channel dynamic equilibrium.
	2	Maintain sufficient flows to prevent high temperatures detrimental to native fish populations.
Riparian Forest	3	Maintain range of successional stages of forest vegetation.
Backwaters	4	Maintain and reestablish backwater ecosystems
	5	Maintain and restore hydrologic connectivity between backwaters and river channels through surface flows.
Floodplain	6	Maintain hydrologic connectivity between river channels and wet meadow ecosystems.
	7	Maintain and reestablish natural diversity in wet meadow ecosystems.
	8	Maintain and reestablish natural diversity in native upland ecosystems.
Landscape	9	Protect and where feasible reestablish the mosaic of habitats in the central Platte River floodplain to support key ecological functions and native biodiversity.
	10	Maintain diversity of water-dependent wildlife including migratory and nesting birds, mammals, amphibians, reptiles and invertebrates.
	11	Prevent toxic levels of contamination in water consistent with state water quality standards.

Team determined that partitioning of the landscape by ecosystem type facilitates identification of assessment endpoints and, ultimately, environmental management.

In the central Platte River floodplain ecosystem, movement of water is the dominant force driving many physical-hydrogeologic processes. The physical-hydrologic processes both directly and indirectly support and maintain biodiversity. Given the importance of hydrology, four of the management objectives explicitly recognize the need for maintaining or mimicking a hydrologic regime capable of maintaining the structure and function of the river floodplain ecosystem. Structure, here, refers to the composition of habitats, their spatial arrangement (geometry), and the way in which they are connected and used by organisms or to facilitate an ecological process. Function refers to flows of energy, materials and organisms. The management objectives focus on key groups of organisms or landscape elements (ecosystems).

Given the importance of hydrology in maintaining this ecosystem, an important management decision is to what extent, and how, the current hydrologic regime should be altered to restore and maintain the landscape mosaic and the ecosystems it comprises. A relevant ecological question is, to what extent can changes in the hydrologic regime restore and maintain the system? Because of competing water uses, it may not be feasible to alter the current hydrologic regime sufficiently to restore and maintain the system. Managers must consider the efficacy of alternative management methods such as channel clearing and the implications that approach has for neotropical migratory birds. Historically, neotropical migrants were aa minor component of the native avifauna. Neotropical migrants have experienced significant habitat loss elsewhere and now utilize riparian woodlands that have become established on what was once open channel habitat.

Land use conversion from wet meadow to cropland and other intensive uses is another potential source of habitat loss. Finally, agricultural chemicals (i.e. pesticides, herbicides, and fertilizers) have the potential to degrade the floodplain ecosystem, through toxicity and eutrophication. This is especially true given the extensive connections between groundwater and surface water; however, the potential effects of agricultural chemicals may be insignificant compared to other sources of stress. Managers must decide where to focus their limited resources to obtain maximum ecological benefits. Estimates of ecological risk can be useful for prioritizing management actions and identifying land parcels for special protective measures.

Assessment Endpoints

Assessment endpoints are explicit expressions of the actual environmental values to be protected. The assessment endpoints translate the management goals into ecological endpoints that are susceptible to one or more stressors. Assessment endpoints must be directly or indirectly quantifiable; however, identification of these assessment endpoints does not imply that the data needed to make these quantitative determinations necessarily exist for the Platte River watershed. Rather, the assessment endpoints provide a framework and focus for data collection. The assessment endpoints also serve a critical function in the problem formulation because they provide the basis for conceptual model development, which is the process of portraying the functional relationships among assessment endpoints and their predicted responses to stressors.

Assessment endpoints were defined and selected based on three criteria: (1) how well they represent the management goal (societal value); (2) how well they represent attributes of the ecological integrity of the middle Platte River floodplain (ecological relevance); and (3) the likelihood they will be adversely affected by one or more stressors (susceptibility). The assessment endpoints are listed in Table 2 in relation to the management objectives they address.

There is a certain amount of redundancy among landscape-, ecosystem-, and population/community-level assessment endpoints. The apparent redundancy derives from three observations made by the Team: (1) Each level of assessment has different criteria for observation and measurement; thus, each provides a different vantage point for assessment; (2) Individual species and animal communities are of special concern to managers and they are important in determining success of management actions; however, species cannot be managed in isolation from their habitats; and (3) Scientific understanding of ecosystems is not adequate to ensure that apparent ecosystem-level integrity will be protective of all species and communities of special concern. Redundancy across levels of biological organization is an acknowledgement of these factors and defines the Team's approach to addressing them.

Table 2. Assessment endpoints for the middle Platte River floodplain risk assessment organized by the level of assessment, and the management objectives they address.

		Management Objective										
Level of Assessment	Assessment Endpoint	1	2	3	4	5	6	7	8	9	10	11
Landscape	Floodplain landscape-mosaic structure and function.	X	X	X	X	X	X	X	X	X	X	X
Ecosystem	Open channel configuration and distribution.	X								X	X	
	Channel and backwater structure and function.	X		X	X	X				X	X	X
	Riparian vegetation successional stage, areal extent, and dispersion.	X		X						X	X	
	Wet meadow ecosystem structure and function.	X				X	X	X	X	X	X	X
Population/ Community	Migratory water-bird diversity, abundance, and dispersion.	X		X						X	X	X
	Sandbar, grassland, and neotropical avifauna survival and reproduction.	X	X	X	X			X	X	X	X	X
	Amphibian survival and reproduction.	X			X					X	X	X
	Riverine and backwater fish and invertebrate community structure and function.	X	X		X					X		X

Landscape-level assessment endpoint

Floodplain landscape-mosaic structure and function. The floodplain mosaic, including its structure and function, was chosen as an assessment endpoint because the patchwork of ecosystem types, interactions among those ecosystem types, and maintenance of landscape-scale processes are all necessary to achieve the management goal. Biodiversity and ecological processes of the floodplain depend upon a landscape-scale, shifting mosaic of habitat types. The predominant landscape-level stressors are hydrologic modification and conversion of land cover from native habitats to cropland and other intensive human uses.

Ecosystem-level Endpoints

Open channel configuration and distribution. The middle Platte River is a braided stream with active sandbars and bedload movement. Periodic floods establish new channels that migrate across the floodplain forming a braided network. The flood pulse scours sandbars on which vegetation may be established, thus maintaining channels in an open condition. Open channels provide nesting habitat for least terns and piping plovers and roosting habitat for sandhill cranes, whooping cranes, and waterfowl. The distribution of open channel habitat controls the distribution of these avian species. Therefore, open channel configuration and distribution were selected as measurable attributes for restoring and maintaining the dynamic equilibrium characteristic of large braided rivers. When floods are reduced in magnitude and frequency, the riverbed does not shift which results in increased stability of the bars and, ultimately, establishment of vegetation. The dominant factor causing loss of open channel habitat and expansion of riparian woodland appears to be reduction in the magnitude and variability of surface water flows.

Side channel and backwater structure and function. Side channels and backwaters provide breeding habitat and refugia for fish and amphibians, and floodplain nutrient sink/source functions. The structure and function of side channel and backwater ecosystems contributes to the biodiversity of the floodplain and maintenance of important landscape processes. Side channels and backwaters are formed by scouring and migration of river flows. When the main channel no longer avulses (i.e. does not cut across the floodplain forming new channel paths) backwaters and side channels gradually grade toward terrestrialization, often being replaced by woodland vegetation. Lower, more stable flows also facilitate conversion of these ecosystems to cropland.

Riparian vegetation successional stage, areal extent, and dispersion. Riparian habitats support a disproportionately large amount and diversity of biota. Alteration of the riparian woodlands affects biodiversity, water quality, and other ecosystem functions. At the same time, alluvial riparian woodlands adversely affect sandhill cranes and other channel roosting water-birds that prefer unobstructed views of the landscape. Diversity in alluvial forest succession is maintained by river channel migration simultaneously depositing alluvium and eroding vegetated sandbars and banks. The attributes are key to maintaining woodlands in a dynamic equilibrium with many patches (areal extent and dispersion) in various successional stages. Reductions in the magnitude and variability of river flows results in an increase in the areal extent of riparian habitats in more advanced successional stages.

Wet meadow vegetation composition and abundance. Wet meadows are an ecosystem type in floodplains characterized by poor soil drainage, high water tables and nutrient-rich soils. They support more than 200 plant species and a range of wildlife. They also support a variety of invertebrates that are an important

source of high quality nutrition for sandhill cranes. Of fundamental significance is the hydrologic control of the groundwater regime by connections to flows in the nearby Platte River. Wet meadow community structure is highly sensitive to small-scale topographic changes (i.e. ridge vs. swale) with corresponding changes in productivity.

