# Alternative Methods to Maintain and Enhance Wet Meadow Habitat Along the Platte River, Nebraska

# FINAL MONITORING REPORT 1997-2000

Project Sponsors: Central Platte Natural Resources District, Nebraska Public Power District, The Central Nebraska Public Power and Irrigation District, and Nebraska Game and Parks Commission

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#### Abstract

The Platte River and its associated wet meadows are an important habitat resource for regional biodiversity and migratory birds. A demonstration project was undertaken to study alternative methods of maintaining and enhancing Platte River wet meadows using means other than streamflow. Experimental treatments were implemented at demonstration sites. The resulting conditions are compared to pre-treatment baseline conditions. Project treatments including groundwater pumping, re-shaping surface topography, and diverting surface drains are shown to maintain and enhance wet meadow hydrology at demonstration sites. Demonstrations support the ability of resource managers to maintain and enhance wet meadow habitat, providing another tool to benefit the habitats of the central Platte and the species that rely on them.

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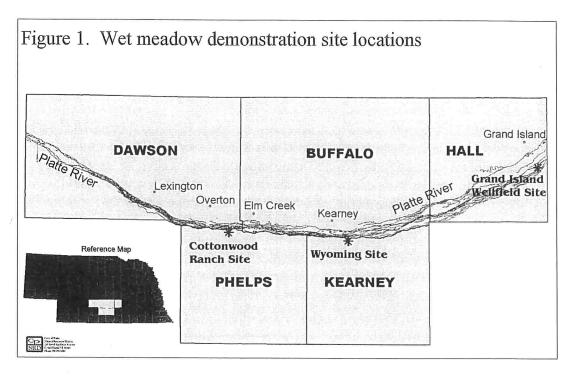
# I. <u>INTRODUCTION</u>

The Platte River system is one of the most highly developed river basins in the world (Simons & Assoc. 1990). At the same time, the central Platte River and its associated wet meadows are an important habitat resource for regional biodiversity, numerous migratory birds and other species. Central Platte River habitats are host to species federally listed as endangered (e.g., whooping crane, interior least tern, American burying beetle) and threatened (e.g., piping plover, western prairie fringed orchid, bald eagle). Wet meadows once occurred extensively along the Platte River; however, substantial reductions have occurred during the past century (Sidle et al., 1989). Many wet meadows have been drained, leveled and converted to cropland.

The sponsors of this demonstration project, Central Platte Natural Resources District, Nebraska Game and Parks Commission, Nebraska Public Power District and The Central Nebraska Public Power and Irrigation District, with the aid of grants from the Nebraska Environmental Trust Fund, joined together in an attempt to study alternative methods for maintaining and enhancing Platte River wet meadows. The project goal is to assess the feasibility of enhancing the ecological integrity and hydrology of Platte River wet meadows at three south-central Nebraska demonstration sites using means other than streamflow. Success is measured by gaining insights into developing alternative methods to enhance and maintain wet meadows. Maintenance and enhancement of water levels in Platte River wet meadows can be important in providing feeding and loafing areas for sandhill cranes and other migratory waterfowl, and can support reproductive and other life-stages of wetland organisms. Hydrologic regimes in Platte River wet meadows contribute to anaerobic soil conditions and promote the growth of hydrophytic vegetation. Information gained through this study will be useful in managing and developing other habitats along the Platte River. Wet meadows along the Platte River typically consist of lowland grasslands with a series of linear wetlands or swales and elevated sandy ridges. For purposes of this project, a wet meadow is defined as a grassland with waterlogged soil near the surface but without standing water for most of the year (Mitsch and Gosselink, 1993).

The three demonstration sites utilized were the Cottonwood Ranch (CWR) property near Overton, Nebraska, the Grand Island wellfield (GIWF) site located south of the city of Grand Island and the Wyoming (WYO) property located southeast of Kearney (Figure 1). Project sponsors developed site enhancement plans (Central Platte NRD, et al., 1998) with input from participants of a Wet Meadow Workshop held in May 1997. In addition, two independent experts reviewed revised draft plans. Baseline biological and hydrologic monitoring began in early 1997. Enhancement plans were implemented in 1998 and 1999.

This report contains baseline and post-treatment hydrologic and biological monitoring results from 1997-2000. Some hydrologic monitoring tracks the "water year" as defined by the U.S. Geological Survey as the 12-month period from October 1 through September 30. Site conditions with project treatments implemented are compared with pre-treatment baseline conditions.



# II. <u>DEMONSTRATION SITE DESCRIPTIONS AND DEVELOPMENT</u>

Demonstration study sites were selected based on information gleaned from a literature search, interviews with local resource managers, an objective to have an east to west geographic mix through the central Platte River valley, proximity to the river, existing baseline hydrologic and biological information, existing physical features, land ownership, and access rights. Development of the study sites was conducted as generally laid out in project enhancement plans (Central Platte NRD, et al., 1998).

#### Grand Island Wellfield Site-

Figure 2 depicts the GIWF site, located approximately 3 miles south of the city of Grand Island, Nebraska, on the eastern portion of Indian Island in the Platte River. The site and additional surrounding lands are owned and managed by the city of Grand Island. In 1997, the property contained 16, 1500 gpm (gallons/minute) wells spread across the eastern 2/3rds of the property. Another 5 wells were installed on the western 1/3<sup>rd</sup> of the property in 2001. The principal function of the property and its groundwater is to serve as the primary drinking water supply for Grand Island. Protection of the quality of this groundwater resource is imperative to the city.

The wet meadow study site is located in the southwest quarter of Section 10, T10N, R9W in Hall County. The site is bordered on the north and south by active Platte River channels. The majority of the area is maintained as grassland, dominated by smooth brome (*Bromus inermis*), reed canarygrass (*Phalaris arndinacea*) and big bluestem (*Andropogon gerardii*). The current and recent site management practice is to hay the grassland in the late summer or early fall. No grazing, row crop cultivation or public access is presently permitted. The wet

meadow enhancement site is traversed with several shallow swales. Depth to groundwater over the area ranges from just below the soil surface in the swale bottoms to over 1m at the relatively higher ridges. Site soils consist mainly of Platte loam (U.S. Department of Agriculture, 1962). A fair to poorly drained, calcareous, highly organic, shallow bottomland soil with a low water holding capacity. The coarse substratum has very rapid permeability.

Site-specific objectives are to increase the amount of water and control the time water is at or near the soil surface, to increase water availability to plants and facilitate the establishment and enhancement of a native plant community. Significant changes in biological communities are viewed as unrealistic given the demonstrative nature of the project and its timeframes. Hydrologic enhancements to portions of the site are intended to provide interspersed areas of wetlands, moist soils and drier ridges.

Grand Island wellfield site developments included the installation and seasonal operation of a water supply well and associated water distribution system. The water supply source for pumping applications at the GIWF site is a groundwater well with a submersible electric pump located approximately 1730 feet north-northwest of the outlet ("riser") pipe. The well capacity is approximately 600 gpm and delivers water to the riser via a buried 8" PVC pipe. Drawdown from the water supply well was not anticipated to affect water levels in the treatment area given its proximity to the Platte River and distance from the riser. The well is 140 feet deep and screened on the bottom 40 feet. Three fenced site enclosures are located in treated and untreated areas. A grid of 9 observation wells and a stilling well (located adjacent to the north channel of the Platte) as well as two observation wells located immediately south of the site were used to monitor water levels in the area. Capital costs associated with site development (excluding costs related to planning, monitoring components and administration) were approximately \$13,010.

#### Cottonwood Ranch Site-

The Cottonwood Ranch site (see Figure 3) is located approximately 5 miles southeast of Overton, Nebraska in the northwest quarter of Section 16, T8N, R19W in Phelps County. The site is owned and managed by Nebraska Public Power District. At the commencement of the project approximately 140 acres of the site were used as non-irrigated cultivated cropland. The remaining 20 acres are part of a swale with a drainage ditch running along the north side for approximately 500 meters where it flows into another swale. The area near the drainage ditch and swale were planted to tall wheatgrass (*Agropogon elongatum*) prior to initiation of the project. This species has become the dominant species in all but the wettest areas. Dominant species in the swale bottom are those adapted to mesic conditions. The lowest areas of the demonstration site are delineated as seasonally flooded palustrine wetlands by the National Wetlands Inventory. The site was grazed during part of the treatment period.

Depth to groundwater over the area ranges from at the soil surface in the bottom of the swale to over 2 m at the higher elevations. An excavated groundwater drain exists along the south side of the site. Soils at the site consist mainly of Leshara silt loam (U.S. Department of Agriculture, 1973). This soil type is characterized by poorly drained, medium textured materials deposited by water. These soils have moderate permeability, high available water

capacity, moderate organic content and are moderately to highly alkaline. The second major soil type on site are Wann loams. Wann loam soils have moderately rapid permeability, high water capacity, moderate organic content and are slightly to moderately alkaline.

CWR site-specific objectives include increasing the time water is near or above the soil surface, increasing water availability to plants and facilitating the establishment of a native community. While the restoration and enhancement measures implemented on site were not intended to impact the hydrology of the entire quarter section, they were intended to provide interspersed areas of wetlands, moist soils and dry areas, increasing the value of the demonstration site as a wet meadow.

CWR site developments focused on using the existing groundwater drain as a source of water for site hydrology enhancements. A gravity flow system was installed in an effort to test the performance of a water supply system operating without the use of artificial energy sources. An electric pump (capacity ~500 gpm) was added to the system to supplement water supply outputs as needed. The basic design of the water collection system involved the installation of one-half mile of 10" PVC solid and 6" perforated poly pipe which transport water from the drain located south of the wet meadow treatment site. The capacity of the gravity flow system operating without the assistance of the pump is as much as 650 gpm, although production varies significantly depending on flow in the drain. Water is delivered to the treatment area through a 10" PVC pipe approximately 900 feet long. Areas previously cultivated were seeded to native species using native prairie hay harvested from Lillian Rowe Sanctuary near Gibbon, Nebraska.

A grid of observation wells set across the site and staff gages (located in the groundwater drain) were established to monitor water levels in the area. Capital costs associated with site development (excluding costs related to planning, land leasing, monitoring components and administration) were approximately \$26,930.

#### Wyoming Site-

The Wyoming site is located approximately 2 miles southeast of Kearney, Nebraska in the northwest quarter of Section 20, T8N, R15W, Kearney County, Nebraska (see Figure 4). The site is owned by the Wyoming Water Development Commission and is managed through a Memorandum of Understanding with the U.S. Fish and Wildlife Service (Service) signed on December 19, 1988. The entire Wyoming-owned property (which includes lands across the Platte River to the north in Buffalo County) is approximately 470 acres. An area of 236 acres on the north side of the property consists primarily of active river channel and riparian forest and grassland. Since 1995, the Service has cleared much of the forested area on the north and south sides of the channel of woody vegetation. The south side of the area consists of 234 acres, including about 110 acres of grassland, dominated by intermediate wheatgrass (Agropyron intermedium). The grassland area was previously farmed, and is currently grazed and hayed. A drainage ditch traverses the south side of the site, and an irrigation well is located near the center of the south side of the property.

Depth to groundwater over the area ranges from at the soil surface in low-lying areas to 1-2 m at higher elevations. Flows in the adjacent south side drain vary depending on the time of year and amount of groundwater irrigation occurring in the vicinity.

Soils on the WYO site are primarily Gibbon loam (U.S. Department of Agriculture, 1984). These are deep, somewhat poorly drained, nearly level soils on Platte River bottomlands, which are formed in alluvium. They are moderately alkaline and moderately saline. Permeability is moderate, runoff is slow and available water capacity is high. Organic matter content is moderate.

The Service constructed a plowed dam across a portion of the southern edge of the property in the fall of 1994. The dammed area (including natural drainages) was pumped into from the on-site well during late February through March to enhance use by cranes and other migratory waterfowl.

Objectives for the WYO site focused on the creation of temporary, seasonal and semipermanent wetlands through shallow excavation and hydrologic alteration. To meet site objectives, water was delivered to the excavated linear wetland and playa and to an existing linear slough. The Service plans to manage the property for sandhill cranes and migratory waterfowl.

At the WYO site (referred to in some earlier project reports as "WYO SO"), two potholes (playas) and a linear slough were excavated as part of this project. The existing on-site well using a propane fueled power unit was used in 1999 to apply water to treatment areas. The capacity of the well is ~1000 gpm. Electric fence exclosures were placed around portions of the site's excavated wetlands and around a portion of a natural slough to control on-site grazing. Several existing observation wells at the WYO site were supplemented with the installation of additional project observation wells and staff gages to monitor water levels in the area. Capital costs associated with site development (excluding costs related to planning, land lease, monitoring components and administration) were approximately \$11,060.

# III. HYDROLOGIC MONITORING

#### A. METHODS

Hydrologic monitoring of the demonstration sites consisted primarily of collection of surface and groundwater levels, on-site precipitation, Platte River stage and discharge near each site, and project water applications.

An array of project observation wells (one with a continuous recorder) and staff gages were established at each site to monitor groundwater and surface water levels in 1998. Figures 2-4 depict the locations of each site's observation wells and staff gages. The U.S. Fish and Wildlife Service had previously installed observation wells at the WYO site, including one with a recorder. Staff gages were installed in excavated wetlands at the WYO site and in the drain at the CWR site. A stilling well was used at the GIWF site to aid in tracking site-specific Platte River stage and discharge.

Observation wells were surveyed to document elevations at the "top of pipe" (top of the observation well with cap removed) and at the ground surface adjacent to the well. Observation wells were generally read every 7-10 days, less frequently outside of the growing season and more frequently during project water applications. During the growing season, an attempt was made to read the observation wells at a consistent time of day, preferably in the morning hours, in order to minimize water level variations resulting from evapotranspiration. The stilling well and staff gages were typically read at the same times observation wells were read. Continuous recorders were installed in an observation well at each site to provide data to relate water applications to site hydrology. Continuous recorders were installed in July 1998, at the GIWF site (1998 water year); and in October and November 1998, at the CWR and WYO sites, respectively (1999 water year).

Continuous recorder data was plotted against hand measurements for the observation wells with continuous recorders. Figures 5, 6, and 7 show these plotted comparisons for the GIWF (observation well #98-2), WYO (observation well #4), and CWR (observation well #98-WM) sites, respectively. Plotting this data together can allow continuous recorder data to supplement hand measurements when they were missing or vice versa. Continuous recorder data, generally recorded at 15-minute intervals, can show water level peaks and troughs that occur between hand measurements. However, the continuous recorders had periods of missing and erroneous data. The hand checks provide data during these missing periods. These two complementary sets of information are plotted together to help discern effects of river stage, precipitation, and project pumping treatments on water levels throughout the remainder of this report.

Platte River stage and discharge data were gathered for each site from an on-site stilling well (at the GIWF) and at the nearest U.S. Geological Survey (USGS) gaging stations. The Grand Island gaging station is located approximately 3 miles downstream of the GIWF site and provided stage and discharge data very similar to the site's stilling well (i.e., observation well OW #98-10) which sets on the middle channel of the Platte River. The Overton gage is located approximately 3 miles upstream of the CWR site. The Kearney gage is located approximately 2 miles upstream of the WYO site.

The National Weather Service maintains weather stations at the Grand Island and Kearney airports and at the Canaday steam-electric generating station, which are within 9 miles of the GIWF site, 6 miles of the WYO site and 10 miles of the CWR site, respectively. National Weather Service data utilized in this report is readily available from the High Plains Climatic Center, associated with the University of Nebraska at Lincoln. Because of the importance of precipitation data to the study's hydrologic assessments, and given the potential for significant differences in precipitation between the demonstration sites and area weather stations, on-site precipitation data was collected using rain gages. Rain gages were typically read at the same time observation wells were read or in association with precipitation events.

Soil texture, color, percent organic matter and permeability measurements were made at the sites. The two main sources of water loss from wetlands are percolation into the ground water and evapotranspiration.

Project water applications or treatments were documented on data sheets including such information as: time water supply pumps/diversions were started and stopped, rate of water pumped (gpm) or staff gage readings at points of delivery as measured in a concrete flume of known dimension (cfs), totalizer readings (i.e., volume of water pumped), electric meter readings of energy used (in kilowatt/hours), and time of day (for interim readings).

#### B. RESULTS

#### Grand Island Wellfield Site-

Observation well data was collected at the GIWF site from March of 1998 through the end of water year 2000 (i.e., September 30, 2000). Table 1 shows the data collected at project observation wells (OW# 98-1 to #98-9), at non-project area observation wells (OW#88-1 and #95-8) and at the site stilling well (OW#98-10). Continuously recorded groundwater data was collected in observation well #98-2 throughout the demonstration study period. Platte River discharge data from the U.S. Geological Survey (USGS) gage at Grand Island for 1997-2000 are shown in Figure 8.

On-site precipitation data is presented in Table 2. On-site precipitation monitoring began at the GIWF site in March of 1998. Precipitation for the spring and summer months of 1998 show levels generally at or above the average for the period of record. Precipitation for water year 1998-99 was over 7 inches above the average for the period of record. The spring of 1999 and the months of June and August were wetter than normal. The fall of 1999 was considerably drier than normal. Dry conditions continued into the 1999-2000 water year with that year posting total precipitation levels over 10 inches below the long-term average. Except for a wetter than average July, the spring and summer of 2000 were significantly drier than the average of the previous 100-year average. Monthly on-site and precipitation at the Grand Island National Weather Service station are compared in Table 3.

Table 3. Monthly precipitation at the Grand Island wellfield site (in inches).

			2	
			<i>(*</i>	Average for
Month	1997-98	1998-99	1999-2000	Period of Record*
October	2.98**	1.7	0.0	1.52
November	0.65**	2.8	0.2	0.98
December	0.24**	trace	trace	0.66
January	0.14**	trace	trace	0.53
February	0.09**	trace	1.8	0.72
March	3.07**	0.8	1.9	1.49
April	4.0	5.2	1.8	2.47
May	5.45	5.1	1.9	3.93
June	4.2	7.45	0.7	3.91
July	3.5	2.4	4.3	3.14
August	2.45	6.6	0.8	3.02

 $\sim 14.7$ 

25.06

0.5

~32.6

September 0.1

~26.9

<sup>\*</sup> Precipitation for Grand Island, NE, Source: National Weather Service, period of record is January, 1900 to December, 1999.

<sup>\*\*</sup> Precipitation amounts taken from the Grand Island Weather Station.

Soil characteristics for the all demonstration sites including percolation rate, color, compaction, pH, percent organic matter and composition are summarized in Table 4.

The site-specific objectives for the GIWF focus on controlling and increasing the amount and duration water is at or near the soil surface, increasing water availability to plants and facilitating the establishment and enhancement of a native wet meadow community. To help meet site objectives, project water applications were conducted during the crane migration season (primarily March and early April) to provide surface water in the wet meadow and during May and June (coinciding with the historic peak flows of the central Platte River) to facilitate the establishment and enhancement of wetland plant species.

Given that the site's water supply and delivery systems were not in place until the early summer of 1998, a demonstration pumping was conducted in July and early August. The water supply well ran continuously from July 16 to August 6, 1998, delivering over 154 million gallons. During these 21 days of pumping, measurements were made of the area where surface water formed. Within 24 hours of initiating pumping, water had reached a point ~1250 feet down gradient of the riser. Surface area measurements taken on July 24 documented an area of ~ 4 acres of surface water created by the application. By August 3, the wetted area created was over 8 acres in size (Figure 9). The area of standing water was reduced to nearly nothing within 24 hours after pumping was stopped, although soil conditions remained saturated for several more days.