Population and Community-level Endpoints

Migratory waterbird diversity, abundance, and dispersion. Channels of the middle Platte River are used as a staging area for a range of migratory waterbirds including sandhill cranes, whooping cranes, and a variety of ducks and geese. All are highly valued ecological resources. Approximately 80% (about 500,000) of the continental population of sandhill cranes spend upwards of six weeks staging on the middle Platte River. Sandhill cranes roost in open channels and forage for invertebrates in nearby wet meadows and waste corn in cornfields. This species has tremendously high societal value, attracting visitors from around the world. The population is susceptible to displacement by narrowing of channel habitats forcing birds into fewer reaches of the river with channels at least 150m wide, which is believed to be preferred habitat. They are also susceptible to hydrological changes in wet meadows that affect numbers of invertebrates (earthworms and snails), a critical component in the diet of sandhill cranes.

Several million ducks and geese use the middle Platte River region each year. They depend on open channel habitats for roosting and feeding. Reductions in water levels causes crowding and attendant stress, and increased probability of disease transmission (e.g. fowl cholera).

Piping plover, least tern, core grassland, and neotropical migrant survival and reproduction. The floodplain supports a rich assemblage of breeding birds which are principally found in sandbar, woodland, and wet meadow habitats. Least terns and piping plovers depend solely on unvegetated sandbar habitats for nesting. Feeding sites must be free of disturbance with continuous water flow within 100m of the roost. Core (i.e. not edge) grassland species serve as sensitive indicators of wet meadow habitat fragmentation. The core-grassland bird species that rely on wet meadow habitats for breeding include upland sandpiper, bobolink, grasshopper sparrow, dickscissel, and meadowlark. Fragmentation reduces their incidence and abundance. Neotropical migrants serve as sensitive indicators of diversity for woodland breeding birds. The susceptibility of neotropical migrants to shifts in homogeneity of forest structure makes this group of species the best indicator of diversity in woodland succession.

Amphibian survival and reproduction. Because of their dependence on both aquatic and terrestrial habitats, amphibians are good indicators of the structure and function of these habitat types and habitat mosaic. Backwaters and wet meadows are particularly important for reproduction, and the suitability of these habitats for spawning is strongly influenced by the hydrologic regime. General baseflow and episodic inundation of lowlands create wetlands and ephemeral pools that are essential spawning and brood sites for amphibian reproduction. Adults are more sensitive to upland conditions and can be adversely affected by use of wet meadows and riparian woodlands by livestock and conversion to cultivated agriculture. Hydrologic changes have the dual effect of eliminating the wetland habitats and facilitating conversion to cultivated agriculture.

Riverine and backwater fish and invertebrate community structure and function. River channels and backwaters support a variety of fishes and aquatic invertebrates which in turn support, either directly or

indirectly, recreational fisheries, and provide forage for birds and wildlife. These communities are also important parts of the biodiversity of the Platte River floodplain. The fish communities of these habitats includes the pallid sturgeon (*Scaphirhynchus albus*) which is a federally listed endangered species. Fish species that are candidates for federal listing include lake sturgeon (*Acipenser fulvescens*), paddlefish (*Polydon spathula*), sturgeon chub (*Hybopsis gellda*), sicklefin chub (*Hybopsis meeki*), and plains topminnow (*Fundulus Sciadicus*). The fish and invertebrate communities are placed at risk by changes in their physical habitat that derive from hydrologic alteration, including deleterious increases in water temperatures during summer. Agricultural chemicals are an additional source of risk to these communities. The extensive connection between groundwater and surface water in the floodplain increases the capacity for agricultural chemicals to migrate from the point of application and enter surface waters where they can adversely affect fish and aquatic invertebrates.

APPENDIX B. *Management Concerns*

There are literally hundreds of entities whose managers make decisions managing or impacting the resources of the Middle Platte area. Representative entities/managers include local resource users, such as farmers, Central Nebraska Public Power and Irrigation District, Platte River Whooping Crane Habitat Maintenance Trust, City of Grand Island, Grand Island Chamber of Commerce, Central Platte Natural Resources District, and at the state level, the Nebraska Game and Parks Commission. Regulators also impact on resources of the Platte, such as the Environmental Protection Agency (EPA), Department of Health, Department of Environmental Quality, Department of Water Resources, and the Central Platte NRD. The variety of concerns about the management of ecological resources in the watershed is presented for each of these entities below.

Resources users - Local

Farmers economic survival depends on profitable crop production, which typically involves intensive use of land. Economic incentives, such as property taxes, force wet meadow conversion to cropland (or intensively grazed pasture). Crop production typically requires intensive use of inputs, including fertilizer and pesticides, but this use contaminates drinking water. Livestock production sometimes uses riparian areas for water and shelter (windbreaks), and may require grazing and management of wet meadows.

Central Nebraska Public Power and Irrigation District manages Lake McConaughy, the supply canal, hydroelectric plants and irrigation service for the Middle Platte. There are a number of associated concerns, including: project re-licensing; economic viability of farmer/irrigators and the district itself; recreation, fish and wildlife in Lake McConaughy versus the Middle Platte River; meeting instream flow requirements of FERC and the State of Nebraska for threatened and endangered species; meeting NPDES permit water quality requirements with discharge of Lake McConaughy in Keystone Lake without jeopardizing generation of electric power; pressure from riparian landowners to reduce discharges to avoid flooding caused by lower channel capacity resulting from past district operations; effectiveness of constructing nesting habitat for threatened and endangered species in the Middle Platte River, and finally the impacts on other resources.

Platte River Whooping Crane Habitat Maintenance Trust works to maintain sufficient habitat for the endangered whooping crane. To achieve this goal, the Trust mechanically clears vegetation from the river channel for crane roosting habitat as a substitute for former natural systems, such as scouring flows. Riparian vegetation is also cleared to provide adequate sight distances to replace natural forces that are

notA3 fully understood. Other involvement in the watershed includes: obtaining land rights to wet meadows and riparian land from willing sellers and paying taxes on the land (this use of financial resources causes varying public reactions); maintaining relations with landowners and neighbors who lease the trust's land for grazing or cropland; advocating adequate flows in the river to maintain the habitat; maintaining habitat while providing opportunities for the public to view the migrating cranes and provide good public relations.

The City of Grand Island provides municipal services, including public water supply, waste water treatment, and electric power. Related management issues include: whether there is adequate flow in the river to (1) supply enough water to the well field and (2) to prevent the encroachment of ground water from cropland in the uplands that is contaminated with nitrate; taking action in state water rights proceedings to protect the supply of water in the river without antagonizing the farmers who trade in the city, to prevent the threat of another boycott; meeting the NPDES requirements for the waste water treatment plant discharges; and, having adequate water supplies for the municipal power plant.

Grand Island Chamber of Commerce, both staff and members such as motels and restaurants, are concerned about maintaining crane habitat and populations and providing viewing opportunities to maintain and increase tourism.

Central Platte Natural Resources District (NRD) initiated management of the Platte in the provision of instream flows, construction of recreation facilities, and planning and applying for a water right for a diversion for a ground water storage/irrigation project (Prairie Bend). Associated issues include: statutory responsibility for obtaining and holding instream flow rights; providing recreational opportunities for viewing migratory birds; developing an economically viable project for stabilizing ground water levels; and reducing the concentration of nitrate in the ground water by storing supplemental irrigation supplies from the river underground, while leaving sufficient water in the river to meet instream flow requirements.

Resources users - State

Nebraska Game and Parks Commission initiatives by the G&PC create concerns that include providing fisheries, wildlife habitat, and recreation lands and opportunities in the Middle Platte without reducing the same in Lake McConaughy; obtaining instream flow rights to provide flows not covered by the Central Platte NRD's right.

Regulators - Local

Local concerns in the Central Platte NRD are described below according to stressor type, namely: nonpoint and point sources, hydrologic modifications, recreation, and atmospheric inputs.

Nonpoint sources (i.e. surface runoff, nutrients and pesticides) are not believed a serious problem in the Middle Platte Basin. Because of the flat terrain, the runoff tends to lose much of the sediment before it reaches the Platte River. NRD's are required by state law to have a sediment and erosion control plan that requires cover on all highly erodible cropland.

One of the local concerns about surface water contamination is the distance between quality monitoring stations on the Platte River. Certain contaminants are detected in the river, however, the point of contamination is uncertain. Another concern involves the timing of the samples; most samples are collected at maximum flows, when the highest level of contamination is probable. This level is short lived and clearly not the mean. USGS, NDEQ, NDOH and NRD's are jointly responsible for this management in this area.

Leaching of contaminants is designated as the responsibility of the NRD's through state law. Central Platte NRD and Tri-Basin NRD have Groundwater Management Plans in effect to address this problem. Because of wide variations in groundwater contamination, the solutions are primarily local. Potable drinking water is a necessity for people living in the area and therefore is a concern of all.

Wetlands have been identified throughout the area and it is illegal to drain or place fill material in wetlands without a permit. Determination of wetlands is the responsibility of the Soil Conservation Service.

Livestock grazing or overgrazing is not known to be a problem in this area. The only way to manage this is through the farmer-rancher. Proper management of livestock grazing is simple economics for most ranchers and practiced in most instances.

Hydrologic changes, such as surface water irrigation and hydropower is of tremendous concern to the public, both local and statewide. Management practices in this area must address economic impact both locally and statewide. Flow patterns have changed from what they were historically, however, the habitat has changed rather than destroyed. Return flows from both irrigation and hydropower must be recognized. Shrubs and trees on the sandbars are at the point now where it is not realistic to consider scouring flows beneficial unless sandbars are mechanically cleared. Flows adequate to clear these bars would create flooding throughout the river valley. Surface water irrigation and groundwater withdrawal have reached a balance on the south side of the river at present time. Irrigation and hydroelectric return flows have improved summertime flows when the river was historically dry.

The State Department of Water Resources is responsible for river flows at the present time. The state through Governor Nelson has developed an instream flow plan that is acceptable on the state level and therefore it may be logical to use this plan for

management. Federal Regulations on River Flows would override state laws that now exist. It must be recognized that changes in these flows in any way probably will have a direct effect on the economy of the area. Variability in climate has a definite impact on hydrological changes in the river. Through the use of irrigation storage facilities we can now regulate the river flows to a certain extent, however, we must still be dependent on snowfall and rainfall. Previous to this the river went from flood stage to a dry river in the same year as the climate dictated.

Feedlots could become a problem for point source pollution because they are becoming larger and more concentrated. Most feedlots over a certain head capacity are required by the NDEQ to install pits to handle manure runoff. This has not been enforced as it should be and therefore problems have erupted in this area. The NDEQ should remain the agency responsible for feedlots, however, enforcement must be stepped up. Local interests are concerned about this problem and hopefully public pressure will create better enforcement.

Point source pollution on the commercial, industrial and municipal levels will be addressed through Wellhead Protection Areas. These areas are designed to identify all possible point sources of pollution and develop a time of travel from contamination point to the municipal well fields. This is an EPA approved program offered through NDEQ. Many municipalities have gone through the process of developing these areas, however, many are reluctant because it is a labor intense process. This identification is required in the new NRD Groundwater Quality Management Plan and therefore NRD's will probably be pressuring to get this accomplished.

Unpermitted landfills should be a thing of the past in the Platte Valley. It is illegal to have any type of landfill except for burning trees. Farmsteads are no longer allowed to even have private landfills. The penalty for noncompliance is stringent enough that they probably will no longer exist.

Nebraska Game and Parks is responsible for administering regulation of recreational activities. Some of these activities are not only disruptive to wildlife, but also to property owners in the area.

Monitoring of atmospheric inputs will have to continue to determine if any pollution of this kind does materialize. The "tunnel" of exhaust along I-80 may be too far out to be considered a stressor in this report.

Regulators - State

Department of Health concerns include the adequacy of the quantity and quality of flows in the river to provide a suitable water supply for public water suppliers in the middle Platte area.

The Department of Environmental Quality, responsible for surface and ground water quality, is concerned with the adequacy of water supplies for human consumption, recreation, fish and wildlife, and protection of wetlands.

The Department of Water Resources is responsible for regulating the quantity of surface water. Management concerns relate to the protection of rights of irrigators and other water right holders; and the protection of threatened and endangered species in granting water rights.

Regulators - Federal

The surface waters of the middle Platte River basin are designated for the following uses in Nebraska Water Quality Standards: Recreation Class A (whole body contact - 204 miles); Aquatic Life (607 miles); Agricultural Water Supply (607 miles); and Industrial Water Supply (66 miles) (NDEQ. 1992). The Platte River alluvial aquifer also serves as the primary drinking water source for citizens in the Middle Platte watershed. The Nebraska Department of Environmental Quality is delegated responsibility by the U.S. Department of Environmental Protection Agency under the Clean Water Act to implement programs to control sources of pollution to maintain the physical, chemical, and biological integrity of the nation's waters.

Federal legislation such as the Clean Water Act, National Environmental Policy Act, Endangered Species Act, Federal Insecticide, Fungicide, and Rodenticide Act, Safe Drinking Water Act, and Resource Conservation and Recovery Act provide mandates which govern federal agency involvement in natural resource conservation and ecosystem protection. Administration priorities include sustainable development; pollution prevention; ecosystem management/geographical targeting; employing sound science in decision-making; biodiversity protection; and building state and local capacity to deal with environmental issues. These management concerns have a bearing on the Middle Platte ecological risk assessment.

APPENDIX C. *Major Sources of Stress and Rankings in the Middle Platte River Watershed*

Middle Platte Stressor Characteristics

SOURCE OF STRESS	EXPLANATION (mechanism, stressor)	Rank (0-3)
NONPOINT SOURCES: Farming practices	Surface Runoff (to ponds & streams): nutrients, pesticides	2
	Leaching (to groundwater): nitrates, pesticides	3
	Aerial Drift of Chemicals: wet meadow habitat alteration	1
	Ag. Expansion: wetland habitat loss	2
NONPOINT SOURCES: Livestock grazing	Cattle Access to Streams: habitat destruction (mussel beds, wet meadows, stream banks)	2 (local) 1 (watershed)
	Overgrazing/Trampling: habitat alteration (wet meadows structure)	2 (local) 1 (watershed)
NONPOINT SOURCES: Urban, Residential, Commercial Development	Septic System Drainage: GW/SW contamination by nutrients, pathogens Lawn Chemical Runoff: nutrients, pesticides Runoff from parking lots, highways: nutrients, toxics Spills from Proposed Airport along I80: toxics	1
HYDROLOGIC MODIFICATION: Surface Water Irrigation, Hydropower	Water Withdrawals/Flow Alterations: stream flow pattern disruption, channel, floodplain alteration, instream, riparian and floodplain habitat loss	3
HYDROLOGIC MODIFICATION: Groundwater Irrigation	Water Withdrawals: water table alteration, floodplain habitat alteration	3

HYDROLOGIC MODIFICATION: Municipal & Industrial Water Supplies	Water Quality Changes: altered temperature and DO, stream flow pattern disruption, sediment, nutrients, toxics	2 (local) 1 (watershed)
HYDROLOGIC MODIFICATION: Channelization	Habitat Loss/Alteration: wet meadows, primarily adjacent to tributaries	2
HYDROLOGIC MODIFICATION: structures	Habitat Loss/Alteration: Wet meadows	2
FLOODPLAIN DEVELOPMENT: Sand & gravel operations	Habitat Loss: Wet meadows	3
FLOODPLAIN DEVELOPMENT: Residential	Habitat Loss: Wet meadows	2
FLOODPLAIN DEVELOPMENT: Transportation	Habitat Loss: Wet meadows, prime farmland, riparian	2
CLIMATE VARIABILITY	Habitat Loss/Alteration	2
POINT SOURCES: Feedlots	Surface Runoff: Pathogens, nutrients Leaching to Groundwater: pathogens, nutrients	2
POINT SOURCES: Commercial, industrial, municipal, LUSTs, unpermitted	*Groundwater*: Industrial Discharges: RDX, metals, toxics, BOD, NH3 Illegal Dumping: Toxics, pesticides Leaching from NPL/RCRA Sites: Toxics, metals Leaching from LUSTs, Landfills: Toxics, metals *Surface Water*: POTW Discharges: Ammonia, BOD, nutrients, metals, pathogens	2 (local) 1-2 (watershed)
EXOTIC SPECIES	Altered patterns of plant colonization and competition	2
	Loss of diversity	2
RECREATIONAL ACTIVITIES: Off Road Vehicles, Air Boats and other Disturbance	Streambank Erosion, Harassment of Wildlife: sediment, nutrients, population pressures	2 (local) 1 (watershed)
	Taking of Wildlife/Fish: population pressures	1

ATMOSPHERIC INPUTS: Power Plants and Transportation	Air Deposition: exhaust from highways, toxics, industrial emissions	1

APPENDIX D. *Observed ecological effects of stress in the Middle Platte Watershed*

Class	Ecological Effect	Citation
Habitat	23-45% loss of wet meadows 1938-1982	Sidle, 1989; Gunigo, 1990; Currier anc. 93
Habitat	Increase in riparian forest from 29% to 75% of habitat	Sidle, et al. 1989
Habitat	Development of forested corridor allowed hybridization among east/west species	Savidge anc. 93; (Short)
Habitat	Structural diversity in wet meadows reduced	Currier, anc. 93
Biota	Fewer aquatic birds, more woodland birds nesting in trees in riaprian corridor	Sidle, anc. 93
Biota	Few white pelicans rest in areas of riparian forest and narrow channels (need areas without nearby predator cover)	Sidle, et al. 1990
Biota	Loss of least tern and piping plover habitat (open sandbars)	O'Brien & Currier, 1987
Biota	Shift in sandhill crane distribution: no longer found west of Kearney	Sidle, anc. 93
Biota	Avian cholera outbreaks result from overcrowding in smaller habitat patches (killed > 200 k since 1975)	Gunigo, et al. 1990