With the collection of additional data in 1999 and 2000, the relationship between the area of surface water created by pumping and water surface elevations (as measured at the continuous recorder) were addressed in more complete terms.

Based on the results of the 1998 demonstration pumping and 1999 precipitation levels, the water supply well ran the majority of the time from March 1 to April 6, 1999 (~37 days), and from May 3 to June 23, 1999 (~32 days). The pump was kicked out of service by power outages on a couple of occasions. The system delivered over 480 million gallons to the treatment site in 1999. During these 69 days of pumping, measurements were made of the area were surface water formed. Surface area measurements taken on March 11, 1999, show an area of 12.3 acres of surface water created by the water application after 11 days of pumping (Figure 9). The inundated area depicted in Figure 9 does not show extensive additional areas of the site where soils were saturated due to project pumping. As in 1998, the area of standing water was considerably reduced within 24 hours after pumping ceased, although soils remained saturated for several days.

The study site is cut for hay in late summer or early fall. According to Robert Thomazin (contract farm manager for the City of Grand Island), the study site area hayed (~115 acres) produced 167.2 tons of hay in 1997 and 191.3 tons in 1998. Project pumping and rainfall during the 1999-growing season did not harm and likely improved hay production on the site. The site yielded 213.2 tons of hay in 1999, an average production of nearly 2 tons/acre. Hay production in 2000 was considerably lower (129.4 tons) due to dry conditions existing from the fall of 1999 through the fall of 2000, although hay quality was reportedly high.

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Project pumping in 2000 was similar to 1999 levels. After a very dry fall of 1999 and winter of 1999-2000, pumping was started on February 28, 2000 and run nearly constantly until April 18 (~51 days) when sandhill crane numbers in the area reached low levels. During this time approximately 393 million gallons of water were delivered by project pumping. Water applications were started up again on May 15 and ran until June 15, 2000 (~32 days), delivering about 250 million gallons, for a total gallons pumped in 2000 of 643,355,000 in roughly 83 days. Water application data for all years are detailed in Table 5 and summarized in Table 6.

Table 6. Summary of project water applications at the Grand Island wellfield site.					
Water Year	Days Pumped	Gallons Pumped	Acre/Feet Pumped		
1998	21	154,220,000	473		
1999	69	480,653,000	1476		
2000	83	643,355,000	1975		

Taking into account such factors as precipitation conditions when pumping was conducted and soil permeability, project pumping at the GIWF site substantially enhanced the hydrology of the site by increasing the area of surface and saturated soils and the duration of soil saturation.

#### Cottonwood Ranch Site-

Observation well data was collected at the CWR site beginning in August 1998. Table 7 shows the data collected at site observation wells (OW #98-WS, -WM, -WN, -ES, -EM, -EN, -NW, and -NE) and at three staff gages (R-staff, W-staff and E-staff) located in the drainage ditch. Continuously recorded data was gathered in observation well #98-WM. Platte River discharge data for 1997-2000 from the gage near Overton are shown in Figure 10.

On-site precipitation data is presented in Table 8. Total area precipitation for the water year 1998 was nearly the same as the average for the 38-year period of record. Precipitation for water year 1999 was over 4 inches above the average for the period of record. Site precipitation was below normal for most months in 1999, but considerably wetter than normal in April, June and August. During water year 2000, precipitation levels were over 10 inches less than in the previous water year and nearly 6 inches below the average for the period of record. Monthly CWR on-site and average period of record precipitation at the Canaday Steam Plant National Weather Station are compared in Table 9.

The site-specific objectives for the CWR focus on increasing the time water is near or above the soil surface, increasing water availability to plants, and facilitating the establishment of a native community. To meet site objectives and given the fact that the gravity flow water delivery system is designed to be operated at low cost, water applications were made fairly constantly during the fall of 1998, from April-July, 1999 and March-July, 2000. The system delivered roughly 31,000,000 gallons (95 ac/ft) in 1998, 79,000,000 gallons (242 ac/ft) during 1999 and 75,000,000 gallons (230 ac/ft) in 2000. Project water applications for the site are detailed in Table 10 and summarized in Table 11. The gravity feed water system was

run as much as possible to evaluate system effectiveness, prevent freeze-up and establish higher groundwater levels on the site. Operational constraints due to unforeseen circumstances limited the effectiveness of the gravity feed system during water years 1999 and 2000. High flows in the drainage ditch, vandalism and other factors necessitated repairs and adjustments to the system. Low levels necessitated shutting down the system in July, 2000. With the installation of an electric pump to the system in the late fall of 1999, the system now has the ability to provide supplemental water over and above what can be supplied by the gravity system alone.

Table 9. 1	Monthly precipitation at the Cottonwood Ranch site (in inches).
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Month	1997-98	1998-99	1000 2000	Average for
October	4.15**		1999-2000	Period of Record*
November		0.0	0.0	1.36
		2.8	0.0	0.83
December	0.35**	trace	0.0	0.43
January	0.19**	trace	0.0	0.42
February	0.70**	0.1	1.7	0.43
March	1.94**	0.4	2.3	
April	1.27**	5.5	0.6	1.27
May	4.28**	3.1	2.3	1.95
June	2.2	9.0	5.5	3.72
July	4.7	1.7		3.60
August	0.8		2.9	3.65
-		3.6	0.3	2.76
September	1.0	0.6	1.0	2.00
Total	~22.7	~26.8	~16.6	22.43
recipitation for	Canaday Stoo	m Dlant C	NT 1	ر ۱ ، سرس

<sup>\*</sup> Precipitation for Canaday Steam Plant, Source: National Weather Service, period of record is November, 1961 to December, 1999.

Table 11. Summary of project water applications at the Cottonwood Ranch site.

Water Year         Days Diverted           1998         56           1999         105           2000         120	Gallons Diverted 31,000,000 79,000,000 75,000,000	Acre/Feet Diverted 95 242 230
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Water applications were effective in creating localized surface water areas. The size of the area with standing water and adjacent wetted areas was highly variable dependent on precipitation, evaporation potential and evapotransporation. When the system was delivering water, the effects of precipitation were more pronounced due to already saturated soils. Precipitation events that normally would not have resulted in standing water, increased the size of the wetted area and surface water persisted longer than it otherwise would have. Because the fall of 1998 and the spring and summer of 1999 were generally wet, it was difficult to quantify the amount of area that could be wetted by the delivery system alone. Project water deliveries during 2000 coincided with dry conditions. Wetted areas resulting from system operation ranged from an area of less than an acre immediately down gradient

<sup>\*\*</sup>Precipitation amounts taken from the Canaday Steam Plant Weather Station.

from the outlet source to creation of a wet swale that was approximately 0.5 miles long by 30 to 150 feet wide. While quantifying the exact capabilities of the system is difficult, the system enhanced the hydrology of the site by providing saturated soils and surface water areas where none would otherwise exist.

#### Wyoming Site-

Observation well data was collected at the WYO site beginning in late November of 1998. Staff gages located in the excavated drain south of the site and at locations in the excavated wetlands were read starting in January, 1999. Table 12 shows the data collected at site observation wells and at five staff gages. Continuously recorded data was gathered in observation well #4 beginning in November of 1998. Platte River discharge data from January 1997 through September 2000 for the Kearney gage are shown in Figure 11.

On-site precipitation data collection began on March 1, 1999, however the gage was lost soon afterward. Given the proximity of the site to the Kearney Airport (~8 miles), Kearney data was utilized as an estimation of precipitation at the WYO site. Total precipitation for water year 1998 was over 6 inches above the average for the period of record (68 years). In water year 1999 precipitation was over 13 inches above the long-term average, with on-site precipitation levels for March, 1999 (5.4 inches) notably higher than levels recorded at Kearney (0.54 inches). By contrast, water year 2000 was considerably drier, with precipitation levels over 6 inches less than the average for the period of record. Monthly Kearney area (and some WYO on-site) precipitation data and period of record precipitation data from the Kearney National Weather Station are compared in Table 13.

Table 13. Monthly precipitation at Kearney, NE and the Wyoming site (in inches).					
Average for				Average for	
Month	1997-98	1998-99		1999-2000	Period of Record*
October	3.84	1.43		0.02	1.41
November	0.61	2.26	1"	0.08	0.86
December	0.45	0.08		0.15	0.60
January	0.16	0.34		0.53	0.53
February	0.57	0.14		1.79	0.64
March	3.76	5.4**		2.19	1.56
April	3.55	4.2**		1.12	2.34
May	3.90	5.35		2.68	3.97
June	3.92	8.23		3.63	4.03
July	7.66	2.78		3.34	3.15
August	1.78	6.67		0.93	2.66
September	0.22	0.87		1.21	2.31
Total	30.42	~37.75		17.67	24.07
* Designation Control NE Common Next and West and Commission of Common Next and Common Next an					

<sup>\*</sup> Precipitation for Kearney, NE, Source: National Weather Service, period of record is January, 1931 to December, 1999.

Objectives for the WYO site focus on the creation of temporary, seasonal and semipermanent wetlands through shallow excavation and hydrologic alteration. To meet site

<sup>\*\*</sup>Precipitation measured at WYO Site.

objectives, water was delivered to the excavated linear wetland, excavated playa and to an existing linear slough. The U.S. Fish & Wildlife Service plans to manage the property for sandhill cranes, waterfowl, and other migratory waterbirds.

The water supply well at the WYO site was operated from February 17 to June 3, 1999, delivering water to all or some of the demonstration sites. A total of 8,646,800 gallons of water were delivered to the site during 142.1 hours of pumping at a rate averaging just over 1000 gpm during that time period (Table 14). Water applications and excavations were effective in creating surface water areas. The size of the areas with surface water varied depending on such influences as precipitation, evaporation potential and evapotransporation. During times when project-related pumping was delivering water, the effects of precipitation were more pronounced due to existing saturated soils. Thus precipitation events that normally would not result in standing water increased the size of the wetted areas and that surface water persisted longer than it otherwise would have.

While it may be difficult to quantify the precise influence of the project treatments, they positively affected the hydrology of the site by providing saturated soils and surface water areas where none would exist otherwise. A pump for the water supply well could not be acquired to conduct water applications during 2000.

#### General-

By definition, a key to wet meadow maintenance and enhancement is having water available at or near the land surface. This can be accomplished in a variety of ways. One method is the interception of water percolating down to the water table by materials with low hydraulic conductivity present at or near the land surface. These materials do not transmit water very well and can form something of a barrier, holding water at or near the land surface after a rain event or artificial recharge. Advantages to this include being able to keep water at or near the land surface, even when the water table is not at or near land surface. Another method is to induce recharge to an area until the water table intersects or is close to the land surface. An advantage to this method is that groundwater is a more stable regime than standing bodies of surface water. In general the presence of a combination of these scenarios is likely and it can be difficult to quantify the extent of each. However, analyzing the timing and volume of water it takes for a treatment to affect ground water levels can help the overall understanding of the system.

Given the project's focus on hydrological aspects of the wet meadow study sites, comparisons were made of four factors, which principally influence their hydrology, i.e., local area precipitation, river stage, project water applications, and project water pumping. Hydrologic comparisons are made by visual inspection of hydrographs and groundwater contour maps of the treatment areas. Development of scientific cause and effect relationships for the wet meadow hydrology would require the development of a local area water budget approach using a groundwater model. This however is beyond the scope of this study. The data collected though would provide key input and calibration data to develop such a tool.

The hydrographs of local area precipitation and water levels continuously recorded at the GIWF, CWR and WYO sites are shown in Figures 12, 13, and 14, respectfully. It should be

noted that continuous recorder data was not always error free and uninterrupted because of instrument malfunctions. The recorder data was checked as described in the methods section. Figures 12, 13, and 14 depict the influence of groundwater recharge from precipitation on increases in water levels. While the magnitude and duration of precipitation impacts on study site hydrology obviously depend on such factors as the magnitude and duration of the precipitation event, as well as soil drainage characteristics, the relationship is clear.

To further illustrate the effect of precipitation, groundwater contour maps were developed for a set of observation wells readings three days after a 1.5" precipitation event and 37 days after the same event with no rainfall in between. The Cottonwood Ranch site was used for this illustration because the drain on the south of the site maintains a stable groundwater level and the Platte River is one-half mile North of the site so changes in river stage would have negligible or no influence on the site within a three day period. Figure 15 shows the groundwater mounding three days after the rainfall event along the main slough that traverses the property west to east. Figure 16 shows the same area 37 days later when the mound no longer exists under the slough. In both figures the drain along the southern boundary works to control the groundwater levels in the area. The direction of groundwater flow is toward the drain for all contour maps developed at this site.

Water can be delivered to the wet meadow demonstration sites in different ways. Two methods are utilized in this Project. The first method takes advantage of intersecting the water table by installing slotted pipe in an existing artificial drain to intercept the water table and pipe it to a wet meadow site. The second method uses an extraction well to pump water out of the groundwater and pipe it to the wet meadow site. The extraction well itself is placed a distance from the site so the cone of depression has minimal affect on the water level in the vicinity of the wet meadow. The GIWF and WYO sites use an extraction pump to deliver water to wet meadow site, while at the CWR site the hydrology of the site is enhanced by piping the water from an artificial drain to the wet meadow.

Using the extraction well technique, water is delivered from the pump to the riser at GIWF site and from the pump to the outlet at the WYO site. Water table contour maps were made of conditions that existed near the end of a pumping treatment to analyze affects on groundwater. These site conditions were documented during a time which allowed isolation times of high and low river stages and precipitation events to more tightly constrain the effects of pumping. During the pumping interval, the GIWF site shows a discernable water table mound at the riser where the water was delivered (Figure 17). The GIWF hydrograph of OW #98-2 data versus pumping (Figure 18) also shows clear correlation between pumping treatments and water level increases. The WYO hydrograph of OW #4 versus SG #4 and pumping (Figure 19) shows a delayed effect between the water treatment and increases in ground water level. This is evident from the increases in the surface water levels (SG #4, Figure 19) at the onset of pumping, with overall increases in the ground water level (OW #4, Figure 19) occurring some time after initiation of pumping. The WYO site during pumping interval (Figure 20) showed no clear and convincing effect from the pumping event on the water table contour when compared to the water table contour during high Platte River stage (Figure 21), which was before any water treatments.

Pumping is expected to have some drawdown in the area near the pumping well. However, no noticeable difference resulting from pumping occurred in the hydrograph for the observation well closest to the pumping well for the WYO (Figure 22) or the GIWF (Figure 23) sites. However, the WYO site water table contour map during pumping interval (Figure 20) had some drawdown affect when compared to the WYO site water table contour map during high Platte River stage (Figure 21), which was before any water treatments.

Platte River stage is a groundwater level control in areas along the river where the study sites are located. The river acts as a drain when groundwater levels are high relative to the river and the groundwater gradient is toward the river. The river is a source of recharge to the groundwater when the river is high relative to groundwater and the gradient is away from the river. Generally in the river reach where the study sites exist, the gradient is not very distinguished either away from or toward the Platte, thus the groundwater gradient parallels the river. A goundwater gradient paralleling the river indicates no gain or loss between surface and groundwater.

Figures 24, 25 and 26 display the daily Platte River stage at various gages and continuous recorder data at the study sites. River stage and the groundwater levels in the recorder wells show increases during periods of precipitation and are relative stable during periods of no precipitation. Opportunities to discern the effect of river stage on groundwater levels might have been good during the late fall of 1999 (see Figures 24, 25 and 26) as no project related water applications were taking place at the study sites and precipitation events were virtually non-existent. River stage during this time was relatively stable and high, and yet continuous recorder data do not show corresponding levels of stability. Water levels increased over a foot between the end of September and the end of the calendar year at the GIWF and CWR sites. Water levels at the WYO site decreased in October then rose slightly in November and December. There may be some relationship that becomes more evident during times when groundwater levels are at their seasonal lowest, possibly indicating something of a groundwater "base" level influenced or maintained in some manner by river stage.

Groundwater contour maps were developed at the GIWF and WYC sites for low and high river stage. Figure 27 displays the groundwater elevations at low river stage and Figure 28 at high river stage at the GIWF site. Notice the elevations on both maps are fairly uniformly spaced between the channels and the gradient of groundwater flow is basically parallel with the river. When comparing the elevations across the map at any number of points, the difference in groundwater level is around 2.5 feet. While the difference in river stage between these to time periods is greater, around 3 feet. Figures 29 and 21 display the low and high river stage conditions at the WYO site. Groundwater elevations indicated movement of groundwater is in a northeasterly direction toward the river under both stages. The difference in river stage is around 3.3 feet while the groundwater elevation difference is around 1.7 feet. This would further indicate groundwater as being a more stable regime than surface water. Groundwater is influenced more by long-term averages, than the short-term fluctuations you would expect with surface water.

# IV. BIOLOGICAL MONITORING

#### A. METHODS

Biological monitoring methods used for this project are primarily described in Nagel (1998) and Nagel (1999a).

#### 1. Birds-

Bird use of the wet meadow sites was documented throughout the calendar year beginning in 1997 and ending in 2000. The level at which monitoring was conducted varied depending on time of year. Project cooperators monitored spring bird use. During crane migration periods (i.e., February through April) an attempt was made to visit each site at least three times per week using the following guidelines: one visit between sunrise and three hours after sunrise, one visit between three hours after sunrise and three hours before sunset, and one visit three hours before sunset to sunset. Because this effort was undertaken using personnel of the cooperating partners, the ability to stick to the above schedule and was sometimes compromised. Therefore results are given as number of cranes seen per visit. For visits that have multiple observations of cranes during the visit, the maximum number of cranes seen was used in the comparisons.

Project contractors conducted breeding bird surveys once or twice per year during the month of June in 1997 through 2000. Surveys were conducted at established counting stations along transects within the wet meadow study sites. The observer counted all birds within a 45 m radius of the point for 3 minutes. The CWR site had two transects which ran north and south with 8 counting stations 90 m apart on each transect. The WYO site had two north – south transects which equally divided the property and each transect had 6 counting stations. The GIWF site had four transects which equally divided the property and each transect had 5 counting stations. All counts were finished by 1000 CDT. For more detailed descriptions of transect location dates of annual surveys and site conditions see annual avian monitoring reports contained in Nagel (1997, 1999a, 1999b and 2000) and Central Platte NRD, et al., (1999 and 2000). Breeding bird densities are expressed as the number of birds per 100 acres. Densities were calculated only on species thought to be nesting on the sites, all other species were noted as visitors.

Fall migratory bird surveys were conducted once per year in October at each of the sites. Surveys were conducted by doing continuous counts along transects. Two east-west transects were surveyed at both the CWR and WYO sites. Four north-south transects were surveyed at the GIWF. All surveys were completed by 1030 CDT. Results are reported as number of birds seen.

In addition to the above efforts others that visited the sites kept notes on the birds, which were encountered while conducting other activities such as groundwater and vegetation monitoring. These observations are incidental and are reported only to establish species occurrence on the sites.