Biota	Loss of biodiversity (primary in vegetation, secondary in fauna)	Savidge & Currier, anc. 93
Biota	Growth of exotic invaders in wet meadows pland communities (ie. purple loosestrife, bluegrass)	Savidge, anc. 93
Biota	Loss of native fish species: 20 species have disappeared since 1940's	
Biota	Introduced mosquito fish displaces native fish by outcompeting them	Sidle, anc. 93
Biota	Decline in mussel populations, limited to one principal side channel with regular flow (high dieoff during drought year of 1990)	Decline in mussel populations, limited to one principal side channel with regular flow (high dieoff during drought year of 1990)
Biota	Extensive periodic fish kills correlated with low flows in late summer: 6-7 events every 10 years	Currier, anc. 93

APPENDIX E. *Excerpts from Nebraska Water Quality Report (NDEQ, 1992)*

Designated Use Support (Existing Conditions)

"Adequate data and information were available to assess 276 stream miles or 45 percent of the basin's designated stream mileage for Aquatic Life Use Support during 1990 and 1991. Recreational use support was assessed for 158 of the 204 stream miles assigned the use. Table C.1 shows levels for beneficial use support based on stream miles for the Middle Platte River Basin." (Ambient Water Body System Report)

Table C.1. Middle Platte River Basin Summary of Beneficial Use Support during 1990 and 1991.

	Full Support	**Threatened**	**Partial Support**	**Non Support**	**Total Assessment**
Recreation Class A (203.8 miles)	0	0	80	98.2	178.2 (77%)
Aquatic Life (607.2 miles)					
Coldwater Class A (0 miles)	0	0	0	0	0
Coldwater Class B (42.5 miles)	27.5	0	15	0	42.5

Warmwater Class A (344.3 miles)	0	23.4	146.9	0	170.3
Warmwater Class B (220.4 miles)	0	0	63.0	0	63.0
	27.5	23.4	224.9	0	275.8 (44%)
Public Drinking Water Supply (0 miles)	0	0	0	0	0
Agricultural Water Supply (607.2 miles)	158.2	0	0	0	158.2 (26%)
Industrial Water Supply (66.4 miles)	66.4	0	0	0	66.4 (100%)
Overall Use Support	27.5	13.4	225.0	98.2	364.1 (60%)

Causes and Sources of Designated Use Impairment

Factors which prevented full support of recreational uses relate primarily to impacts from agricultural nonpoint sources. Minor impacts from domestic point sources and urban nonpoint sources were also present. Partial support of the Aquatic Life use in Warmwater A segments resulted primarily from agricultural nonpoint sources.

Forty-four percent of the major stream impacts in the Middle Platte Basin can be ascribed to agricultural nonpoint sources, while 38 percent are impacted by stream channelization. Eighteen percent have natural impacts. Minor impacts from municipal and industrial point sources and natural causes affected approximately 291 miles. The miles impacted by causes and sources within the Middle Platte River Basin are listed in Tables C.2. and C.3.

Table C-2. Total Stream Miles Impacted by Various Cause Categories in the Middle Platte River Basin.

Cause	Major	Minor
NPS		42.32
Fecal Bacteria	44.51	
Pesticides		
Ammonia		25.42
Metals		43.04
Inorganics		44.61
Organic Enrichment/DO		70.03
Salinity/TDS/Chlorides		
Flow Alteration	120.59	

Loss of Habitat		54.59
Unknown	59.99	

Table C-3. Total Stream Miles Impacted by Various Source Categories in the Middle Platte River Basin.

Source Category	Major	Minor
Industrial Point Sources		65.60
Municipal Point Sources		70.03
Agriculture	140.55	
Urban/Storm Runoff		
Channelization	120.59	
Natural		154.87
Unknown	59.99	

Table C-4. Water Quality-Based Limits - Water Quality Limited Segments, 303(d) segments, TMDLs, will get a water quality-based permit.

Segment #	Stream	Facility	Comments
MP1-20000	Platte River	Central City WWTP	Expected to exceed instream ammonia criteria based on discharge concentrations reported in 1991
MP2-10000	Platte River (trib. to)	Kearney #1 WWTP	Expected to exceed instream ammonia criteria based on discharge concentrations reported in 1991
MP2-10000	Platte River (ditch to)	Grand Island WWTP	Expected to exceed instream ammonia criteria based on discharge concentrations reported in 1991

APPENDIX F: *Selection of Assessment Endpoints*

The process for the selection of endpoints was iterative and the result of several work group meetings. The process consisted of four basic steps:

Step 1. Identification of Reference Condition

To accomplish the goal of maintaining the 7 habitat types (urban, agricultural, riparian woodland, aquatic, sandbar, wetmeadow, and upland grassland) and the landscape in which they are embedded, a reference state towards which land management must progress had to be determined. Pristine or presettlement condition was rejected as the control habitat condition due to the extreme temporal variability that characterizes the Middle Platte Watershed (not to mention the logistical constraints on identifying this state). Therefore, those patches that best approach the conditions described in this document (section 4.0, high quality habitat as determined by the "best professional judgement" of the habitat focus groups), will be used as the reference condition for each habitat type. A key attribute that is used in determining the reference habitat is the intrinsic value (where "value" includes, ecological, economic, and aesthetic components) of a given patch within the landscape. Central to the determination of "value" for a given habitat patch is the potential for the

protection and enhancement of the ecological integrity of the Middle Platte watershed.

Step 2. Rating of Assessment Endpoints

A series of assessment and measurement endpoints were identified for each ecological component (Appendix E and F). Each of these assessment endpoints were rated based on three criteria: susceptibility, societal value, and ecological relevance (Suter, 1990). The value of the ratings were High (H), Moderate (M), or Low (L; Appendix G).

Step 3. Selection of Assessment Endpoints

Within the Middle Platte Watershed: the landscape mosaic, four habitat types (upland grassland, wetmeadow, sandbar, and aquatic), and three functional groups of fauna (breeding birds, migratory birds, and native fish) were chosen as final assessment endpoints. The landscape mosaic was chosen as an assessment endpoint because all or most of the qualities of the habitat and biotic endpoints of interest will be some function of (or strongly related to) a healthy mosaic, or critical mix, of patch types at the landscape level (Noss, 1990). The habitat and biotic endpoints were selected due to their ratings for susceptibility, ecological relevance, and societal value and for their overall importance in supporting ecological integrity in the landscape. Other potential assessment endpoints (e.g. water quality and hydrology) remain in the analysis as measurements to provide objective information about ecosystem conditions, however the analysis of these additional indices is limited.

Step 4. Describing the Assessment Endpoints and Selecting Measurement Endpoints

Subgroups were organized around the ecosystem/habitat assessment endpoints (aquatic, sandbar, wetmeadow and the upland grassland "focus groups"). Objectives were to reach agreements on the structure and composition of each critical habitat, the ecological role of the key biota, and to identify potential measurement endpoints for all assessment criteria. Potential measurements were chosen for their high susceptibility to loss of functioning, structure, and composition (from the impacts of the major stressors) at the landscape, and ecosystem levels. Appendix *xx* contains the potential list of measurements, which could indicate the status of the assessment endpoints. Appendix *xx* contains a list of available measurement endpoint datasets. Appendix *xx* lists identified needs for other datasets not available.

APPENDIX G. *Original Rankings of Proposed Assessment Endpoints*

Workgroup ratings for susceptibility, societal value, and ecological relevance criteria of proposed Middle Platte Assessment Endpoints based on Suter, 1990.

Rating of proposed middle Platte River Assessment Endpoints

Assessment Endpoints: Habitats and Landscape patterns	*Susceptibility*	*Societal Value*	*Ecological Relevance*	*Data Availability*
Wetmeadows/ Wetlands	High	High	High	High
Sandbar / Herbaceous River Island	High	High	High	High

Aquatic (lotic, lentic, backwater)	High	High	High	Moderate
Riparian Shrub / Forest	Low	Moderate	Moderate	Moderate
Upland Prairie Grassland / Shrub	High	Moderate	Moderate	Moderate
Cropland	Low	High	High	High

Biota	*Susceptibility*	*Societal Value*	*Ecological Relevance*	*Data Availability*
Migratory Birds	High	High	High	High
Resident Birds	Moderate	High	Moderate	Moderate
Threatened / Endangered Species	High	High	High	High
Primary Producers	High	Low	High	Low
Aquatic Food Chain	High	Low	High	Low
Indigenous Amphibians	High	Moderate	High	Low
Indigenous Fish Species / Populations	High	Low	High	Moderate
Sport Fish Species / Populations	Moderate	High	Moderate	Moderate
Game Species	Moderate	High	Moderate	Moderate

APPENDIX H. ***Proposed Ecological Values and Assessment:*** *Assessment Endpoints and Measurements for Four Primary Components of a Functioning and Sustainable Middle Platte River System.*

Component #1. Habitats and Landscape Patterns

Ecological Value: Maintenance, and where possible, enhancement of the mosaic of habitats in the Middle Platte River System in order to support the diverse flora and fauna dependent upon them while providing for existing recreational, commercial, and agricultural uses.