#### 2. Invertebrates-

Invertebrates are indicators of change or current status of ecosystems. From 1997 through 2000 surveys and sampling were conducted for invertebrates at all three demonstration sites. The purpose of the sampling was to establish a baseline of invertebrate diversity and abundance so as to provide a measure of the change in the invertebrate communities at these sites over time. Five methods were employed to determine invertebrate species richness and abundance at the three sites.

Soil samples were taken from established vegetation monitoring quadrats along four transects on each site during each sampling season. A sample consisted of a 2-3" core from the surface to 20 centimeters deep. Invertebrates were separated from the core sample by using Burlese-Tullgren funnels at 50% rheostat setting for one day and 100% rheostat setting for two days.

Pit trapping was conducted at each site in 1997, 1999, and 2000. Each site was trapped approximately 51 trap-days per season. Traps consisted of small containers with a 2.5cm layer of automotive antifreeze in the bottom to kill and preserve specimens.

Foliage sweeps were conducted at each site in 1997, 1999, and 2000. During 1998 sweeps were conducted only at the GIWF site. A sample consisted of one hundred 1-meter long sweeps with five samples collected per site. Aquatic insects were collected from the GIWF site during 2000 using random sweeps through standing water.

Butterflies were identified and counted using standard methodologies along established transects and were recorded as to species observed and number of butterflies observed per observer hour.

Invertebrate specimens collected over the course of the study were identified, cataloged, preserved in 70% alcohol and are presently housed in the University of Nebraska - Kearney Museum collection.

#### 3. Vegetation-

To allow for comparisons of pre and post year treatments, permanent sampling sites were established at each of the three demonstration sites. Transects were laid out in a north to south direction at approximately equal intervals in an attempt to sample all major soil series and elevations represented on each site. Using a differential GPS, 10 x 10 meter quadrats were located along each transect approximately every 300 meters. Four transects and 18 quadrats were established on the GIWF site, two transects and 10 quadrats on the CWR site, and two transects and 6 quadrats on the WYO site.

Identifying exact quadrats for subsequent sampling presented some problems. In 1997 a combination of GPS and measuring the distance from fences was used. In addition to this method, in 1998 a rebar was buried in the center of each quadrat and a metal detector was used to find the quadrats. In 1999, a board painted bright orange was placed at the corner of each quadrat.

Data was collected on species composition, biomass, and percent cover. Species unidentifiable in the field were collected and identified later in the University of Nebraska at Kearney Herbarium.

#### 4. Mammals-

Small mammal live trapping, pit fall trapping, and on site observations were conducted on all three properties from 1997 to 2000. Live trapping consisted of transects of between 30 and 50 Sherman live traps operated for 1 to 2 consecutive nights. Pit fall trapping conducted in association with invertebrate monitoring was conducted along similar transects for up to 14 consecutive days. Field crews also recorded any observations of mammals made at other times.

#### 5. Amphibians and Reptiles-

Surveys were conducted for herptiles (amphibians and reptiles) during 1998, 1999, and 2000 at all three demonstration sites. Four survey/collection methods were employed over the course of the study.

- 1) Anuran calling surveys. These surveys were conducted after dark with observers walking along transects established at each site. The observers would stop at designated locations for two minutes, recording the presence of each species heard. At the CWR site two surveys were conducted during 1998 (April and May), one survey was conducted during 1999 (September), and one survey was conducted during 2000 (April). At the WYO site four surveys were conducted during 1998 (two in April and two in May), one survey was conducted during 1999 (August), and one survey was conducted during 2000 (May). At the GIWF site three surveys were conducted during 1998 (two in April and one in May), and two surveys were conducted in 2000 (April and May).
- 2) Amphibian larvae seining. All bodies of water were seined on each of the sites one time each year (late May or early June).
- 3) Daytime area search surveys. Daytime searches were conducted each year in order to locate herptiles. During 1998 and 1999 search patterns were followed with observers walking established transects. In 2000 the areas were randomly searched on days amphibian larval seining was conducted.
- 4) Basking boards. Pieces of wood approximately one foot square in size were placed at regular intervals along established transects. Daytime observations of these boards and other materials found on the properties were conducted for herptiles hiding below.

#### B. RESULTS

#### 1. Birds-

#### Sandhill Cranes-

Sandhill crane surveys were conducted because of the importance of wet meadows to sandhill cranes. Table 15 shows the number of survey visits to each site and average number of cranes observed per visit. One of the purposes of wet meadow enhancement is to improve habitat conditions for sandhill cranes. However the data collected is insufficient to evaluate

sandhill crane response to project enhancement efforts. The GIWF site did see an increase in crane use when water application was started. The CWR site also had an immediate response to water application by sandhill cranes. Other factors such as disturbance and vegetation stature confound interpretation of sandhill crane use of the sites. Adjacent to the GIWF site is a trap shooting range and a model airplane runway. Sandhill crane use of the wet meadow site is non-existent when either area is being used and the cranes likely learn to avoid areas with disturbances.

Evaluation of sandhill crane use on the WYO site over the course of the study is not possible. Data on sandhill crane use of this site was only collected in 1999 and 2000. On only 3 occasions in 1999 and none in 2000 were sandhill cranes observed on the site.

Sandhill cranes showed an immediate response to water application at the CWR site. The site had some crane use in 1997 when the area contained crop residue. In 1998 the site was left as crop residue with water added which resulted in a substantial increase in sandhill crane use of the site. The site was also seeded using native hay in the spring of 1998. After this point in time the area was left idle and the vegetation became tall which negated its value as sandhill crane habitat for the remainder of the project. Future management of the site is planned to include both the water applications and vegetation management, which will improve habitat conditions for the sandhill cranes.

#### Breeding Birds-

A total of 19 bird species were noted as nesting on the three sites. The only apparent trend is seen at the GIWF site where the density of breeding birds declined throughout the study period (Table 16). It would be premature to conclude a cause and effect relationship of water augmentation and breeding bird response at any of the sites. Although this project impacted hydraulic conditions of the site, it did not affect other management. Management such as haying may have had a greater impact on the species and densities of breeding birds than project water applications. The change in the CWR site from cropland to early stages of grassland restoration may have impacted the area more than the water application.

#### Fall Migrants-

A total of 32 species were identified on the study sites during the fall migration surveys (see Table 17). Water applications at all sites was terminated or greatly reduced by the time fall surveys were completed. Thus project impacts to fall migrants would be minor and would primarily result from vegetative response to the water applications. An exception was the CWR site that had a major influx of weedy plant species during the restoration phase. This provided an abundance of seeds as a food source.

Table 18 is a listing of bird species that were seen at each site, these data are observational and non-systematic. This data is presented for the purpose of establishing bird use during the time of the study. At the current time it is not possible to use avian response to management as an indicator of success for this project. While this project affected the hydrologic conditions of the sites, it did not significantly modify vegetation composition, vegetation management or disturbance factors, which may have a greater impact on the avifauna use of the sites. Avian response to water applications would best be discerned from long-term

monitoring of the sites. More detailed explanations of bird use of the sites are contained in annual project reports by Nagel (1997, 1999a, 1999b, 2000) and Central Platte NRD, et al., (1999 and 2000).

#### 2. Invertebrates-

Thirteen families of non-insect invertebrates and 11 orders consisting of 62 families of insects were collected, identified, and preserved. Foliage sweeps resulted in 45 families (Table 19), pit trapping yielded 26 families (Table 20), soil samples 12 families (Table 21) and aquatic dip netting 11 families (Table 22). Butterfly counts resulted in the identification of 51 species (Table 23).

Sampling at the GIWF site resulted in the largest number of individual invertebrates as well as the greatest species richness. Of the 62 families of insects collected over the course of the study, 53 families were present at this site. Eleven of the 13 non-insect families were present and 48 butterflies identified were present at the site. A mean of 113 butterflies was identified per observer hour with a range of 73 - 182 per hour.

On the CWR site 34 of the 62 families of insects, all 13 families of non-insect invertebrates, and 28 species of butterflies were collected or observed. The mean number of butterflies identified per observer hour was 66 with a range of 15 - 143 per hour.

Of the three sites, the WYO site contained the fewest individual invertebrates as well as the smallest species richness with 24 families of insects, 7 families of non-insect invertebrates, and only 24 species of butterflies. A mean of 26 butterflies per observer hour was recorded with a range of 16 - 31.

Invertebrate abundance and species richness are indicators of the level of quality and balance for an ecosystem. According to this measure the GIWF site may presently be the most balanced of the three sites and the WYO site the least balanced.

The GIWF site had the greatest abundance and largest species richness of all invertebrates, partly due to the collection of aquatic insects that were not sampled at the other sites, however, with those excluded it was still the richest site. The GIWF had the smallest insect herbivore to predator ratio (60% - 40%), which is an indication of a balanced ecosystem. The GIWF site also had the greatest butterfly abundance and diversity.

This significant difference in abundance and richness of invertebrates at the three sites is most likely due to the history of use of the sites (i.e. as hay, pasture and cropland) and not related directly to project treatments. This is especially true of the soil invertebrates that may require up to 10 years to recover following major management changes. In large part the CWR site continues to function as a cropland ecosystem with high mite and springtail numbers and low numbers of ants and beetles. Invertebrates at the GIWF are fairly typical of ungrazed prairies in the region and the WYO site contains typical pasture fauna (Nagel 1999a, 1999b, 2000) and Central Platte NRD, et al., (1999 and 2000).

#### 3. Vegetation-

A plant list (Table 24) and percent cover/species were determined within each quadrat at each site (Tables 25, 26 and 27). Plant names follow the Great Plains Flora Association (1986). Wetland ratings were taken from Reed (1988). Species composition was determined by 2-3 botanists estimating the midpoint of percent coverage for each species within a quadrat using the Cover Class method of Goldsmith et al., (1986).

Cover Class	Range of % Cover	Midpoint
1	0-1	0.5
2	1-5	3.0
3	5-25	15.0
4	25-50	37.5
5	50-75	62.5
6	75-90	82.5
7	90-100	95

Overall percent contribution/species/site/year was determined by summing the midpoint cover contribution and dividing by the total contribution of all vegetation species (e.g. CWR site 1997 Agropyron elongatum percent cover contribution  $6.5 = 10/154 \times 100$ ). See Tables 25, 26 and 27. In an effort to determine if treatments resulted in changes in species composition from upland adapted species to wetland adapted species, plant species were analyzed according to wetland indicator ratings.

USFWS Wetland Indicators reflect the range of estimated probabilities of a species occurring in wetland versus non-wetland habitats across the entire distribution of the species (Reed 1988).

## USFWS Indicator Categories:

Obligate Wetland (OBL). Occur almost always under natural conditions in wetlands. Facultative Wetland (FACW). Usually occur in wetlands, but occasionally found in non-wetlands.

Facultative (FAC). Equally likely to occur in wetlands or non-wetlands.

Facultative Upland (FACU). Usually occur in non-wetlands, but occasionally found in wetlands.

Obligate Upland (UPL). Occur in wetlands in another region, but occur almost always under natural conditions in non-wetlands in the region specified.

A positive (+) sign indicates more frequently found in wetlands and a negative (-) sign indicates less frequently found in wetlands (Reed 1988).

For our analysis species were divided into four categories.

- 1) No Wetland Indicator (0).
- 2) Wetland (W) = OBL, FACW, FACW+, FACW-, FAC+.
- 3) Intermediate (I) = FAC.
- 4) Upland (U) = FAC-, FACU, FACU+, FACU-, UPL.

9

9

Percent contribution of species within each category was summed for each year/site. See Tables 28, 29 and 30.

It is not currently possible to use vegetation response to project treatments as an indicator of project success. While project treatments affected hydrologic conditions of the demonstration sites, longer-term monitoring of the sites with continued treatments is necessary to discern any significant change in vegetation. A relatively wide variation in precipitation levels over the course of this study confounded efforts to discern project effects on site vegetation. More detailed explanations of vegetation characteristics at the demonstration sites are presented by Nagel (1997, 1999a, 1999b and 2000) and Central Platte NRD, et al., (1999 and 2000).

#### 4. Mammals-

Live trapping and pit fall trapping from 1997 through 2000 resulted in the capture of 59 small mammals comprising six species (Table 31). Due to the sparse number of captures and recaptures it was impossible to make estimates of population size using mark and recapture formulas. Six additional species were observed on the sites but were not captured (Table 31).

The general lack of species diversity and the low number of small mammals captured (<0.3 per trap night) may be directly related to haying, grazing, and cultivation of the properties in the recent past. With only two years of post treatment data for review, it is too early to evaluate the effectiveness of the actions taken at each site on the species richness and carrying capacity of these sites for mammals.

## 5. Amphibians and Reptiles-

Six species of amphibians and six species of reptiles were identified on the three sites over three years (Table 32). Four amphibians and three reptiles were identified in 1998, four amphibians and no reptiles were identified in 1999, and five amphibians and four reptiles were identified in 2000.

Calling surveys in the spring of 1998 and 2000 documented the presence of the western stripped chorus frog (*Pseudacris triseriata*), southern plains leopard frog (*Rana blairi*), and Woodhouse's toad (*Bufo woodhousii*) at the CWR and WYO sites. At the GIWF site only *P. triseriata* was heard. No calls were heard during the two late summer calling surveys in 1999.

The WYO site produced both the largest number of larvae collected each year and the greatest species richness. During 1998 there was an abundance of the plains spadefoot toad (*Scaphios bombifrons*), and *B. woodhousii* larvae with *R. blairi* and *P. triseriata* also collected. In 1999 the number of larvae were quantified with 16,600 *B. woodhousii* and 209,400 *S. bombifrons* collected. In 2000 the proliferation of emergent vegetation in the pools made seining difficult and thus only occurrence was recorded. Three species, *P. triseriata*, *S. bombifrons*, and *R. blairi* were collected. Amphibian larvae were collected from the CWR site during 1998 and 2000. During 1998 ephemeral pools held high densities of S. *bombifrons*, however no quantification was conducted. During 2000 *P. triseriata* were

located at one site. Again, no density counts were made. No larvae were collected at the GIWF site during any of the three years.

With the exception of numerous *R. blairi*, very few herptiles were located during the daytime area searches or under basking boards. Most of the reptiles observed were seen during other times when researchers were on the properties.

Few species of herptiles were observed or collected from the three demonstration sites over the course of the study. However, the specimens collected provide a baseline of the presence and relative abundance of herptiles on the sites. The time span of the study is considered too short to evaluate any impact of project treatments on herptiles.

# V. OPERATION AND MAINTENANCE

Early in development of the project, reviewers pointed out the potential value in tracking and assessing operational and maintenance costs associated with the project and it's varied treatments and facilities. Little operation and maintenance cost information exists for engineered wet meadow enhancement projects on the Platte River. Cook (1995) documented relatively low initial capital costs and ongoing operation and maintenance costs associated with a recharge basin project. McCue (1996) suggests artificial management of wet meadows associated with a ground water demonstration program to be a relatively expensive proposition. Currier (1995) noted earth moving and the construction of low-head dams as an expensive means of enhancing wetland surface hydrology, particularly if substantial clearing of mature trees is involved.

With the completion of project development and considerable water applications in 1999, operation and maintenance costs could begin to be summarized and assessed. Table 33 summarizes project operation and maintenance costs for 1999 and 2000.

Table 33. Project operation and maintenance costs.						
Grand Island wellfield site	Water Year 1999	Water Year 2000				
Electricity for water supply well	\$1,006.02	\$1,241.64				
Winterization of system	120.60	68.62				
Spring preparation of system	30.89	32.38				
	\$1,157.51	\$1,342.64				
Wyoming site						
Propane for pumping well	\$ 375.00	\$ 0.00				
Cost to use pump	250.00	0.00				
Set up and maintenance of well	250.00	0.00				
Noxious weed control	150.00	64.00				
	\$1,025.00	\$ 64.00				
Cottonwood Ranch site						
Maintenance of water system	\$1,881.52	\$1,446.00				
Operation enhancement to system	276.30	0.00				
	\$2,157.82	\$1,446.00				

Totals of \$1,157.51 and \$1,342.64 were spent on operation and maintenance activities during water years 1999 and 2000, respectively at the GIWF site. Of those amounts, \$1,006.02 (87%) and \$1,241.64 (93%) was spent for energy use and for minimum monthly electrical connection fees. Energy rates ranged from \$0.067 - 0.045/KWH depending on monthly and seasonal consumption. The operation of the electric water supply well involved virtually no labor costs. While electric service was occasionally interrupted, restart costs were not incurred since pump restarts were done during monitoring events at the site. Other operational costs were limited to late winter set-up of the water distribution system and late fall winterization of the system to prevent freeze-up. To date the system has run reliably with minimum maintenance or operational costs over and above energy costs. A total of 480,653,000 gallons of water were pumped at the GIWF site during the 1999 water year at a total operation and maintenance cost of \$1,157.51 or about \$0.0000024/gallon of water delivered. Similarly, during 2000 a total of 643,355,000 gallons were pumped during 2000 for \$0.0000021/gallon.

Annual operation and maintenance costs at the WYO site for 1999 (the only year project pumping occurred) included energy costs of \$375.00 for propane (\$0.49-0.50/gallon), rental of the power unit for pumping costs of \$250.00 (\$25.00/week x 10 weeks), labor to set up and maintain the system costing \$250.00 (\$10.00/hour x 25 hours) and weed control labor costs of \$150.00 (\$10.00/hour x 15 hours), for a total annual cost of \$1,025.00. Excluding weed control costs, \$875.00 was spent to deliver 8,646,800 gallons of water at the WYO site at a total annual operation and maintenance cost per gallon of water delivered of \$0.000101. It should be emphasized that a major component of the treatment at the WYO site was excavation to ground water, a practice not involving significant maintenance costs.

Costs associated with operating and maintaining the water delivery system at the CWR site are still in somewhat of a state of flux as system operation is refined. However, if early experience is an indication of long-term trends, the absence of energy costs associated with the gravity flow system may be more than offset by high labor costs associated with operation. Larger capital costs associated with a more efficient design may be a more cost-effective approach over the long-term. In the summer of 2001, project sponsors modified the original delivery system design, burying the majority of the system adjacent to the drain. During the 1999 water year a total of \$2157.82 was spent operating and maintaining the system to deliver approximately 79,000,000 gallons of water at the site. This translates into an estimated cost of \$0.000027/gallon of water delivered. The system's electric pump did not operate during this time period. In 2000, roughly 75,000,000 gallons were delivered for \$1,446.00 or \$0.000019/gallon.

A longer-term assessment of these costs will be useful to habitat managers looking for a cost-effective means of delivering water.

# VI. DISCUSSION

The hydrology of central Platte River wet meadows is complex and not well understood (Wesche, et al., 1994). Precipitation, river stage, soil characteristics, evapotranspiration and soil freezing and thawing all influence groundwater elevations underlying wet meadows.

Hydrologic conditions of these meadows include both wet periods in the spring and dry periods in the summer. Draining, conversions to cropland, flow management, road building and numerous other changes have contributed to the loss of wet meadows and the modification of their hydrology. Hydrologic fluctuations in Platte River wetlands and a mosaic of larger scale hydrologically varied slough habitats are important determinants of species diversity in Platte River wetlands (Goldowitz et al., 1999).

Relatively few studies have looked at maintaining or enhancing wet meadow hydrology along the central Platte River, and fewer still have focussed on utilizing means other than streamflow. Cook (1995) found that wet meadow hydrology at a site on the National Audubon Society's Lillian Rowe Sanctuary could be successfully recharged utilizing an engineered recharge basin. With a recharge rate of 0.23 cfs per day for a 20-day period, a recommended depth to groundwater was achieved under the study site. Cook's ability to artificially raise and maintain groundwater levels to within 1 to 1.5 feet of soil surfaces is described as a useful tool for water resource managers.

Currier and Goldowitz (1995) created backwater areas using inflatable plastic dams in order to artificially manipulate Platte River stage and examine the resulting impacts on groundwater levels in adjacent wet meadows. The study found that the treatment probably had little hydrologic impact and that the artificial sills might be able to maintain a portion of the desired hydrologic baseline, but are probably not capable of meeting criteria deemed necessary for long-term sustainability of wet meadows.

Currier (1995) used windmill pumping to enhance wetland hydrology at a Platte River site near Prosser, Nebraska. He concluded that the windmill's small pumping capacity was not effective in creating widespread surface water wetlands at this relatively dry site. With a higher water table, Currier speculates that windmill pumping might have been more successful. Re-contouring sloughs at an adjacent site was also attempted in an effort to retard drainage and effectively lower surface elevations in relation to the current groundwater level (as was done as part of this project's treatment at the WYO site). Currier notes that in the limited areas where scraping was done, local hydrology was enhanced and additional wetland species were found in such areas. Construction of low-head dams to enhance hydrology in wetlands at a site near Elm Creek, was noted as the most successful technique in meeting hydrologic criteria. Currier emphasizes the importance of river flows in wet meadow hydrology and characterizes his artificial attempts to manipulate local hydrology as relatively ineffective.

The U.S. Fish and Wildlife Service (1992) utilized water from a groundwater recharge/nitrate dilution project near Wood River to enhance the hydrology of an area wet meadow. Water applications were made from a pipeline, which provided water pumped from the Platte River. The Service (McCue 1996) noted that funds were not available to adequately study the artificial application of water and that unanswered questions linger regarding the biological utility of artificially managing Platte River wet meadows.

This project utilized several methods of water application on different types of land areas with variations in topography, soils, and vegetation cover to enhance precipitation and

runoff. The project demonstrated that water treatments can be made on tracts of land to improve the duration of standing water and improve the habitat conditions for some species in a wet meadow.

The U.S. Fish and Wildlife Service have documented desired characteristics of central Platte River wet meadow hydrologic regimes, including: naturally timed to seasonally coincide with the phenology of riverine and wetland biota; duration sufficient to ensure the reproductive life-stages of wetland organisms; duration sufficient to achieve anaerobic soil conditions and promote growth of hydrophytic vegetation; inter-annual frequency sufficient to sustain relatively short life-cycles of wetland biota; and year to year magnitude can vary, with consideration given toward inter-annual long term average. The demonstrations conducted as part of this project have been shown to enhance or manage many of the hydrologic characteristics deemed important by the Service. Ground and surface water levels were enhanced and maintained by artificial non-streamflow means. Treatments were implemented to control the timing, duration and magnitude of changes to wet meadow hydrology.

Given the relatively short time frame of implementation of project treatments, it remains to be seen if these non-streamflow project treatments will result in long-term, enhancements to the ecological integrity of Platte River wet meadows. The primary wet meadow characteristic focused on is site hydrology. Similar to Currier's findings at Uridil-2, in the small areas where such scraping was done, the groundwater elevations relative to soil surface was enhanced and additional wetland species were found. In meeting the hydrologic criteria, the treatments implemented at CWR hold considerable promise as they involved relatively small capital costs and could be accomplished with minimal ongoing operating and maintenance costs. The site's soils are similar to other central Platte meadows and, like many areas along the Platte, managers can make use of existing area drains.

Project treatments (i.e., gravity flow, groundwater pumping, and re-shaping of surface topography) maintained and enhanced wet meadow hydrology at demonstration sites. Information gained through this study can be an integral component of wetland restoration and management on other habitats along the Platte River.

The hydrology of the meadows is complex and not totally understood. We may never completely understand the hydrology and biology of wet meadows, but given their value, all reasonable options, including artificial enhancements, should be considered by resource managers on the Platte River. These demonstrations support our ability to maintain and enhance wet meadow habitat using means other than streamflow, providing another tool for managers to use to benefit the habitats of the central Platte and the species that rely on them.

# VII. <u>LITERATURE CITED</u>

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Figure 2. Grand Island Well Field Site



Hall County, SW1/4 of Sec 10, T10N, R9W

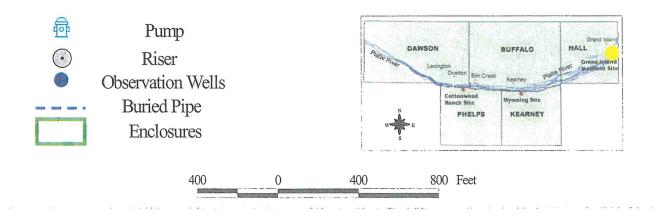
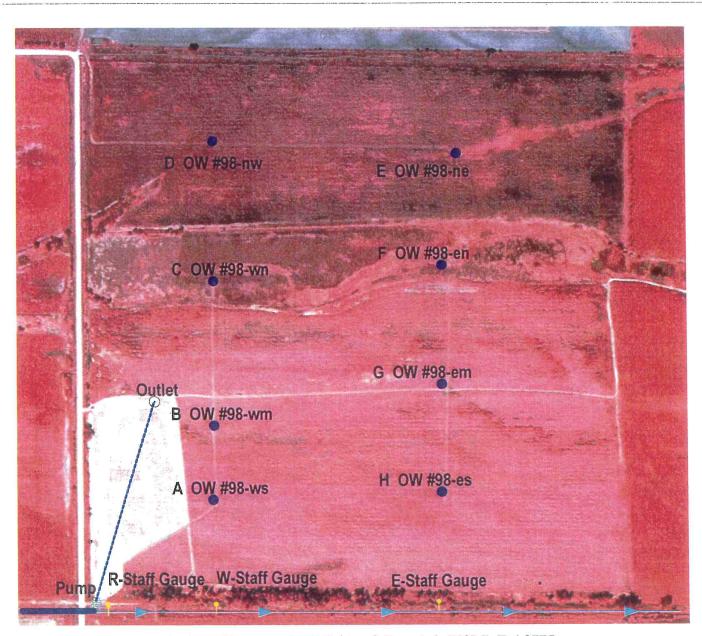


Figure 3. Cottonwood Ranch Site



Phelps County, NW1/4 of Sec 16, T8N, R19W

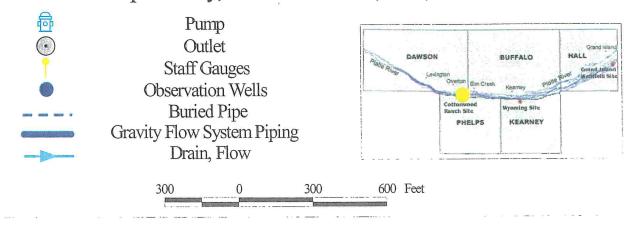
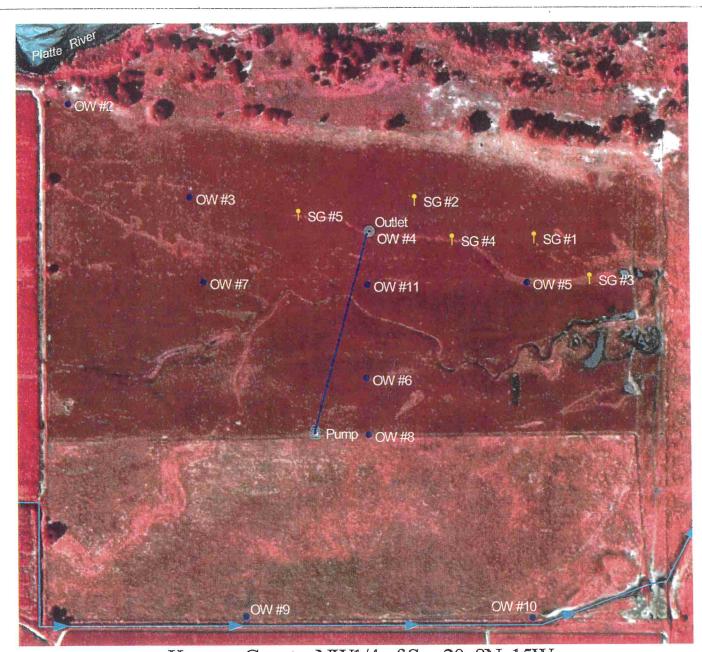
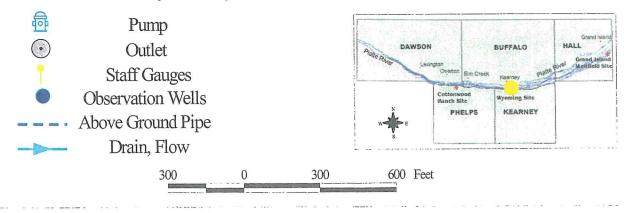


Figure 4. Wyoming Site



Kearney County, NW1/4 of Sec 20, 8N, 15W



119/200 Nordrand onoroo 811/2000 11122000 61/2/200 1 81,37,00 31,41200 1,145,00 101/01/0899 Continuous Recorder SINTINGS 11/8/1999 Figure 5. Grand Island Wellfield Hydrograph 61,81,999 611911999 M19/1989 3/201/099 ---- OW #98-2 21/8/1989 OW #98-2 vs. Continuous Recorder 111911989 ~2/20/1998 11201998 1 102/1008 81211888 17231988 STATE OF THE STATE 0.5 -0.5 -2.5 0 5. -3.5 က္ Water Level (ft)

,21,0100 1110100 ,01,100 08/1/00 08/12/00 8 7 8 8 8 8 8 8 8 021,4100 01/5/00 12/10/08 11/16/88 Continuous Recorder 1017109 081/8168 011/9/88 06/19/99 Figure 6. Cottonwood Ranch Hydrograph 05/20188 ---- OW #98-wm 04/20188 03/2/188 OW #98-wm vs. Continuous Recorder 051/0/09 01/20188 1212/198 11/21/08 10122108 08/27/88 08/23/98 07124198 ņ ကု က 2 0 4 Water Level (ft)

Figure 7. Wyoming Hydrograph ow #4 vs. Continuous Recorder

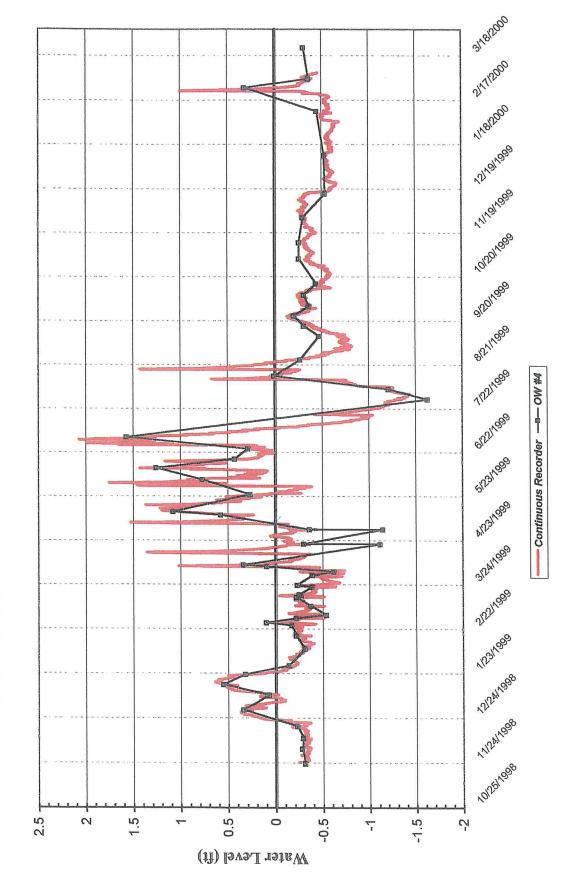
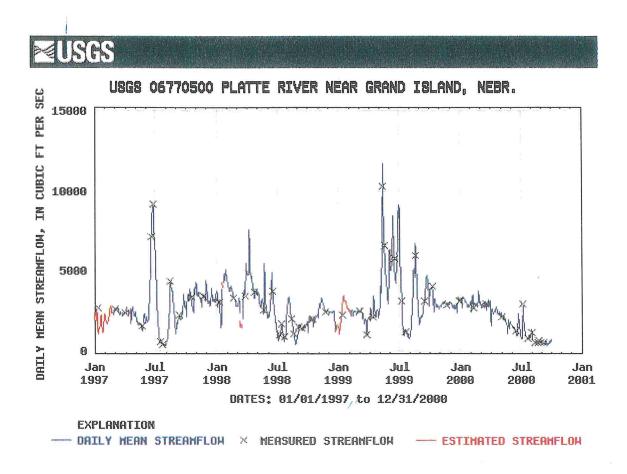
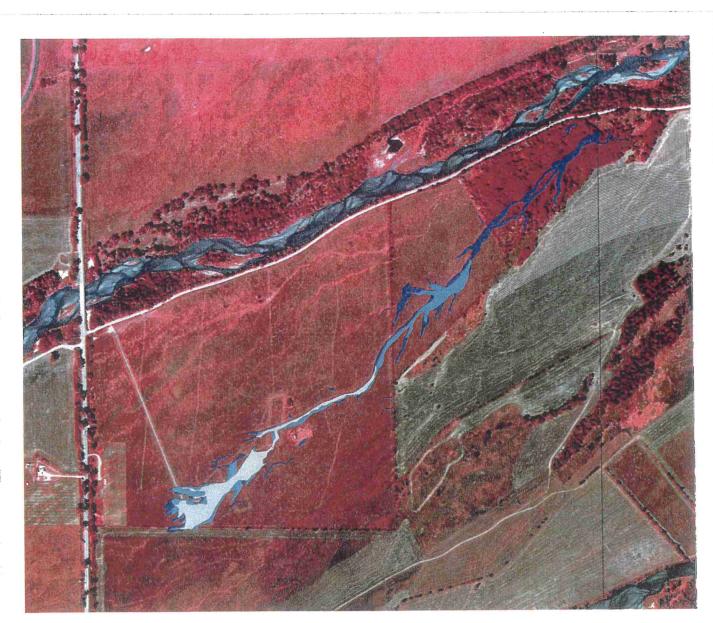


Figure 8. Platte River discharge at Grand Island gage



Provisional Data Subject to Revision

Figure 9. Wetted area at Grand Island wellfield



Hall County, SW1/4 of Sec 10, T10N, R9W

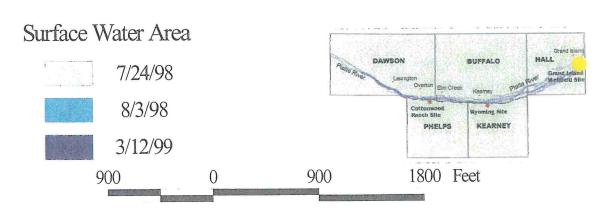
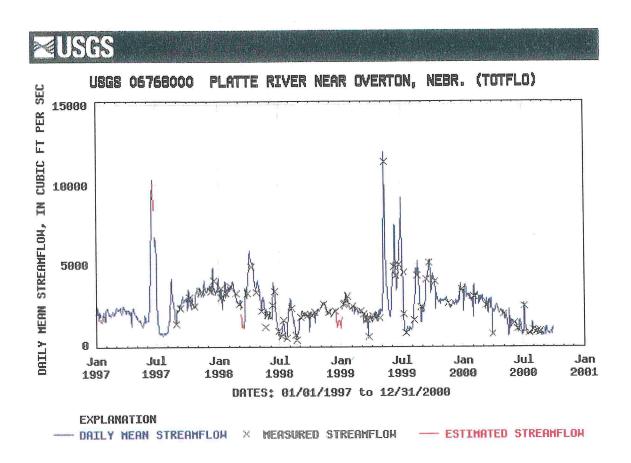
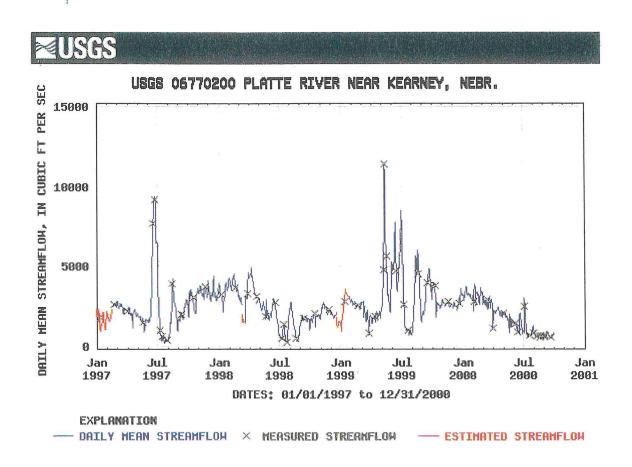


Figure 10. Platte River discharge at Overton gage



Provisional Data Subject to Revision

Figure 11. Platte River discharge at Kearney gage



Provisional Data Subject to Revision

1191200 3.5 3.0 2.5 0.5 0.0 NOTOTO oliologo 811/200 11/2/2000 61/2/200 51/3/2000 413/200 314200 21/3/200 114200 ,21,61,888 11/6/1000 ,01,01,099 oliely 98 SHTINGS TINBINDS Figure 12. Grand Island Wellfield Hydrograph GI/BI/BBB 61/91/88<sup>9</sup> OW #98-2 and Continuous Recorder Data vs. Precipitation M1911989 3/21/089 21/8/1889 N/9/1989 1,2121,998 Precipitation 11/20/1998 1012117998 91211/988 8/21/8/8 123/1888 0.5 -0.5 -1.5 -2.5 -3.5 0 Ŋ က္ Water Level (ft)

Precipitation (in)

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- Continuous Recorder

Precipitation Event

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91711/88<sup>89</sup>

81/81/888

11/9/1988 61/91/999

H211888 M7211,088

31211,000 21,91,989 11211,998 12/21/1998 11211988 101211998

91211/98° 81231/08° 11241998 6/24/1988

Figure 13. Cottonwood Ranch Hydrograph OW #98-wm and Continuous Recorder Data vs. Precipitation 9 2 4 ო N 0 Precipitation (in)

Figure 14. Wyoming Hydrograph OW #4 and Continuous Recorder Data vs. Precipitation

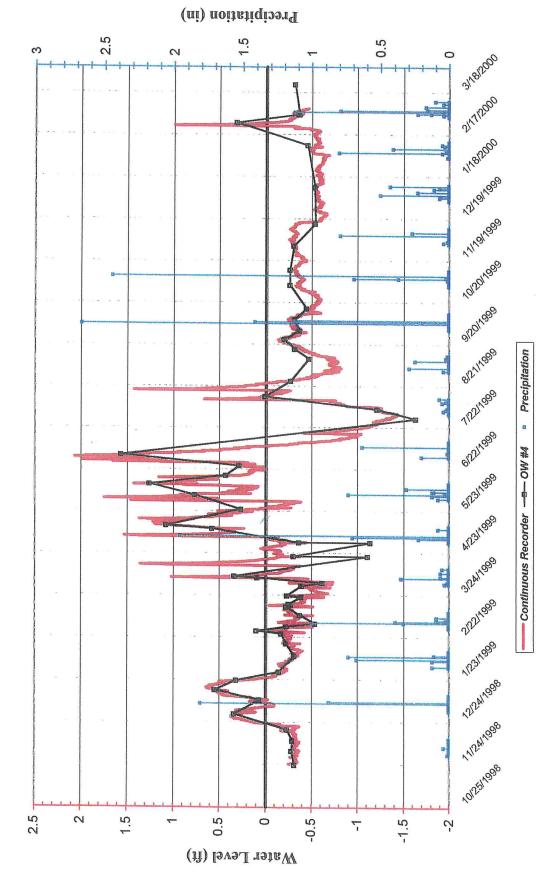


Figure 15. Cottonwood Ranch (Water Table Contour Map) Three Days after Precipitation (11/13/98)