Assessment Endpoints	**Measurements (*)**

Aquatic (lotic, lentic, backwater) (H,H,H)	Quantity: area (river miles) Physical: sediment load; wetable surface Chemical: water quality criteria Biological: bacteriological (fecal); index of biotic integrity (IBI); index of invertebrate community integrity (ICI).
Sandbar/Herbaceous River Island (H,H,H)	Quantity: area of sandbar and vegetative cover Physical: water depth, flow, flow variability Chemical: NA Biological: vegetative coverage and type, absence/presence of indicator flora and/or fauna, community measurements
Riparian Shrub/Forest (L,Mi,L)	Quantity: area Physical: NA Chemical: NA Biological: vegetative coverage and type, absence/presence of indicator flora and/or fauna, community measurements
Wetmeadows (Other Wetlands) (H,H,H)	Quantity: area (acres) Physical: antecedent moisture, ground water depth Chemical: NA Biological: Vegetative coverage and type, absence/presence of indicator flora and/or fauna, community measurements
Prairie Grassland / Upland Woody Communities (HMoH)	Quantity: area (acres) Physical: NA Chemical: NA Biological: (TBD)
Cropland (L,H,H)	Quantity: area (acres), production volume Physical: NA Chemical: pesticide use Biological: type of crops (%)
*Rating for suseptibility, societal value, and ecological relevance H=high; Mo=Moderate; L=Low; Mi=Mixed	

Component #2. Biota

Ecological Value: Maintenance, and where possible, enhancement of the abundance and diversity of the living resources of special importance to the middle Platte River System.

Assessment Endpoints	Measurement Endpoints
Migratory Birds (H,H,H) * aquatic (cranes, piping plover, least tern, etc.) * terrestrial (songbirds)	population counts and surveys (temporal and seasonal, nesting success)
Breeding Birds (M,H,M) * Red-tailed hawks, owls, falcons ...	population counts and surveys
Threatened and Endangered Species (H,H,H)	actual counts (individuals)
Primary Producers (H,L,H)	biotic index; periphyton
Aquatic Food Chain (H,L,H)	invertebrate community index
Amphibians Community (H,M,H)	population counts (transect) abundance and diversity surveys
Indigenous Fish Species or Populations (H,L,H)	fish surveys
Sports Fishery (M,H,M) (including catfish)	estimated fish catch, including weight, age, and condition; fish surveys
Huntable Wildlife (M,H,M)	game take including weight, age,and condition; population surveys, particularly for game caught by trapping (huntable wildlife associated with water)

Component #3a. Ecosystem Water Quality

Ecological Value: Maintenance, and where possible, enhancement of the water quality such that the water resources (surface and groundwater) of the Middle Platte watershed support designated aquatic life uses while also supporting other designated uses (e.g. drinking water, human health, agricultural etc.).

Assessment Endpoints	Measurement Endpoints

Surface water quality (M,H,H)	Physical: pH, temperature, turbidity Chemical: water quality criteria, fish advisories Biological: bacterial criteria, bioassessments
Groundwater quality (H,H,H)	Physical: NA Chemical: water quality criteria; Pesticides: nitrates Biological: bacterial criteria

Component #3b: Ecosystem Hydrology

Ecological Value: Maintenance, and where possible, enhancement of the surface and groundwater hydrology of the Middle Platte watershed in order to support diverse flora and fauna dependent upon them while providing for existing recreational, commercial, and agricultural use.

Assessment Endpoints	**Measurement Endpoints**
Riverine hydrology (H,H,H)	Physical: flow volume, water depth, seasonal variation Chemical: NA Biological: NA
Groundwater hydrology (H,H,H)	Ground water level Chemical: NA Biological: NA