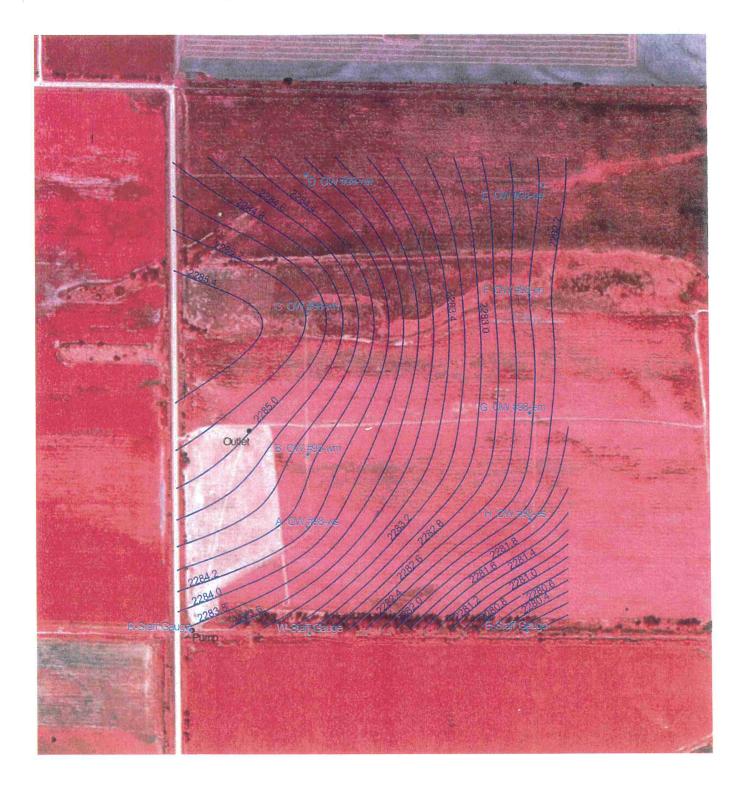


Figure 1 Wet meadow demonstration site locations







Figure 16. Cottonwood Ranch (Water Table Contour Map) 37 Days After Precipitation Event (12/17/98)

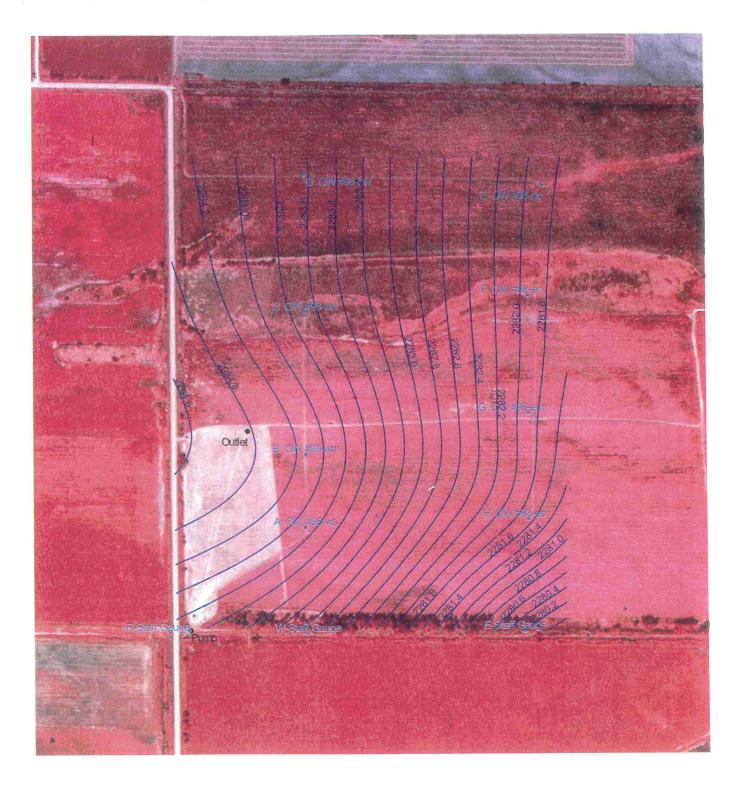


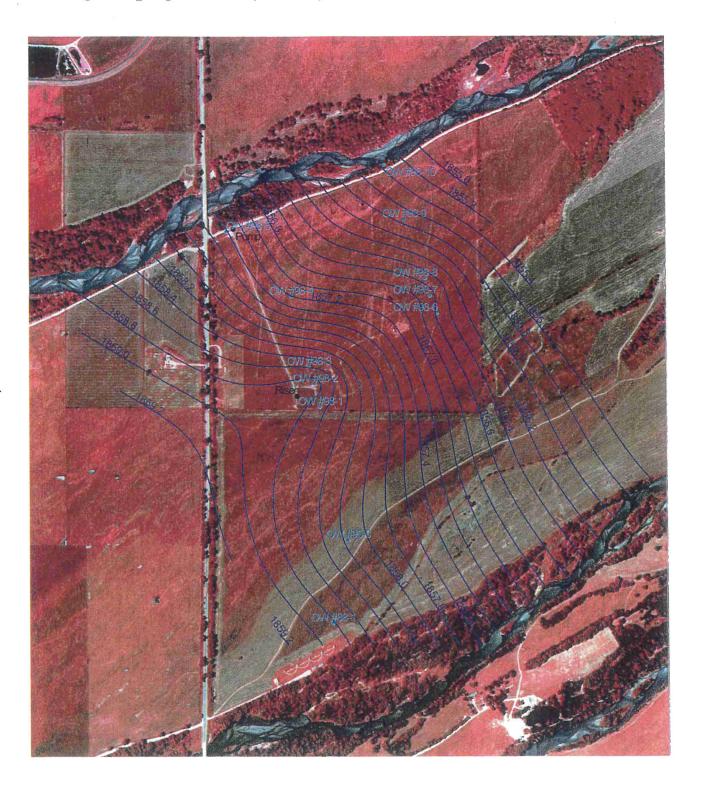
Figure 1. Wet mendow demonstration site locations







Figure 17. Grand Island Wellfield (Water Table Contour Map) During Pumping Interval (4/18/00)









1191200 -2.5 -3.5 -0.5 0.5 Ņ က္ nonorzogo onorros 811/200 11121200 61/21200 51/3/200 all 312000 314200 21/3/200 174/200 ,21,61,099 11/6/1999 1011011080 91/61/999 BINTINGS 717817888 Figure 18. Grand Island Wellfield Hydrograph GN8N989 41,917,98<sup>9</sup> OW #98-2 and Continuous Recorder Data vs. Pumping ANOINESS 3/201/989 Wall base 117917999 1,21201,098 112017998 Pumping 1012117998 01211098 8/21/888 1/23/1988 1 orange SCALLONG SCALLONG SCALLONG SCALLONG 009 500 400 300 200 100 0 Pumping Rate (gpm)

Water Level (ft)

-0.5 1.5 2.5 31/8/2000 ņ 2471200 1181200 ,21,91,999 101501,000 □ Pumping ——Continuous Recorder — □—OW #4 — 1—SG #4 OW #4 and SG #4 and Continuous Recorder Data vs. Pumping 22211.989 1231,090 1,21241,098 11/24/1998 101241,098 1200 1000 800 900 400 200 Pumping Rate (gpm)

Figure 19. Wyoming Hydrograph

Water Level (ft)

Figure 20. Wyoming (Water Table Contour Map) During Pumping Interval (4/20/99)

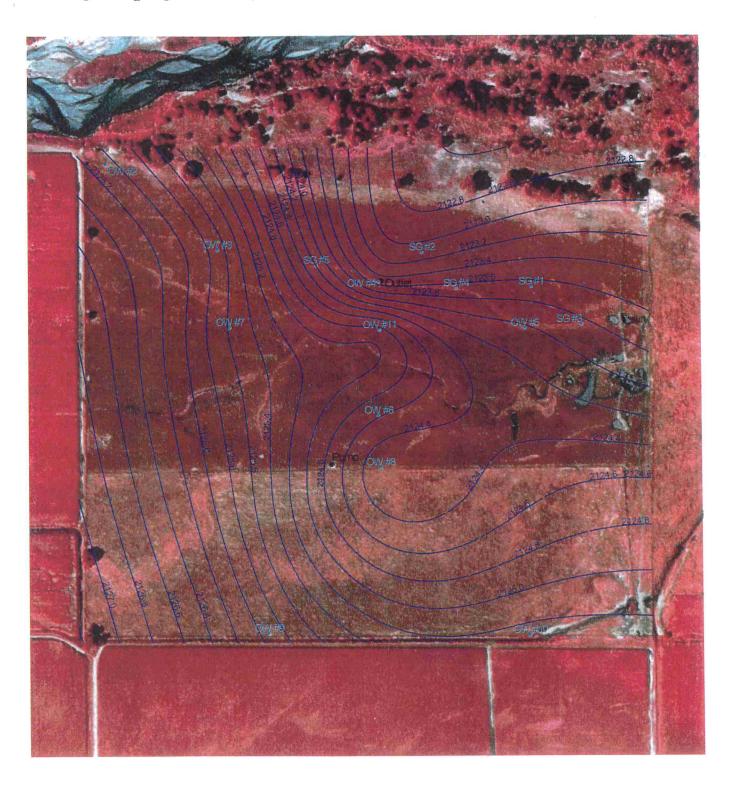


Figure 1. Wet meadow demonstration site locations







Figure 21. Wyoming (Water Table Contour Map) High Platte River Stage (12/29/98)

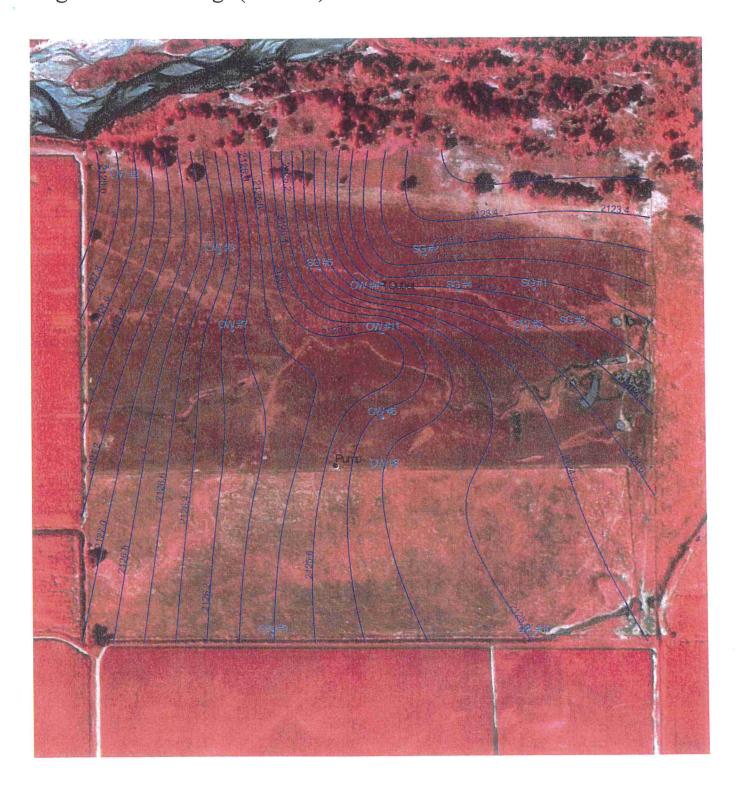
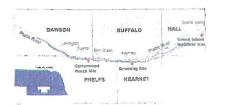


Figure 1 Wet meadow demonstration site locations







Water Level (ft) -0.5 3.5 -2.5 31/8/2000 1 0.5 21/1/200 1181200 ,21,31,98° , 11, 31, 38°S ,01201,088 9/201/999 11211,000 -- OW #8 612310989 Pumping Figure 22. Wyoming Hydrograph Observation Well next to pump (OW #8) vs. Pumping A12311,000 3/24/099 22211,888 \1231\088 1,31241,998 11541998 200 0 1000 1200 800 900 400 (mqg) gniqmuA

Water Level (ft) -0.50 -1.00 -1.50 -2.00 -2.50 -3.00 -3.50 -4.00 -4.50 -5.00 0.00 11912000 nonorgoo oroizado 81/1/2000 717212000 01/2/2000 51/3/2000 M13/2000 3/14/2000 21/3/2000 11/4/2000 ,217517999 11/15/1999 Notion 3/16/1989 81711988 71781798<sup>9</sup> Figure 23. Grand Island Wellfield Hydrograph --OW #98-5 GI/BI/998 HINDINGO Observation Well next to pump (OW #98-5) vs. Pumping M1917999 3/21/1988 Pumping WALL BOOK NYON NOON 1,21201,098 11201998 1012117998 91211988 8/21/888 1/23/1/998 51241,098 A7241,998 3/25/1988 2/23/1998 900 500 400 300 200 100 0 (mqg) ətsA gniqmu¶

101701200 91101200 81/1/200 11,22,00 61/2/200 51/37/00 413/200 3/14/200 Platte River Stage at Grand Island -- OW #98-2 21/3/200 114200 27/5/1999 11/1/1988 ,01,01,09<sup>9</sup> onoroso 81171088 OW #98-2 and Continuous Recorder Data vs. Platte River Stage at Grand Island 11,81,089 Figure 24. Grand Island Wellfield Hydrograph GN8/1888 61,91,999 M191999 3/20/1000 21,81,999 MANASA Continuous Recorder 1,212,01,008 , 1120 H998 1012111998 1012111998 01211098 8/21/988 11231/998 61231,000 ဖ 2 N 4 Water Level (ft)

91/1/200 81/21/2000 71,31200 61/3/200 51/4/2000 4741200 31/5/2000 21,41200 11751200 12/10/1988 1,1,16,1,000 101717999 91711,099 81/81/999 OW #98-wm and Continuous Recorder Data vs. Platte River Stage at Overton 11/9/1999 Figure 25. Cottonwood Ranch Hydrograph 61,91,999 61201,999 47211,999 3211,000 21/9/1989 17211999 12/2/1/098 11211088 101221,998 9/21/998 81231,098 11241,988  $\infty$ ņ O 2 0 4 Water Level (ft)

-Continuous Recorder ---OW #98-#wm

Platte River Stage at Overton

,01201,098 - Platte River Stage at Kearney Figure 26. Wyoming Hydrograph OW #4 and Continuous Recorder Data vs. Platte River Stage at Kearney 11241998  $\infty$ 9 N 0 N 4 Water Level (ft)

31,817,00

Figure 27. Grand Island Wellfield (Water Table Contour Map) Low Platte River Stage (8/23/00)

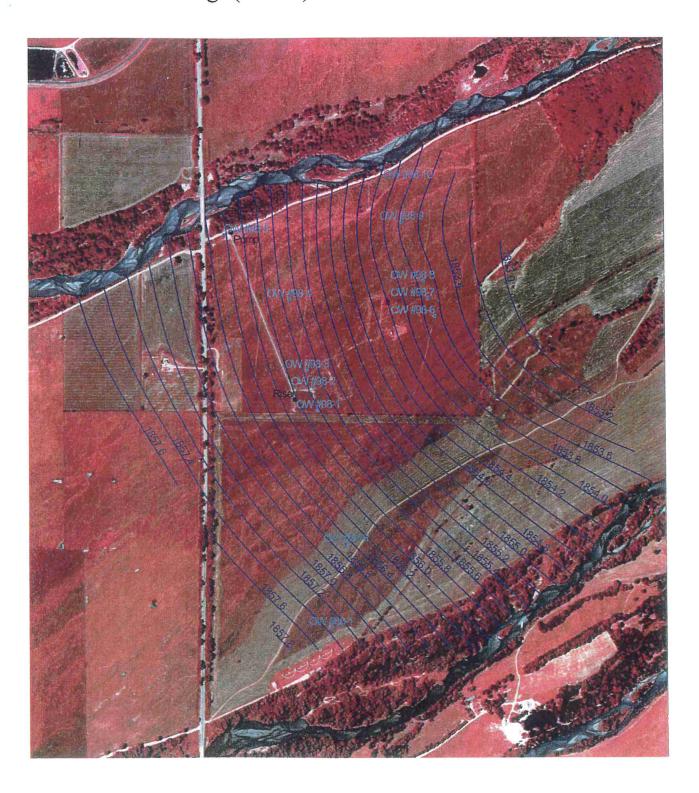








Figure 28. Grand Island Wellfield (Water Table Contour Map) High Platte River Stage (1/21/99)

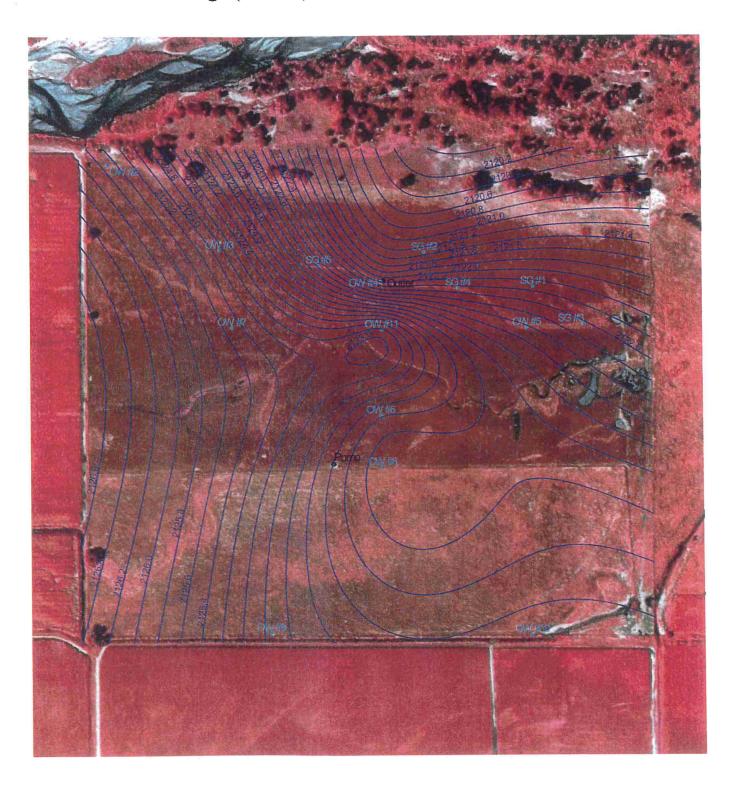








Figure 29. Wyoming (Water Table Contour Map) Low Platte River Stage (7/28/99)









## able 1. Grand Island Wellfield Observation Well Data

-					to Wate															-							
₹ 1	DAY	MO	NTH Stick-up	OW #98-1	hh:mm C		h:mm	OW #98-3 h	h:mm	OW #98-4 I	hh:mm	OW #98-5 hh	:mm	OW #98-6 h	h:mm	OW #98-7 h	h:mm	OW #98-8 h	h·mm	OW #98-9 ht		OM #09 40					
1998		25	3 3	<b>2.74</b> 3.12	10:54	<b>2.68</b> 2.66	10:57	<b>2.66</b> 3.41	10:59	<b>2.82</b> 4.30	11.00	1.88	44.46	2.43		2.65		2.53		2.52	i:mm	OW #98-10 1.70	nn:mm	OW #95-8 I	nh:mm	OW #88-1 h	h:mm
1998		26	3	3.32	14:50	2.86	14:57	3.59	15:02	4.40	11:03 15:07	4.50 4.52	11:10 15:14	5.15 5.33	10:20 15:28	3.22 3.28	10:24		10:28	4.19	10:34	4.44	13:20	2.32		1.78	
1998		30	3	2.97	14:38	2.59	14:35	3.17	14:33	3.73	14:28		14:21	4.73	14:50	2.89	15:32 14:53		15:37 14:54	4.27 3.38	15:42		15:48	5.51	16:08	6.61	16:00
1998		9	4	2.74	10:59	98 all times 2.29	shown are	e Central Day										4.10	14.54	3.30	14:59	3.79	15:07				
1998		15	4	3.02	13:40	2.56	13:46	2.99 3.21	11:04 13:49	3.36 3.69	11:08 13:53		10:47	4.57	11:25	2.73	11:27		11:30	2.93	11:32	3.41	11:37	4.27	11:53	E EC	44.47
1998		20	4	3.63	10:52	3.13	10:55	3.81	10:57	4.30	11:00	4.19	13:57 11:04	4.76 5.36	14:07 11:14	2.58	14:10		14:12	3.50	14:15	3.75	14:19		14:28	5.56 6.36	11:47 14:32
1998 1998		24	4	4.01	10:01	3.53	10:03	4.20	10:05	4.74	10:08	4.63	10:12	5.77	10:19	2.58 2.67	11:16 10:21	4.76 5.21	11:18 10:22	4.10	11:21	4.13	11:25	5.56	11:36	6.72	11:40
1998		29 4	5	3.05 4.21	13:00 9:58	2.64 3.75	13:02	3.27	13:03	4.95	13:07	4.42	13:11	4.87	13:21	2.84	13:22	1	13:24	4.53 3.72	10:25 13:28		10:29 13:31	5.82	10:38	6.89	10:43
1998		11	5	4.40	9:15	3.91	9:59 9:18	4.42 4.59	10:02 9:20	4.96 5.14	10:07	4.76	10:11	6.03	10:21	2.94	10:24	5.47	10:26	4.70	10:31	4.51	10:38	5.57 6.00	13:43 10:48	6.75 7.03	13:47
1998		18	5	4.40	12:50	3.96	12:55	4.63	12:57	5.13	9:23 13:04	4.99 4.99	9:47 13:08	6.16 6.14	9:57 13:20	3.35	9:59		10:02	4.79	10:04	4.59	10:08	6.23	10:20	7.03	10:52 10:26
1998 1998		22 26	5	2.59	8:55	2.07	8:57	2.78	9:00	3.20	9:05		9:10	4.26	9:25	3.10 2.35	13:22 9:27		13:24 9:30	4.85	13:27	4.71	13:30	6.18	13:43	7.24	13:50
1998		2	6	3.01 4.57	8:59 9:06	2.54 4.07	9:02	3.20	9:04	3.74	9:08	4.16	9:14	4.75	9:27	2.26	9:28	0.000	9:30	2.63 3.44	9:33 9:33	1 2000	9:38 9:37	4.07	9:50	5.25	10:20
1998		8	6	2.88	9:38	2.51	9:09 9:41	4.74 3.15	9:11 9:44	5.22 3.90	9:15	5.15	9:20	6.30	9:35	3.49	9:38		9:42	5.00	9:45		9:48	5.25 6.26	9:45 10:09	6.55 7.38	9:50 10:05
1998		12	6	3.80	13:58	3.27	14:02	4.01	14:05	4.71	9:47 14:10	4.49 4.64	9:51 14:16	4.70 5.58	9:59 14:26	2.82	10:03		10:05	3.44	10:08		10:11	5.92	9:16	7.17	9:25
1998 1998		17	6 6	3.28	9:07	2.72	9:09	3.42	9:12	4.03	9:15	4.20	9:21	5.00	9:42	2.89 2.55	14:28 9:46		14:31 9:53	4.44	14:36	4.39	14:39	5.84	14:50	7.01	14:54
1998		24	7	4.56 5.27	9:50 8:52	4.09 4.76	9:51	4.77	9:53	5.31	9:54	5.25	9:55	6.29	9:10	2.55	9:12		9:15	3.82 5.03	9:57 9:17	4.51 5.04	9:59 9:20	5.51	10:10	6.79	10:15
1998		8	7	5.41	9:07	4.84	8:54 9:09	5.43 5.58	8:57 9:11	5.94 6.14	9:01	5.75	9:06	7.01	9:17	2.74	9:19		9:21	5.62	9:25		9:30	6.31 6.98	8:58 9:39	7.39 8.05	9:01 9:42
1998		16	7	5.46	8:48	4.96	8:51	5.64	8:54	6.19	9:13 8:58	5.82 5.80	9:15 9:04	7.20 7.28	9:26 9:17	2.39	9:23		9:21	5.80	9:19	5.45	9:41	7.21	9:31	8.24	9:34
1998 1998		16 17	7					5.67	14:38	6.19	14:26	5.85	14:21	7.20	9.17	3.79	9:21	6.66	9:24	5.83	9:28	5.39	9:31	7.24	9:41	8.21	9:45
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1998		3	8	3.04	10:00		0.00	3.36	10:05	5.55	8:58 10:08	5.53	9:00	5.24 5.24	9:21 10:30	2.74	9:23		9:24	5.23	9:26	4.79	9:28		9:12		9:16
1998 1998		6	8 8	3.27	9:15	2.36	9:17	3.36	9:22	5.50	9:25	5.07	9:30	5.29	9:41	2.78 2.82	10:32 9:43		10:37 9:45	4.70 4.66	10:42	4.40	0.50	6.95	10:59	7.75	10:55
1998		14	8	4.05 4.75	9:20 11:30	3.47	9:23	4.18	9:26	5.43	9:29	5.08	9:34	5.64	9:43	3.39	9:45		9:46	4.67	9:48 9:50	4.43 4.51	9:52 9:53	6.71 6.69	10:03 10:09	7.67 7.66	10:07
1998		18	8	5.02	9:01	4.54	9:03	4.94 5.21	11:25 9:05	5.61	11:28	5 50	0.45	6.51	11:42	4.33	11:44	5.90	11:46	5.15	11:49		0.00	6.83	11:59		10:13 11:55
1998		25	8	5.25	9:19	4.77	9:25	5.45	9:31	5.83 6.08	9:11 9:37	5.53 5.93	9:15 9:43	6.79 7.06	9:37 9:50	4.61	9:33		9:31	5.41	9:27	5.21	9:24				
1998		9	9	5.49	9:13	5.03	9:16	5.70	9:20	6.31	9:23	5.74	9:27	7.32	9:37	4.87 5.13	9:54 9:39		9:56 9:41	5.70 5.84	9:59 9:44	5.53	10:02		10:08		10:14
1998		15	9	5.69 5.76	9:06 8:46	5.21 5.29	9:08	5.85	9:12	6.27	9:15	5.65	9:18	7.47	9:34	5.29	9:30		9:28	5.84	9:25	5.11 5.05	9:48 9:22	7.36 7.38	9:55 9:45	8.34	9:58
1998		22	9	5.76	11:06	5.29	8:50 11:04	5.92 5.92	8:54 11:01	6.34 6.37	8:57	5.60	9:01	7.54	9:14	5.35	9:11		9:08	5.82	9:06	5.01	9:03	7.50	9:25		
1998		30	9	5.77	9:27	5.27	9:25	5.95	9:23	6.32	10:59 9:21	5.64 5.61	10:56 9:16	7.57 7.68	11:16 9:44	5.39	11:19		11:21	5.84	11:24	5.05	11:26	7.39	11:09	8.25	11:12
1998		15	10 10	5.30	9:01	4.78	8:59	5.47	8:57	5.98	8:55	5.41	8:50	7.10	9:44	5.36 4.92	9:45 9:16		9:47 9:17	5.82 5.49	9:49 9:18	5.17	9:52	7.33	9:35	8.15	9:38
1998		20	10	5.29 5.20	11:05 10:15	4.76	40.40	5.46	11:09	5.94	11:10			7.10	11:20	5.12	11:22		11:24	5.47	11:30	4.91	9:20	7.03	9:08	7.96	9:10
					0.5	4.76 5/98 all time	10:18 es shown a	5.40 are Central S	10:20 Standard T	5.89	10:22	5.36	10:25	7.02	9:56	4.84	9:59	6.37	10:02	5.44	10:05	1	10:08	6.95	9:53	7.89	9:50
998		27	10	5.16	11:16	4.69	11:19	5.34	11:21	5.74	11:24	5.42	11:29	7.01	11:39	4 00	11.07	6.25	14.05	F 00	44.55						
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998		20	11	3.52 4.25	11:45 13:50	2.70	40.4=	3.71	11:48	4.63	11:52	4.65	11:54	5.44	12:05	3.26	12:10		12:20	4.41	12:30		11:22	6.22	11:32	7.28	11:34
998		25	11	4.23	13:50 13:37	3.79 3.96	13:47 13:35	4.47 4.59	13:40	5.16	13:35	5.10	13:30	6.10	14:00	3.94	14:10	5.52	14:15	4.82	14:20		14:25	6.25	14:35	7.27	14:40
998 998		3	12	4.44	14:28	3.96	14:25	4.65	13:31 14:22	5.24 5.31	13:27 14:19	5.10 5.12	13:21	6.21	13:53	4.02	13:54		13:57	4.90	14:00	4.74	14:05	6.27	14:19	7.33	14:23
998		9 16	12	4.55	11:30	4.04	11:32	4.72	11:34	5.41	11:36	5.21	14:15 11:39	6.33 6.33	14:34 11:41	4.11 4.19	14:35 11:45		14:37 11:49	4.92 4.99	14:40	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	14:44	6.37	14:03 11:57	7.40 7.48	14:05 12:00
998		24	12 12	4.54	12:11	4.07	12:10	4.73	12:08	5.40	12:07	5.21	12:05	6.32	12:17	4.16	12:19		12:20	4.98	11:52 12:22		11:54 12:24	6.46 6.43	12:28	7.44	12:30
				4.71	9:51	4.26	9:48	4.94	9:46	5.60	9:44	5.73	9:40	6.50	10:00	4.26	10:02		10:04	5.25	10:09		10:12	6.59	10:28	7.57	10:30
999 999		8	1	4.58	13:45	4.33	13:47	4.74	13:49	E 20	10.55	4.00	44.00	0.0	مد و و	to represent											
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999		8	2	3.34	14:26	2.90	14:24	3.62	14:22	4.52	14:19	4.60	14:15	5.33	13:59	3.19	14:02		14:03	4.33	14:05	10.00000000	14:09	5.32	13:51	6.34	13:47
999		17	2	4.16	14:21 16:20	3.40 3.74	14:15 16:15	4.08	14:14	4.93	14:10		14:06	5.71	14:33	3.59	14:34	5.21	14:36	4.77	14:39	5.11	14:42	5.79	14:56	6.89	14:59
999		1	3	4.09	9:11	3.63	9:09	4.44 4.34	16:10 9:08	5.27 5.12	16:05 9:04	5.35 5.21	16:00	5.98	16:25	3.84	16:28		16:31	4.88	16:37	4.95	16:39	6.13	16:47	7.20 7.12	16:50
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١	/EAR	DAY	МО	NTH	OW #9	8-1 hh:mm	OW #6	8-2 hh:mn	0147.490																			
						• • •••••	000#3	10-2 IIII;MN	OW #98-	3 hh:mm	OW #98-4	hh:mm	OW #98-5 I	nh:mm	OW #98-6	hh:mm	OW #98-7	hh:mm	OW #98-8 I	hh:mm (	OW #98-9 H	himm	OW #98-10					
													5.21	14:04						,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	JW #30-3 1		O44 #30-10	nh:mm	OW #95-8	hh:mm	OW #88-1	hh:mm
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	1999		15	3	2				:07 3.2 :55 3.2		2	13:15		13:19	4.79	13:25	2.57	13:28		9:20	4.28	9:25	4.83	13:35	6.05	9:35	7.20	9:40
	1999		17	3	3				12 3.4			8:51	5.24	8:47	4.93	9:04	2.62	9:05	4.21 4.34	13:29 9:07	4.35	13:35			6.05	13:49	7.21	13:55
	1999		9	3	3	12 16			45 3.2		E0.55	3:16	100.00.00	3:20	5.12	3:25	2.78	3:26	4.51	3:28	4.48 4.68	9:10 3:30	4.85	9:13	6.11	9:29	7.21	9:32
	1999		22	3	2	88 10			19 3.1			16:30	5.41	10:40	5.04	16:46	2.71	16:49	4.45	16:30	4.60	16:50	5.00	3:33	6.21	3:40	7.31	3:42
	1999	2		3	3	34 14:		.57 14		550 85		10:13	5.34	10:08	4.72	9:50	2.49	9:51	4.16	9:53	4.36	9:56	5.04	10:50				
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	1999		6	4			4/4/99 all		are Central	Daylight Sa	inas Time	13.00	5.45	13:03	5.11	13:30	2.77	13:31	4.48	13:34	4.63	13:38	4.98	15:15 13:42	6.18	14:59	7.34	15:03
	1999		7	4		78 14:		.24 14	41 3.0			14:35	4.39	14:30	4.56	44.50		62000 000 0						13.42	6.41	14:06		
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	1999		9	4				.56 8		0.000	4.04	8:30	4.52	8:25	4.73	10:18 8:45	2.54	10:20	4.07	10:25	3.61	10:30	4.68	10:35	5.25	15:20	6.49	15:25
	1999	1:	3	4				.65 13				13:52	4.68	13:47	4.86	14:03	2.64	8:47	4.20	8:49	3.88	8:50	4.76	8:55				
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	1999	19	9	4		25 15:		.71 15:	3.93			13:12	4.85	13:15	5.53	13:20	3.30	12:47 13:22	5.13	12:50	3.62	12:52	4.82	12:59	5.94	13:15	7.10	14:37 13:20
	1999	23	3	4		73 13:						15:14	4.39	15:17	4.94	14:57	2.81	14:55	4.88	13:25	3.92	13:30	5.36	13:40	5.43	13:55	6.78	13:59
	1999	29	9	4		68 10:		30 13: 03 10:				13:54	4.98	13:59	5.45	14:05	3.32	14:07	4.42 4.95	14:53	4.00	14:50	4.74	14:45	5.39	14:34	6.62	14:30
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	1999	7	7	5	2.	98 11:	2-2	48 11:	vicinity.		4.27	13:47	4.66	13:40	4.89	14:03	2.74	14:05	4.39	14:07	4.55 4.01	11:09	5.14	11:14	5.96	11:25	7.16	11:27
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	1999	16		6	2. 2.						3.92	14:34	4.02	14:29	4.73	14:55	2.29	9:31	3.90	9:34	3.17	9:38	3.57	9:43		10.00	0 00	13:52
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	1999	1		7	2.			2 22			4.18	13:45	4.01	13:37	5.00	14:07	2.87	12:07 14:09	3.91	12:09	3.09	12:15	3.76	12:18	4.83	12:25	6 50	12.30
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	1999	14	1	7	4.				_	14:15	5.04	14:12	4.38	14:10	6.20	14:36	4.04	14:40	5.60	9:59	2.94	10:02	2.86	10:04	4.41	10:23	5 64	10 25
	1999	20		7	4.2		etite.			13:24	5.46	13:18	5.40	13:10	6.48	14:00	4.32	14:09	5.90	14:44 14:13	4.70 5.22	14:48	3.98	14:53	5.99	14:34	6 94	14 30
	1999	30		7	5.2					11:19 16:29	5.12	11:16	5.32	11:10	6.04	11:58	3.88	12:01	5.46	12:03	4.96	14:17 12:06	5.36	14:22	6.38	13:48	7.48	13 40
	1999	11		8	2.8	1 13:5			5225	13:41	6.03	16:26	5.91	16:20	6.90	16:45	4.85	16:47	6.43	16:48	5.72	16:52	5.04	12:10	6.44	11:48	7 64	11 40
	1999 1999	18		8	2.7	8 9:0			100000	8:55	3.61 3.45	13:31	4.13	13:17	4.50	13:58	2.41	14:01	3.95	14:06	3.22	14:10	5.45 4.19	16:55 14:15	7.12	16.41	8 18	16 38
	1999	24 31		8	4.0	9 8:4	7 3.6			8:40	4.77	8:50 8:37	3.65	8:45	4.49	9:10	2.33	9:12	3.87	9:16	3.02	9:19	3.71	9:22	5.81	14:25	6.85	14 29
	1999	91		8	4.6			17 9:1		9:07	5.41	8:59	4.34 5.14	8:30	5.90	9:44	3.72	9:45	5.29	9:46	4.51	9:48	4.17	9:51	5.88	9.37	6.83	0.20
	1999	16		9	5.1	- N. P. S.			1 5.27	9:28	5.76	9:21	5.14	8:56 9:15	6.40	9:21	4.24	9:25	5.81	9:27	5.09	9:29	4.98	9:32	6.42	9:46	7 50	9 38 9 52
	1999	21		9	5.0				8 5.25	11:03	5.61	10:58	4.86	10:55	6.78	9:41	4.64	9:43	6.18	9:45	5.34	9:48	4.77	9:53	6.82	10:06	7 74	10 09
	1999	30		9	4.9	-	_		SID (2.100-22)	12:42	5.48	12:40	4.72	12:32	6.79 6.66	11:13	4.57	11:14	6.19	11:16	5.04	12:20	4.24	14:40	6.62	14:29	7 56	14 31
	1999	7		10	4.9		_	_		13:04	5.48	13:00	4.84	12:50	6.64	13:07	4.46	13:08	6.00	13:10	4.90	13:12	4.05	13:15	6.54	12:55	7 34	12:58
	1999	11		10	4.9	3 13:5				13:46	5.45	13:44	4.74	13:42	6.66	13:47 13:53	4.44 4.46	13:50	6.08	13:53	4.96	13:56	4.22	14:00	6.46	13:22	7 36	13:28
	1999	13		10	4.8	6 14-0	4.4 5						20/20%		0.00	10.00	4.46	13:55	6.00	13:57	4.92	13:59	4.08	14:01	6.46	14:10	7.29	14:12
	1999	20		10	4.8		5.07			14:21	5.51	14:17	5.09	14:14	6.64	14:31	4.47	14:32	6.00	14.04	6.22							
	1999	29		10	4.8	20				15:50	5.54	15:44	5.02	15:40	6.64	16:08	4.46	16:10	6.00	14:34	5.11	14:38	4.71	14:40	6.48	14:55	7.38	14:57
	1000							7 10:5	5.02	10:57	5.50	9:55	4.94	9:35	6.61	11:13	4.41	11:14	5.95	16:12	5.09	16:15	4.56	16:17	6.56	16:04	7.46	16:00
	1999	4		11	4.8	1 13:5	0 4.3	4 13:4	n are Centra									SSEET	0.00	11:15	5.01	11:17	4.45	10:08	6.54	10:14	7.47	10:16
	1999	10		11	4.7					13:47	5.50	13:44	5.07	13:39	6.56	13:57	4.37	13:59	5.91	14:00	5.04	14:04	4.67	14:07	6.42	14:24	7.27	14.00
	1999	17		11	4.6		7.5			13:40	5.43	13:37	5.03	13:33	6.47	13:55	4.31	13:58	5.85	14:00	4.98	14:04	4.67	14:07	6.43 6.42	14:24 14:30	7.37	14:26
	1999 1999	29		11	4.4					14:41	5.34	14:38	4.90	14:33	6.37	14:51	4.22	14:53	5.75	14:55	4.90	14:59	4.50 4.54	14:07 15:05	6.36	15:19	7.37 7.31	14:33
	1999	8		12	4.4					14:42 16:30	5.22	14:41	4.85	14:38	6.08	14:58	4.04	15:01	5.58	15:03	4.78	15:05	4.50	15:07	6.35	14:51	7.38	15:21 14:54
	1999	22 28		12	4.4	14:2				14:24	5.24 5.24	16:29	5.00	16:27	6.16	16:17	3.98	16:19	5.56	16:18	4.82	16:11	4.56	16:08	6.32	16:21	7.32	16:23
		20		12	4.1				500 (0.000)	15:29	5.24 5.06	14:22	5.01	14:20	6.14	14:30	4.00	14:31	5.54	14:32	4.83	14:35	4.61	14:38	6.32	14:45	7.31	14:47
	2000	11		1	.gr. 000						5.00	15:27	4.69	15:24	5.95	15:40	3.80	15:42	5.33	15:45	4.57	15:50	4.26	15:55	6.19	16:11	7.22	16:13
	2000	25		1	4.0				4.37	16:12	4.98	16:10	165	16.00	F 00								,,0					
	2000	7		2	4.3	•				15:46	5.05	15:44	4.65 4.69	16:06 15:41	5.80	16:27	3.74	16:28	5.30	16:30	4.55	16:34	4.27	16:38	6.13	16:21	7.15	16:23
					4.0	13:52	2 3.5	7 13:5		13:47	4.91	13:45	4.51	13:41	6.04 5.82	16:03	3.84	16:05	5.39	16:07	4.59	16:09	4.28	16:11	6.22	15:54	7.24	15:59
											Ma.		7.01	10.37	5.82	13:56	3.64	13:58	5.20	13:59	4.44	14:02	4.06	14:04	6.05	14:18	7.07	14:24