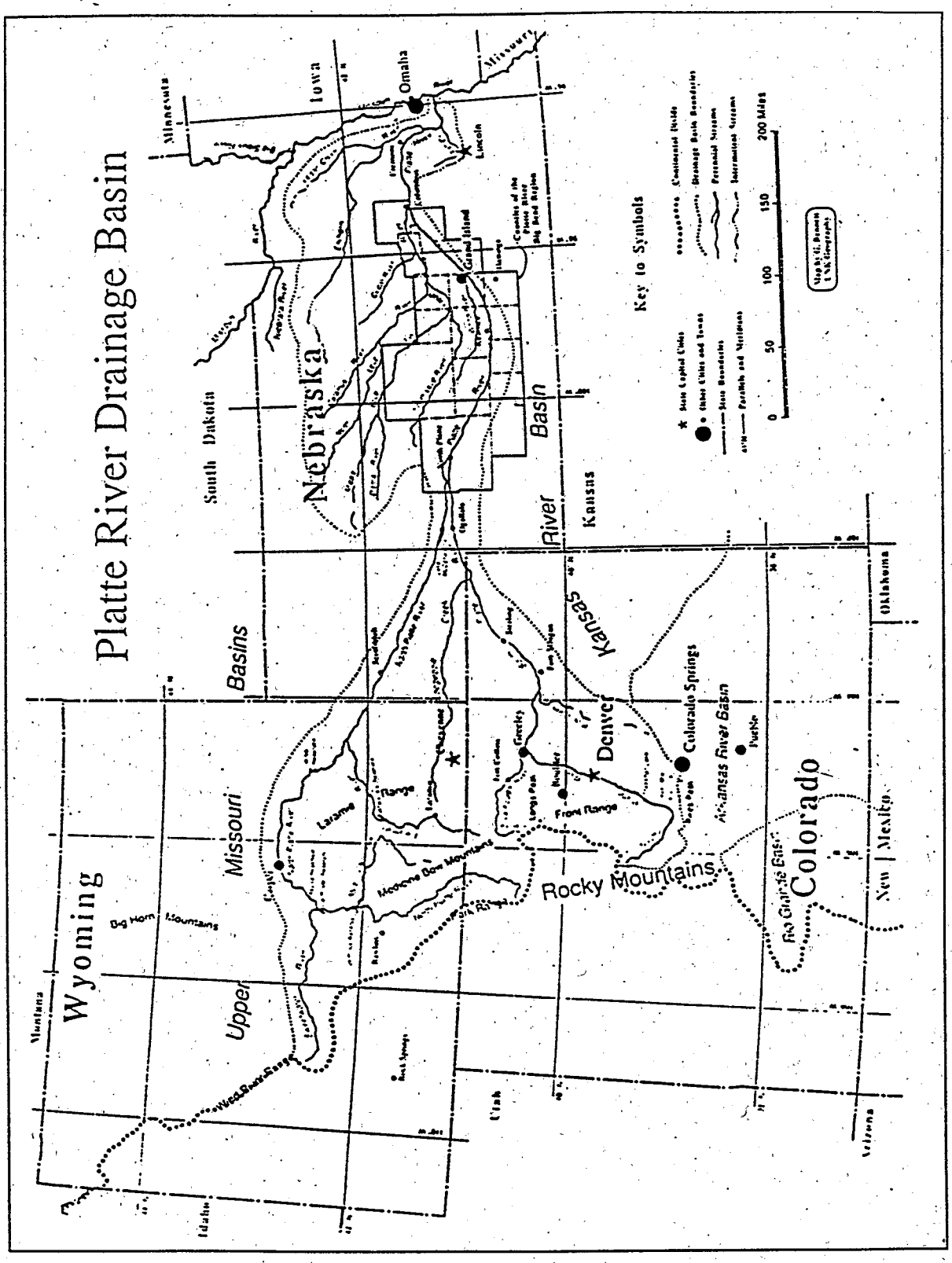

Figure 2. Platte River Basin

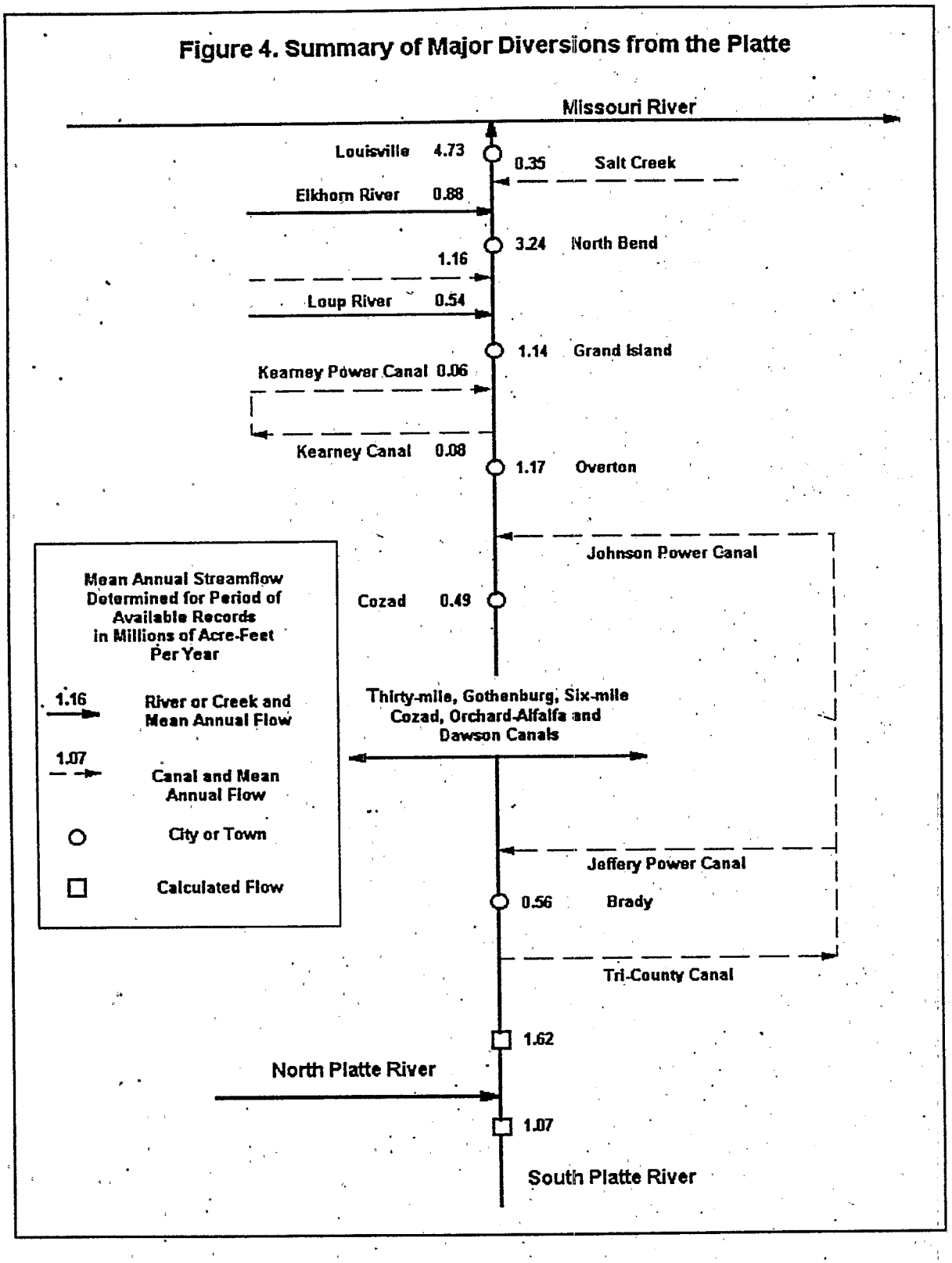

Figure 4. Mean Annual Streamflow along the Platte

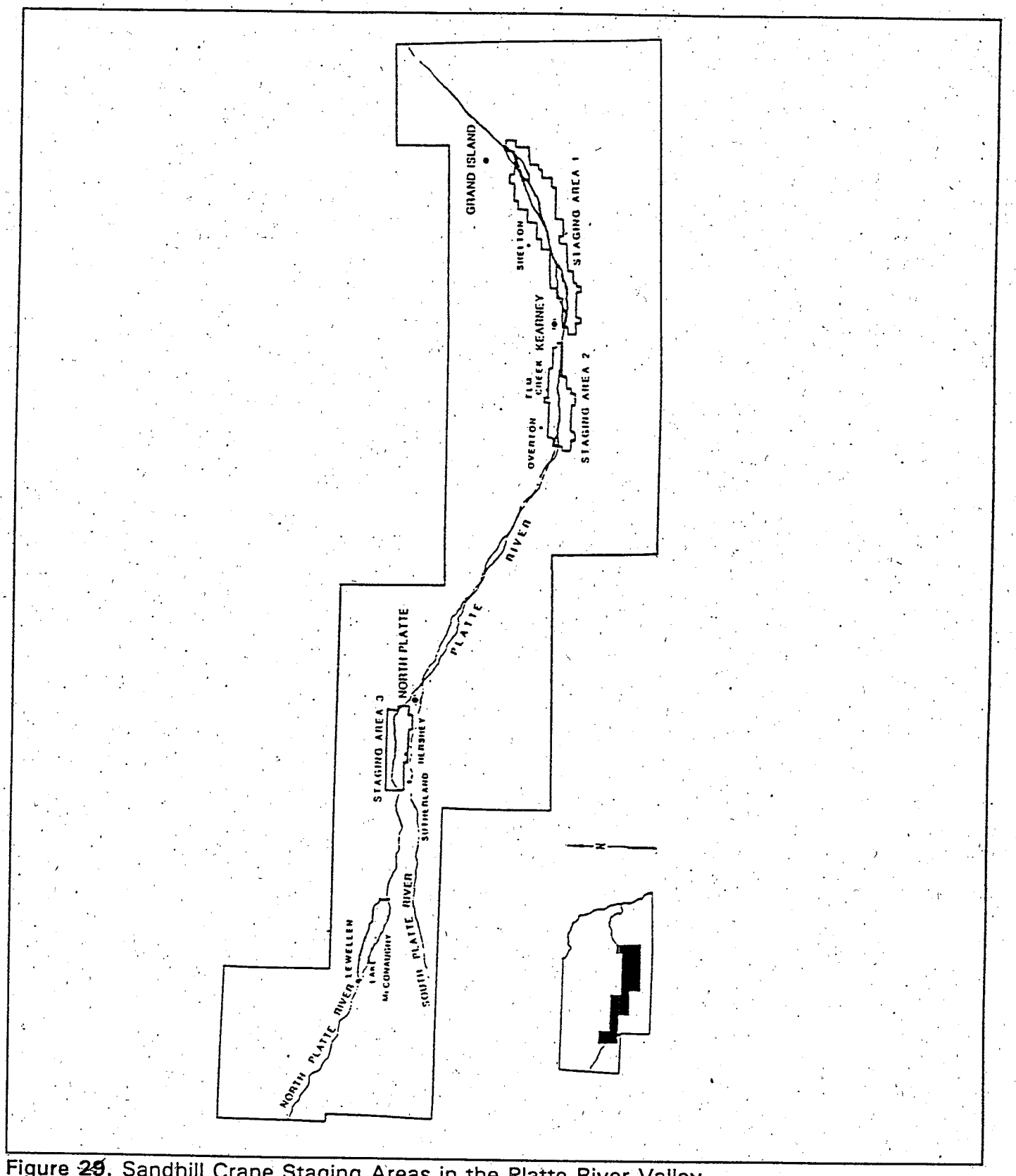