1	YEAR	DAY	MONTH																				2-					
	2000	1		,	OW #98-1	hh:mm	OW #98-2	hh:mm	OW #98-3	L.							1											
	2000	2		<u>-</u>	4.14	14:11	3.63	14:09	4.30		OW #98-4	hh:mm	OW #98-5	hh:mm	OW #98-6	L.E.	200											
	2000			-	3.55	13:51	3.13	13:49	3.79	14:08	4.97	14:06	4.67	14:02	5.89		OW #98-7	hh:mm	OW #98-8	hhumm								
	2000	14		5	2.98	13:55	2.35	13:53	3.17	13:39	4.49	13:37	4.37	13:25	5.39	14:14	3.71	14.10	5.29		OW #98-9 I		OW #98-10		OW #95-8 I	h-mm	0147.4100 4 -	
	2000	22		0	3.28	11:07	2.62	11:04	3.44	13:51	4.45	13:47	4.49	13:43	4.90	13:57	3.24	14:01	4.77	14:17	4.56	14:19	20	14:23	6.12	14:30	OW #88-1 I	
	2000	29	_	·,	2.94	13:58	2.30	13:56	3.17	11:02	4.70	10:59	4.67	10:55	5.11	14:02	2.67	14:03	4.31	14:03	4.22	14:04	4.33	14:09	5.70		7.16	14:32
					3.05	13:36	2.30	12.24		13:54	4.78	13:50	4.65	13:46	4.89	11:15	2.87	11:17	4.50	14:05	4.07	14:08	4.54	14:12	0.70	14:45	6.77	14:48
	2000	5	5 4			Starting 4/1/	00 all times	shown are	Central Da	13:32	5.01	13:29	4.71	13:23	5.15	14:16	2.68	14:18	4.32	11:19	4.22	11:21	4.46	11.20	5.95	11:37	7.00	
	2000	12					2.34	13:50	3.35	yiigiil Savir					3.13	13:42	2.87	13:44	4.56	14:21 13:47	4.17	14:25	4.48	14:29	5.83	14:47	7.09	11:40
	2000	18			3.23	13:37	2.34	13:34	3.33	13:48	5.23	13:45	4.92	13:40	5.43	10.57		-		13.47	4.37	13:50	4.36	13:54	6.00	14:15	6.98	14:49
	2000	25			2.98	10:53	2.25	10:51	3.21	13:32 10:49	5.31	13:28	5.05	13:21	5.40	13:57	3.09	13:59	4.82	14:01	4.04	44.05				14.13	7.06	14:17
	2000	4	5		4.21	9:48	3.73	9:50	4.43		5.03	10:46	4.87	10:41	5.00	13:50	3.09	13:52	4.74	13:54	4.61	14:05	4.55	14:10	6.23	14:40	7.20	
	2000	10	5		4.69	13:53	4.25	13:51	4.91	9:54 13:49	5.14	9:57	4.95	10:00	5.89	10:58	2.74	11:00	4.41	11:02	4.59	13:57	4.62	14:01	6.52	14:31	7.30 7.35	14:42
	2000	16	5		4.26	13:35	3.84	13:34	4.52	13:49	5.45	13:45	5.25	13:38	6.39	9:40	3.63	9:39	5.30	9:37	4.28 4.70	11:05	4.57	11:08	6.09	11:18	7.24	14:33
	2000	23	5		3.83	13:38	2.69	13:37	3.78	13:35	5.16	13:28	5.06	13:25	6.01	14:01 13:41	4.25	14:03	5.81	14:05	5.07	9:35	4.67	9:32	6.31	9:43	7.40	11:20
	2000	1	6		3.58	13:35	2.47	13:32	3.58	13:30	5.78	13:30	5.37	13:25	6.52	13:47	3.86	13:43	5.44	13:45	4.79	14:08	4.85	14:11	6.49	14:33	7.54	9:45
	2000	7	6		3.54 3.57	16:24	2.48	16:26	3.60	16:30	5.84	13:25	5.34	13:19	5.93	13:43	4.17	13:49	5.91	13:51	5.35	13:49 13:55	4.76	13:53	6.25	14:10	7.36	14:35 14:12
	2000	15	6		3.60	9:54	2.48	9:52	3.64	9:50	5.86	16:33	5.50	16:03	5.96	16:15	3.51	13:45	5.26	13:47	5.16	13:50	4.97	13:58	6.71	14:27	7.72	14:30
	2000	16	6		4.56	13:14	2.80	13:12	3.84	13:08	6.01	9:45	5.61	9:40	6.09	10:01	3.58	16:12	5.28	16:11	5.18	16:09	4.82	13:54	6.88	14:17	7.92	14:19
	2000	23	6		5.45	13:50	4.04	13:47	4.76	13:45	6.28	13:06	5.88	12:55	6.52	13:27	3.73	10:03	5.46	10:05	5.39	10:09	4.94	16:07	7.02	16:20	8.04	16:22
	2000	. 28	6		5.71	13:25	4.97	13:22	5.63	13:18	6.16	13:37	5.88	13:32	6.59	13:55	4.12	13:29	5.86	13:33	5.70	13:36	5.11 5.40	10:14	7.12	10:34	8.11	10:22
`	2000	6	7		5.46	13:47	5.22	13:46	5.87	13:44	6.30 6.42	13:14	5.52	13:09	7.21	13:35	4.33	13:57	6.00	13:59	5.69	14:02	5.33	13:40	7.38	13:20	8.40	13:23
	2000	12	7		5.82	9:01 8:48	4.96	8:59	5.63	8:57	6.25	13:37	5.81	13:31	7.44	13:50	5.02 5.20	13:37	6.58	13:42	5.82	13:47	4.85	14:07	7.37	14:26	8.39	14:28
	2000	20	7		5.73	10:53	5.35	8:45	5.99	8:43	6.46	8:53	5.44	8:46	7.24	9:11	5.06	13:55	6.79	13:57	5.94	14:00	5.25	13:50	7.45	13:56	8.27	13:58
	2000	25	7		5.81	9:18	5.26	10:52	5.92	10:50	6.47	8:40	5.71	8:31	7.62	8:54	5.44	9:12	6.56	9:15	5.68	9:18	4.58	14:04	7.52	14:19	8.52	14:22
	2000	4	8		5.93	16:17	5.35	9:15	6.00	9:11	6.53	10:45 9:03	5.88	10:39	7.49	10:59	5.31	8:56	6.95	8:58	5.97	9:01	5.32	9:21	7.36	9:54	8.24	9:56
	2000	9	8		5.99	9:14	5.45	16:16	6.12	16:14	6.55	16:12	5.91	8:55	7.59	9:30	5.41	11:01 9:32	6.86	11:03	5.95	11:07	5.46	9:05 11:12	7.45	9:18	8.34	9:21
	2000	17	8		6.14	15:14	5.52 5.66	9:09	6.16	9:07	6.66	9:02	5.73	16:08	7.75	17:07	5.41	17:08	6.93	9:35	6.03	9:40	5.41	9:45	7.55	11:26	8.54	11:28
	2000	23	8		6.03	8:49	5.58	15:13	6.25	15:12	6.56	15:10	6.05	8:55	7.77	9:21	5.58	9:23	7.07	17:10	6.07	17:12	5.53	17:14	7.59 7.59	10:06	8.56	10:10
	2000	30	8		6.11	9:22	5.67	8:47	6.24	8:44	6.74	8:40	6.23 6.06	15:00	7.97	15:21	5.75	15:22	7.15 7.21	9:25	6.27	9:29 "	dry" >5.50	9:33	7.59	17:03	8.49	17:00
	2000	8 15	9		6.15	10:54	5.69	9:20	6.33	9:12	6.82	9:08	6.13	8:33	7.90	8:55	5.68	8:57	7.19	15:24	6.41	15:26 "	dry" >5.50	15:28	7.81	9:54	8.65	9:56
	2000	22	9		6.22	13:29	5.71	10:52	6.34	10:50	6.81	10:45	6.13	9:00	7.93	9:31	5.73	9:36	7.19	9:00	6.25	9:03	5.71	9:07	7.78	15:16	8.81	15:18
	2000	29	9		6.16	10:26	5.66	13:28 10:24	6.39	13:26	6.82	13:22	6.13	10:41	7.94	10:59	5.75	11:02	7.27	9:40	6.33	9:46	5.55	9:55	7.88	9:27 10:06	8.71	9:29
	2000	3	9		5.96	13:47	5.47	13:46	6.31	10:21	6.75	10:15	6.07	13:10	7.92	13:36	5.75	13:37	7.32	11:03	6.33	11:07	5.60	11:11	7.92	11:25	8.77	10:08
	2000	23	10		5.93	10:11	5.43	9:52	6.11	13:31	6.59	13:28	6.04	10:09	7.92	10:32	5.74	10:33	7.28	13:39 10:35	6.30	13:43	5.58	13:49	7.93	14:05	8.85	11:28
		20	10		5.66	13:33	5.17	13:31	6.09	9:51	6.55	9:40	5.91	13:22 9:25	7.74	13:53	5.56	13:54	7.09	13:56	6.27	10:38	5.56	10:42	7.88	11:10	8.85 8.79	14:08
							-: · ·	10.01	5.80	13:30	6.32	13:25	5.74	13:21	7.72	10:26	5.53	10:24	7.05	10:24	6.13	13:59	5.61	14:04	7.71	14:14	8.61	11:12
														10.21	7.45	13:37	5.26	13:39	6.81	13:40	6.09	10:22	5.50	/10:20	7.65	10:28	8.58	14:17
																				13.40	5.85	13:43	5.32	13:46		3.20	0.00	10:30

## Table 2. Grand Island Wellfield Precipitation Data

DATE	PRECIPITATION (inches)	TIME	DATE	PRECIPITATION (inches)	TIME	DATE	PRECIPITATION (inches)	TIME
1998			1999	W 18		2000		
3/25/98	0	10:45am	1/4/99	Trace	10:44am	1/11/00	0	4:05pm
3/26/98	0	2:40pm	1/8/99	0	1:45pm	1/26/00	0	3:40pm
3/28/98	1.3	9:30am	1/15/99	0	1:12pm	1/27/00	Trace	8:30am
3/30/98	0	2:30pm	1/21/99	_ 0	2:25pm	1/28/00	Trace	10:00am
4/1/98 4/8/98	0.25	9:00am 11:00am	1/25/99	Trace	10:00am	2/7/00	0	1:35pm
4/9/98	0.1	10:48am	2/3/99 2/8/99	0	2:14pm 2:04pm	2/12/00 2/15/00	trace 0	2:00pm 2:03pm
4/15/98	0.2	1:20pm	2/12/99	Trace	8:50am	2/18/00	~1	2:00pm
4/20/98	0.05	10:35am	2/17/99	0	4:00pm	2/23/00	0.5	2:55pm
4/24/98	0	9:50am	2/19/99	0	2:30pm	2/28/00	0	1:24pm
4/27/98	0.05	3:50pm	2/24/99	0.1	3:00pm	2/29/00	0.1	12:59pm
4/29/98	0.4	12:50pm	3/1/99	0	8:55am	3/1/00	0.2	1:40pm
5/4/98 5/5/98	0 0.3	9:48am 8:00am	3/4/99 3/8/99	0	9:05am	3/6/00	0	3:45pm
5/8/98	0.2	8:30pm	3/10/99	0.2 0.1	1:35pm 1:25pm	3/7/00 3/8/00	0 0.6	7:30am 6:03pm
5/11/98	0	9:05am	3/11/99	0.1	1:00pm	3/14/00	0.0	10:51am
5/12/98	0.2	8:35am	3/15/99	0	8:40am	3/16/00	0	6:30am
5/14/98	0	9:00am	3/17/99	0	3:00pm	3/19/00	0.7	6:00pm
5/15/98	0.75	4:48pm	3/19/99	0	4:10pm	3/21/00	0	10:55am
5/18/98	0	12:41am	3/22/99	0.4	10:06am	3/22/00	0.1	1:45pm
5/19/98 5/20/98	0 1.1	10:47am 10:40am	3/24/99 3/26/99	0	1:15pm	3/24/00	0.5	7:30am
5/22/98	2.6	8:44am	3/28/99	0.1	1:23pm 7:05pm	3/24/00 3/29/00	0	11:05am 7:00am
5/26/98	0	8:50am	3/29/99	0.1	1:00pm	4/5/00	0	1:35pm
5/29/98	0.3	4:00pm	4/5/99	1.1	9:10am	4/12/00	0	1:16pm
6/1/98	0	11:50am	4/6/99	0.9	2:15pm	4/17/00	0.7	10:50am
6/2/98	0	8:50am	4/7/99	0	9:30am	4/18/00	0	10:40am
6/3/98	0.4 0.1	11:30am	4/8/99	0	8:20am	4/19/00	0.4	4:00pm
6/4/98 6/8/98	0.1	9:50am 9:30am	4/9/99 4/12/99	0.1 0	1:45pm	4/25/00	0.2	10:00am
6/10/98	0.2	12:05pm	4/13/99	0	2:37pm 12:15pm	4/27/00 5/1/00	0.2 0.3	10:20am 11:25am
6/11/98	0.25	2:00pm	4/15/99	2.5	12:40pm	5/4/00	0.5	1:37pm
6/12/98	0	1:45pm	4/19/99	0	3:20pm	5/8/00	0.9	10:50am
6/15/98	1.75	9:36am	4/23/99	0.1	1:40pm	5/10/00	0	1:20pm
6/17/98	0	8:55am	4/26/99	0.4	2:34pm	5/15/00	0	1:25pm
6/18/98 6/22/98	0.4 0.1	9:55am 4:12pm	4/28/99	0.1	1:20pm	5/16/00	0	1:21pm
6/23/98	0.1	12:50pm	4/29/99 5/3/99	0 0.5	10:35am 1:37pm	5/23/00 5/26/00	0 0.9	1:18pm
6/24/98	0.2	10:00am	5/4/99	0.5	4:35pm	5/30/00	0.9	11:08am 10:55am
6/29/98	0	10:25am	5/6/99	0.8	9:25am	6/1/00	0	4:04pm
7/2/98	0	8:38am	5/7/99	0.2	11:00am	6/7/00	0	9:30am
7/6/98	0.45	8:30am	5/11/99	0.1	3:10pm	6/15/00	0	12:50pm
7/7/98	0.1	8:01am	5/12/99	0	2:25pm	6/16/00	0.1	1:20pm
7/8/98 7/9/98	0 0.1	9:17am 1:35pm	5/13/99 5/14/99	0 0.3	3:00pm 10:45am	6/20/00 6/23/00	0.3	9:25am
7/10/98	0.7	2:05pm	5/15/99	0.9	8:40am	6/28/00		1:08am 1:29pm
7/13/98	0	10:20am	5/17/99	0.5	9:00am	6/30/00		9:20am
7/16/98	0	8:37am	5/19/99	0	9:25am	7/5/00		9:00am
7/17/98	0	2:04pm	5/20/99		10:55am	7/6/00	0	8:45am
7/20/98	0	2:54pm	5/21/99		3:05pm	7/12/00		8:29am
7/22/98	1.25	3:32pm	5/23/99		11:45am	7/17/00		10:57am
7/24/98 7/28/98	0.05 0.2	8:40am 7:21am	5/24/99		9:51am	7/19/00		12:37pm
7/30/98	0.65	8:45am	5/25/99 5/28/99		2:31pm 10:12am	7/20/00 7/24/00		10:34am 8:55am
8/3/98	0.6	9:55am	6/1/99		2:25pm	7/25/00		8:50am
8/6/98	0	8:55am	6/2/99		8:58am	7/28/00		8:55am
8/7/98	0.1	9:05am	6/3/99		1:37pm	8/4/00		4:15pm
8/10/98	0.1	5:07pm	6/7/99		10:05am	8/9/00		8:52am
8/12/98	0.55	5:08pm	6/11/99		2:23pm	8/11/00		10:50am
8/14/98	0	11:20am	6/14/99		3:45pm	8/17/00		3:00pm
8/15/98	0.1 0	6:15pm 8:50am	6/16/99 6/23/99		11:45am	8/20/00		1:30pm
8/18/98 8/21/98	0.9	11:45am	6/25/99		10:55am 1:37am	8/23/00 8/26/00		8:32am
8/25/98	0.9	9:12am	6/28/99		9:40am	8/30/00	*	11:30am 9:00am
8/26/98	0.1	2:55pm	7/1/99		9:25am	9/5/00		8:30am
9/1/98	0	9:02am	7/6/99		2:30pm	9/7/00		3:20pm
9/4/98	0	1:15pm	7/8/99		2:10pm	9/8/00		10:40am
9/9/98	0	8:58am	7/14/99	0	1:10pm	9/15/00	0	1:15pm