Figure 29. Sandhill Crane Staging Areas in the Platte River Valley

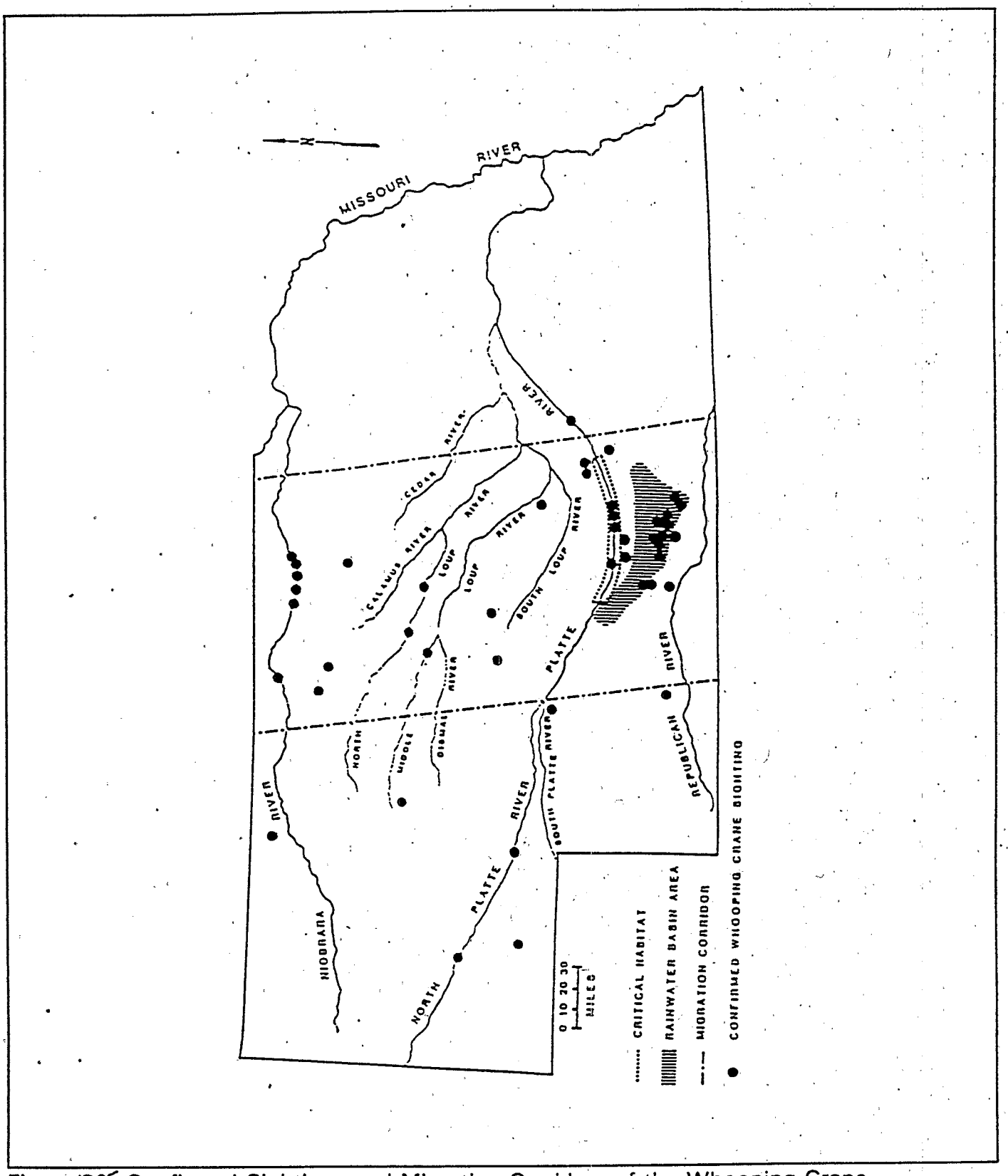

Figure ~~30~~ 9. Confirmed Sightings and Migration Corridors of the Whooping Crane

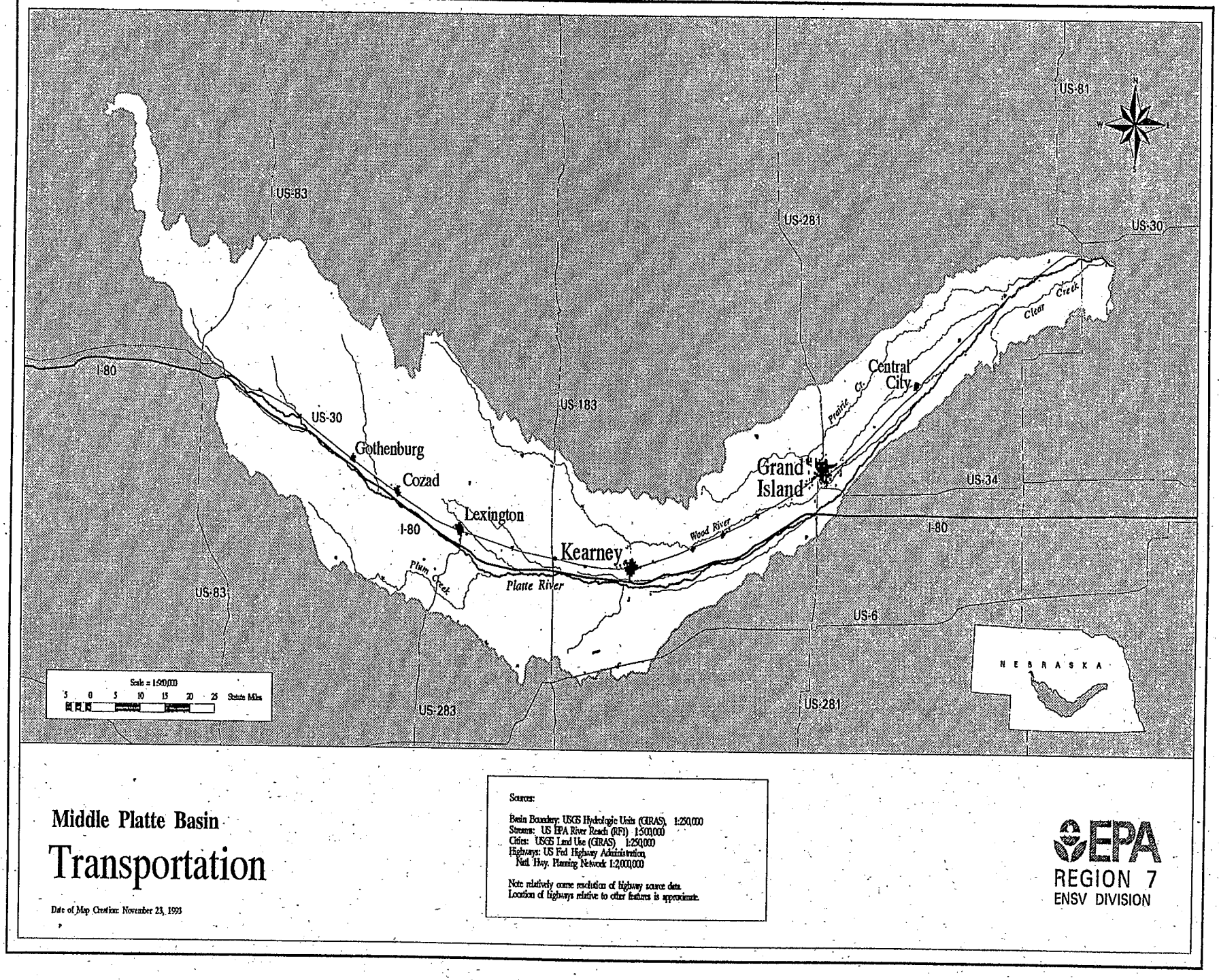

Figure 5. Transportation network in the Middle Platte Watershed

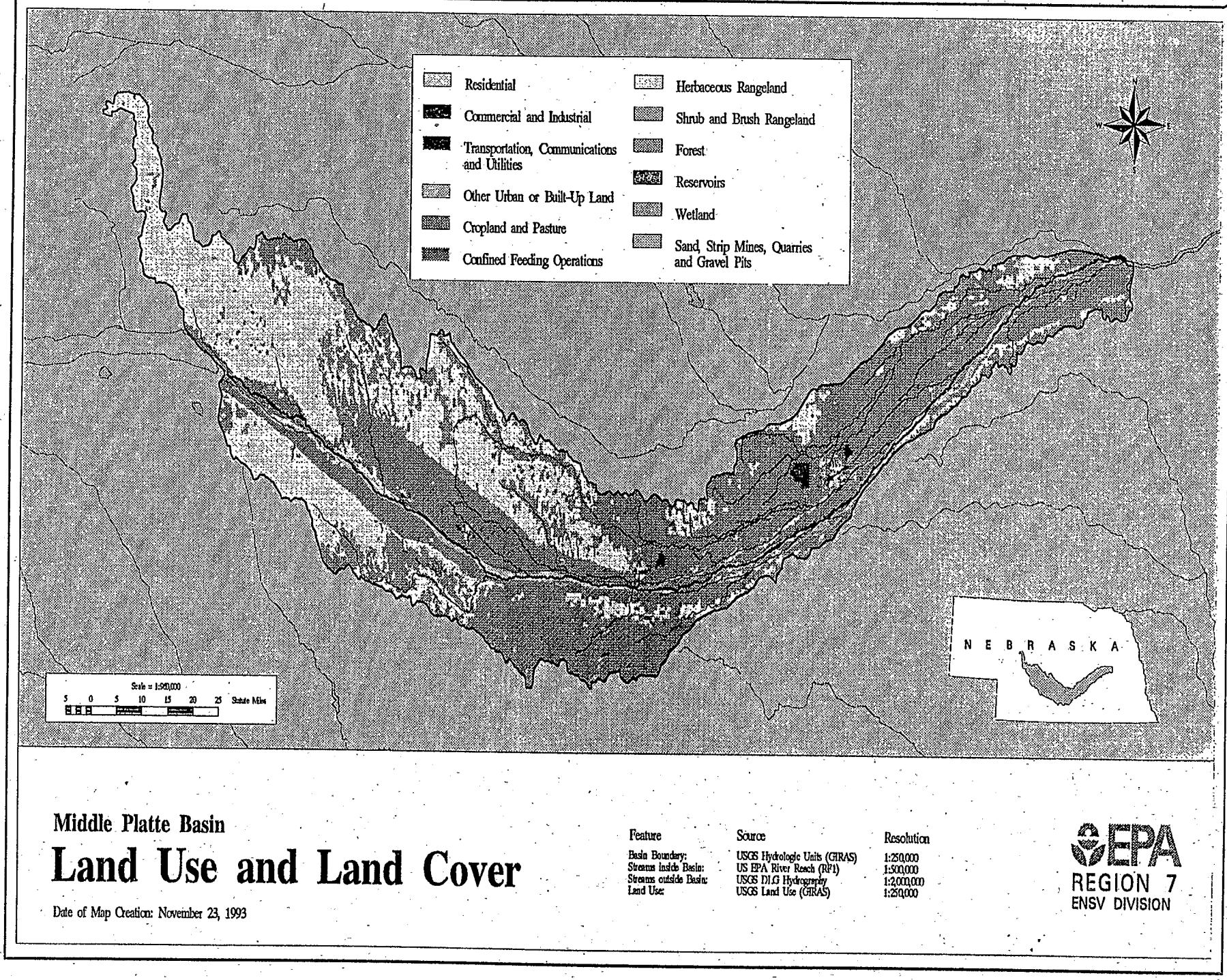

Figure 6. Land use in the Middle Platte Watershed

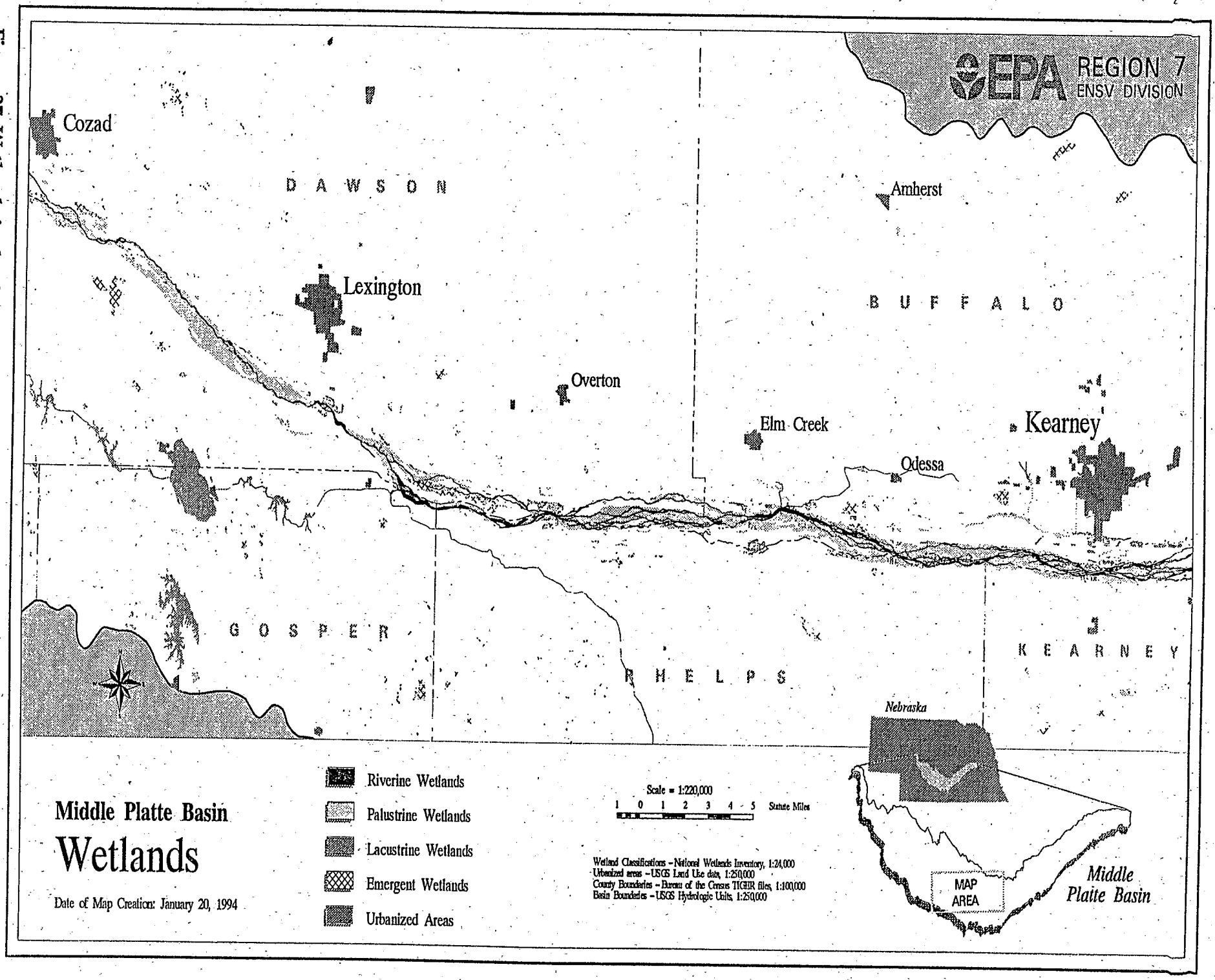

Figure 27. Wetlands in the Cozad-Kearney reach of the Middle Platte Watershed

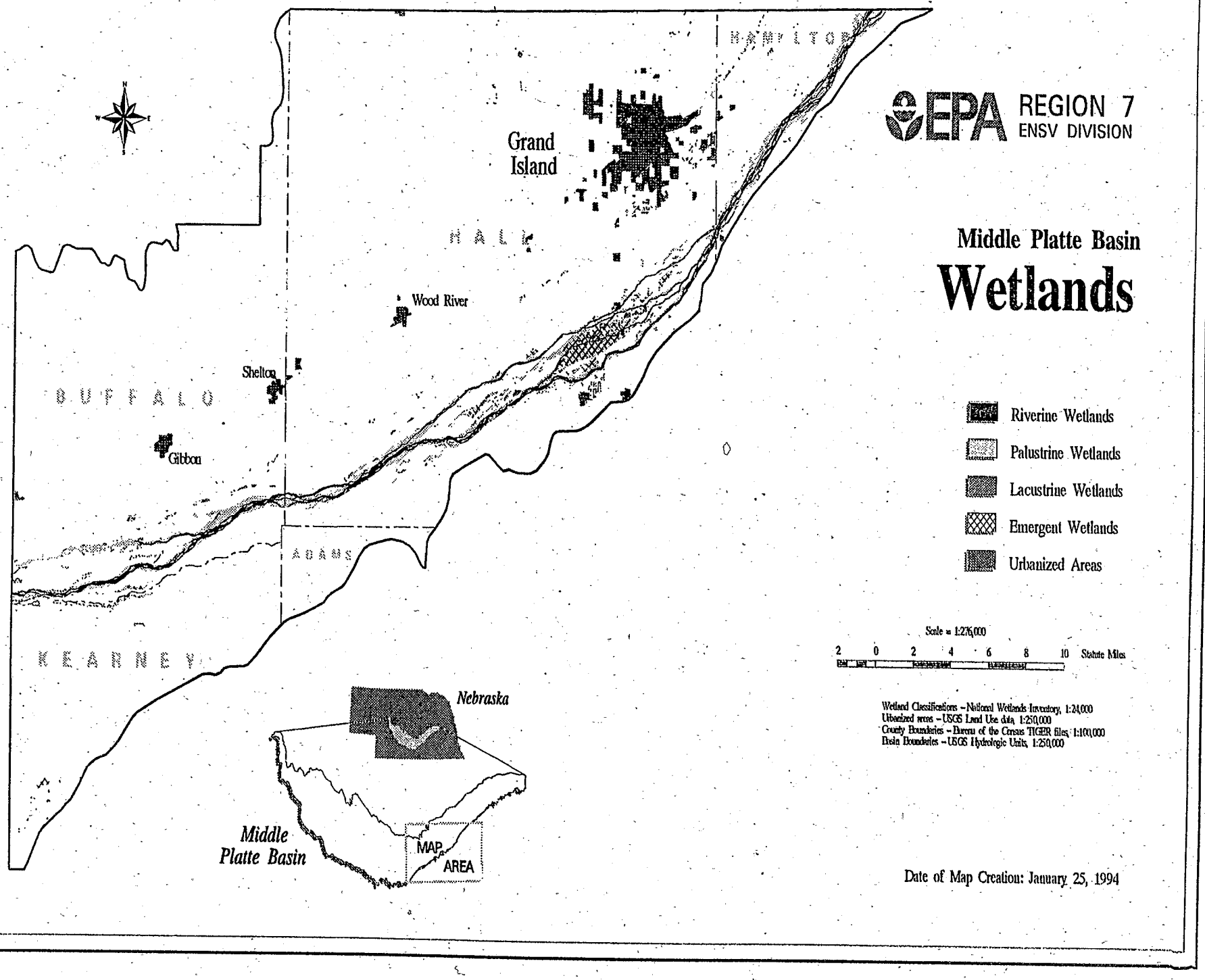

Figure 26. Wetlands in the Kearney-Grand Island reach of the Middle Platte Watershed