DATE	PRECIPITATION (inches)	TIME	DATE	PRECIPITATION (inches)	TIME	DATE	PRECIPITATION (inches)	TIME
<u>1998</u>			1999	(···········)		2000	(mones)	
9/11/98	0	9:40am	7/16/99	1.0	12:50pm	9/22/00	0.5	10.00
9/15/98	0	8:37am	7/19/99	1.1	7:15am	9/25/00	0.5	10:09am
9/17/98	0	3:15pm	7/20/99	0	11:00am	9/29/00	0.6	6:00am
9/21/98	0.1	11:10am	7/24/99	0.3	5:30pm	9/29/00	0	1:20pm
9/22/98	0	10:55am	7/30/99	0.0	4:15pm			
9/30/98	0	9:14am	8/2/99	0.4	2:45pm			
10/2/98	1.0	3:55pm	8/6/99	2.2	2:45pm			
10/5/98	0.3	8:35am	8/11/99	1.7	1:15pm			
10/6/98	0	8:50am	8/16/99	0.6	9:20am			
10/12/98	- 0	9:15am	8/18/99	1.4	8:40am			
10/15/98	0	11:00am	8/24/99	0	8:25am			
10/19/98	0.15	11:00am	8/26/99	0.1	8:50am			
10/20/98	0	10:27am	8/30/99	0.2	9:30am			
10/27/98	0.05	11:10am	8/31/99	0.2	8:55am			
10/29/98	0.2	11:03am	9/8/99	0	12:56pm			
11/2/98	1.2	4:10pm	9/9/99	0	9:14am			
11/4/98	0.7	4:10pm	9/13/99	0.3	8:45am			
11/5/98	0	10:55am	9/16/99	0.9	10:55am			
11/10/98	0.9	4:20pm	9/20/99	0.2	2:30pm			
11/12/98	0	11:30am	9/21/99	0	12:30pm			
11/20/98	0	1:37pm	9/30/99	0	12:50pm			
11/25/98	0	1:20pm	10/1/99	0	8:50am			
12/3/98	0	2:12pm	10/7/99	0	1:40pm			
12/9/98	0	11:35am	10/13/99	0	2:10pm			
12/16/98	0	12:00noon	10/18/99	Ō	9:45am			
12/24/98	Trace	9:39am	10/20/99	0	4:00pm			
12/30/98	Trace	1:04pm	10/29/99	0	9:25am			
			11/4/99	0	1:37pm			
			11/10/99	0	1:30pm			
			11/17/99	0	2:32pm			
			11/22/99	0	3:45pm			
			11/23/99	0.2	1:10pm			
			11/29/99	0	2:35pm			
			12/8/99	0	4:00pm			
			12/15/99	trace	8:30am			
			12/22/99	trace	2:19pm			
			12/28/99	0	3:24pm			

Table 4. Demonstration Site Soil Characteristics

and the same of th	% Organic Matter Compaction (Penetromoter) 1998 1999 2000 st dev (1/2 inch cone lat 6'-12'-18')	gi)	11,42 8,45 12,85 1.75 305-335-375	12.0 2.0 12.1	94 18.82 5.88	8.8 8.95 0.92	12.7 9.77 3.38	12.5 17.98	9.24 3.83 2.75	9.73 14.85 3.62	7.14 19.14 6.00	8.57 24.91 8.57	4.13 19.79 8.13	11.86 13.23 5.18	5.2 6.09 0.46	12.72 24.38 6.60	12.03 10.51 2.02	8.85 17.15 6.00	9.55 9.93 18.50 5.05 305-345-355	14.00			19.30 280-355-385	8.55		Compaction (Penetrometer)	2000 st dev	13.15 2.02	12.38 0.41	0.00	6.48	6.91 1.85	13.0 17.87 3.44 280-305-325	11 11 6 46	7.67 0.00	0.08	20.60	8.10 240-315-325					2000 2000 et dev. (1/2 inch cone in at 8"-12"-18")	15.01 0.38	14.31 3.97	1.58	12.88	1.58	6.0 4.24	1.1	
	Ha		67	- 0	9 6	0.8	0.0	6'9	6.8	8'8	6.9	6.6	8.8	6.9	6.7	6.7	6.7	7.3	6.8	6.5	6.6	6.7	9.6	6.5		3"		6.6	6.7	6.7	6.9	6.8	6.7	8.0	0.0	9. S	0.0	6.6					딤	8.8	6.9	7.0	9.9	6.9	6.7	6.4	
	Soil Composition (Hydremater). % Sand % S1 % Clay Soil Type		101 431	50 14 8 202 Sandy Cray loam	2 2 2	776 001	240 316	11.3 27.5	18.1 15.8	16 4 22 6	25.6 26.3	20.4	19.2 42.4	9.2 17.6 Sa	20.1 12.9	30.3 41.9	32 32.2	18 14.7	24.2 22.2	48.3 32.1 16.0 Sandy clay loans	70.8 17.9 11.5 Sandy loam	19 16.6	12.1 13.7				Soil Composition (Hydrometer)	45 32 1 22 Loam	31.7 23.6	29.6 23.3	17.5 11.4	10 11.2 8	32.4 31.6	17.9 12.4	16.8 13.2	15.6	26.0 24.5 40.7 Com	9 19.1 Sa					omet	% Sand % Sift % Clay Soul Lype	15 21.8		18.3 13.5	12.6 11.3	10.8 12.4	23.2 Sa	
	Munsell Color. Soil Mollins		2 5Y 5/2	10YR 4/2	10115 371		1000 013 250 472			10YB 3/1	10YR 4/1	10YR 4/1	10YR 3/1	10YR 4/1 10YR 3/1		2.5Y 5/2	10YR 5/2			10YR 8/3 GLEY 2.5/N				10YR 5/2		:	Munsell Color	0 4/4	10YR 4/1 2.5YR 6/3		10YR 4/1	10YR 4/1	2.5Y 4/1 white streaks	10YR 3/1	10YR 4/1	10YR 4/1	10YK 4/1	10YR 4/1					sell Co	Soil Mottles	10YR 4/1	10YR 4/1	10YR 4/1	10YR 4/2	7.5YR 5/2 10YR 6/3	10YR 5/2	
GRAND ISLAND WELL FIELD	Percolation Rate (cm drop/10 minutes). Sample 1 Sample 2 Sample 3 Average st dev			18.5 17.5 18.5 0	16 16 16 0	6.0	3.4 6.5 5.8 1.	0.7 0.7 0.7	7.8 6.3	1.1	75 88 74 0	21 00 21	5. 4.2 5.3 C.	0.5 0.5 0.8 0.	31.5 35.3 3.	2.9 3.3 3.3 0.	5.5 5 6.3 1.	4.5 4 4.8 0.	6	0.5 0.5 0.5 0.	0 40	0.5 0.4	i o			COLLONWOOD RANCH	Percolation Rate (cm drop/10 minutes)	Sample 1 Sample 2 Sample 3										000		0.13 0.04 0.86		"	Percolation Rate (cm drop/10 minutes)	Sample 1 Sample 2 Sample 3							
<b>GRAND IS</b>	Transect/Quadrat		T101	T102	1103	1201	1202	1203	1204	Table	1206	1301	1302	1303	1305	TAO.1	1402	T403	T404	T4Q5	W Fence	S101	S102	E Fence	414C++CC	NO LOS		Transect/Quadrat	1101	1103	103	1105	1201	T2Q2	T2Q3	T2Q4	1205	NE Swale	Pipe/Swale	Slougn edge Upland	CIAIRACYCAL	MYCIMING		Transect/Quadrat	7101	1102	1301	1202	1203	Marine Swale	

## Table 5. Grand Island Wellfield Water Application Data

Date         Time of Day         Totalizer Reading (times 100 gallons)         Pump Start Time         Pump Stor           9-Jul-98         1:22pm CDT         40 1:22pm CDT         1:33pm CDT           9-Jul-98         1:33pm CDT         102         1:33pm CDT           16-Jul-98         10:00am CDT         102         10:00am CDT           16-Jul-98         2:21pm CDT         107         2:2:1pm CDT           17-Jul-98         2:05pm CDT         7434           20-Jul-98         2:55pm CDT         29931           22-Jul-98         3:35pm CDT         44982           24-Jul-98         8:40am CDT         57712           28-Jul-98         7:21am CDT         87102	(gallons/minute) (Kilowatt Hours) 550-600 4 550-600 6 550-600 6 550-600 6 550 6 500-600 245 550 974 550-600 1462 550 1874 550 2820 500-550 3315
Section   Sect	(gallons/minute) (Kilowatt Hours) 550-600 4 550-600 6 550-600 6 550-600 6 550 6 500-600 245 550 974 550-600 1462 550 1874 550 2820 500-550 3315
9-Jul-98 1:33pm CDT 102 1:33pm CDT 16-Jul-98 10:00am CDT 102 10:00am CDT 16-Jul-98 10:02am CDT 107 2:21pm CDT 17-Jul-98 2:05pm CDT 7434 20-Jul-98 2:55pm CDT 29931 22-Jul-98 3:35pm CDT 44982 24-Jul-98 8:40am CDT 57712	550-600 4 550-600 6 550-600 6 550-600 6 550 500-600 245 550 974 550-600 1462 550 1874 550 2820 500-550 3315
16-Jul-98 10:00am CDT 102 10:00am CDT 16-Jul-98 10:02am CDT 107 2:21pm CDT 107 0:02am CDT 16-Jul-98 2:21pm CDT 7434 20-Jul-98 2:55pm CDT 29931 22-Jul-98 3:35pm CDT 44982 24-Jul-98 8:40am CDT 57712	550-600 6 550-600 6 550 6 500-600 245 550 974 550-600 1462 550 1874 550 2820 500-550 3315
16-Jul-98 10:02am CDT 107 10:02am CD 16-Jul-98 2:21pm CDT 107 2:21pm CDT 17-Jul-98 2:05pm CDT 7434 20-Jul-98 2:55pm CDT 29931 22-Jul-98 3:35pm CDT 44982 24-Jul-98 8:40am CDT 57712	550-600     6       550     6       500-600     245       550     974       550-600     1462       550     1874       550     2820       500-550     3315       550
16-Jul-98 2:21pm CDT 107 2:21pm CDT 17-Jul-98 2:05pm CDT 7434 20-Jul-98 2:55pm CDT 29931 22-Jul-98 3:35pm CDT 44982 24-Jul-98 8:40am CDT 57712	550 6 500-600 245 550 974 550-600 1462 550 1874 550 2820 500-550 3315 550
17-Jul-98 2:05pm CDT 7434 20-Jul-98 2:55pm CDT 29931 22-Jul-98 3:35pm CDT 44982 24-Jul-98 8:40am CDT 57712	500-600 245 550 974 550-600 1462 550 1874 550 2820 500-550 3315 550
20-Jul-98     2:55pm CDT     29931       22-Jul-98     3:35pm CDT     44982       24-Jul-98     8:40am CDT     57712	550 974 550-600 1462 550 1874 550 2820 500-550 3315 550
22-Jul-98 3:35pm CDT 44982 24-Jul-98 8:40am CDT 57712	550-600 1462 550 1874 550 2820 500-550 3315
24-Jul-98 8:40am CDT 57712	550 1874 550 2820 500-550 3315 550
	550 2820 500-550 3315 550
20 dd 30 7.2 (am CD) 87 102	500-550 3315 550
30-Jul-98 8:45am CDT 102406	550
3-Aug-98 9:55am CDT 132600	
6-Aug-98 8:55am CDT 154260 8:55am CDT	FEO 1007
0.55alli GD1	550 4997
1-Mar-99 2:05pm CST 154262 2:05pm CST	WWW.
10 1202 2:00pm 001	550 4997
	530 5669
8-Mar-99 1:35pm CST 206095 10-Mar-99 1:25pm CST 220966	530 6670
11-Mar-99 2:40pm CST 228640	530 7149
15-Mar-99 8:40am CST 256695	475-525 7396 530 8298
est 17-Mar-99 271600 est. 8:00am	
17-Mar-99 3:05pm CST 271600 3:05pm CST	530 8777
19-Mar-99 10:40am CST 285111	500 9212
19-Mar-99 4:45pm CST 286980	500
22-Mar-99 10:06am CST 307252	525 9923
est 23-Mar-99 317901 est. 8:00pm	CST
24-Mar-99 1:15pm CST 317901 1:15pm CST	500-550 10264
26-Mar-99 1:23pm CST 332395	550 10726
28-Mar-99 7:05pm CST 349214	530 11261
29-Mar-99 1:02pm CST 354858	550 11440
6-Apr-99 2:25pm CDST 415969 2:25pm CDS	
3-May-99 2:24pm CDST 415969 2:24pm CDST	600 13362
4-May-99 4:35pm CDST 424427 4:35pm CDS	T 550 13623
19-May-99 9:25am CDST 424427 9:25am CDST	575 13624
20-May-99 10:55am CDST 432732	550 13878
21-May-99 3:05pm CDST 441954 24-May-99 9:51am CDST 463768	600 14160
	575 14826
	550 15112
28-May-99 10:12am CDST 495122 1-Jun-99 2:25pm CDST 527600	575 15789
2-Jun-99 8:59am CDST 533662	575 16789
3-Jun-99 1:37pm CDST 542953 1:37pm CDS	575 16975
7-Jun-99 10:05am CDST 542953 10:05am CDST	
est 7-Jun-99 544450 est 3:00pm	
11-Jun-99 2:23pm CDST 544450 2:23pm CDST	600 17261
14-Jun-99 3:45pm CDST 567995	575 18039
16-Jun-99 12:35pm CDST 582326	575 18486
23-Jun-99 10:55am CDST 634915 10:55am CD	
28-Feb-00 2:38pm CST 634917 2:38pm CST	550 20145
29-Feb-00 12:59pm CST 641790	500 20367
1-Mar-00 1:42pm CST 649397	525 20612
6-Mar-00 3:45pm CST 687091	550 21823
7-Mar-00 7:30am CST 691973	500
7-Mar-00 6:00pm CST 695162	525 22082
8-Mar-00 6:03pm CST 702728	525 22322
est.13-Mar-00 740297 est. 6:00pm	CST
14-Mar-00 10:51am CST 740297 10:51am CST	525 23517
14-Mar-00 11:51am CST 740606 16-Mar-00 6:30am CST 754060	550 23527
	500-575 23925
00.11	525 25186
22-Mar-00 1:45pm CST 802054 24-Mar-00 7:30am CST 815602	550 25453
24-Mar-00 11:05am CST 816683	550 25872
29-Mar-00 7:00am CST 854567	550 25905
29-Mar-00 6:15pm CST 858283	500-550 27058 550 27170
5-Apr-00 1:35pm CDST 912679	550 27170 600 28787
12-Apr-00 1:17pm CDST 969801	
13-Apr-00 7:30pm CDST 976008	575 30455 550 30636
17-Apr-00 10:50am CDST 10053	550 31626
18-Apr-00 10:40am CDST 18231	600 31863
18-Apr-00 3:45pm CDST 28195 3:45pm CDS	
15-May-00 1:25pm CDST 28195 1:25 pm CDST	600 32153
16-May-00 1:24pm CDST 36400	600 32392
23-May-00 1:18pm CDST 93713	600 34068
26-May-00 11:18am CDST 117333	575 34764
30-May-00 10:55am CDST 149562	600 35719
1-Jun-00 4:04pm CDST 167362	575 36249
7-Jun-00 9:31am CDST 213276	575 37622
15-Jun-00 12:50pm CDST 278272 12:50pm CD	

Table 7. Cottonwood Ranch Observation Well and Staff Gage Data

			Depth to	Wate	r (feet)																				
YEAR DAY	MO	HTM	OW #98-WS h	h:mm	OW #98-WM h	h:mm C	OW #98-WN h	h:mm OV	V #98-ES h	h:mm O	W #98-EM	hh:mm	1 OW #98	-EN hi	h:mm (	OW #98-NW h	h:mm	OW #98-NF h	h·mm R.	Staff h	h:mm W	-Staff hi	ı.mm E	C4-ff 1	
1009	22	Stick-up	2.11		2.06		2.21		2.41		2.2		2	2.57		2.21		2.14						Staff h	ıh:mm
1998 1998	22 5	5 6																		1.7	10:45				
1998	8	6																		0.66	11:00				
1998	9	6																		0.87	7:00				
1998	11	6												*:						8.0	11:00				
1998	5	7															1			0.95	14:15				
1998	3	8																		1.23	7:00 8:00				
1998	5	8																		1.1 0.55	9:45				
1998	25	8	5.94	10:00	4.94	9:55	5.57	10:05	5.95	10:15	5.4	10:2	20	5.5	10:26	6.5	10:30	4.55	10:35	0.55	3.43	0.15	10:38	0.0	10.50
1998	1	9	5.95	11:00	5	11:10	5.6	11:15	6	11:20	5.55			5.7	11:35	6.7	11:40	4.62	11:45			0.15	11:00	0.2 0.2	10:52 11:30
1998	8	9	5.90	12:50	4.85	12:55	5.52	12:57	6	13:04	5.53			5.67	13:20	6.65	13:22	4.65	13:24			0	13:30	0.2	13:50
1998	14	9	5.68	11:30	4.68	11:40	5.4	11:50	5.85	11:59	5.42			5.6	12:20	6.55	12:30	4.59	12:40			0.08	12:22	0.3	12:25
1998	24 29	9	5.33	11:00	4.25	11:05	4.96	11:10	5.59	11:15	5.1	11:2		5.25	11:30	6.19	10:50	4.3	10:40			0.19	11:40	0.3	11:45
1998 1998	15	9 10	5.3	12:00	4.22	12:10	4.92	12:20	5.55	12:30				5.23	12:40	6.16	12:50	9800 No. No.				1197			
1998	15	10	4.97	10:30	3.85 added 1.75 feet	10:40	4.55	10:50	5.25	11:00	4.7	11:1	10	4.90	11:20	5.8	11:45	3.95	11:50					0.65	11:35
1998	28	10	4.75	13:00	5.15	13:10	4.23	13:20	5.00	13:30	4.45	13:4	10	4.60	13:50	E 40	14.05	0.7	44.45	0.40	44.00	0.74			
` 1998	29	10	4.8	12:20	5.27	12:30	4.32	12:40	5.12	12:50	4.54			4.72	13:10	5.49 5.55	14:05 13:20	3.7 3.76	14:15 13:30	0.42 0.3	14:36 12:05	0.74	14:39	0.9	14:54
1998	30	10	4.8	12:30	5.27	12:40	4.33	12:50	5.12	13:00	4.55			4.72	13:20	5.57	13:45	3.75	13:55	0.3	13:15	0.70	13:25	0.0	40.05
1998	5	11	3.9	8:52	4.22	9:05	3.32	9:15	4.30	9:25	3.6			3.85	9:45	4.75	9:50	3	9:55	0.0	10.10	1.00	9:30	0.8 1	13:35 9:42
1998	13	11	3.95	10:30	4.25	10:40	2.18	10:50	4.40	10:55	3.55			3.75	11:15	4.48	11:20	2.80	11:30	0.68	10:30	1.15	9:41	0.9	9:34
1998	17	11	4.13	12:00	4.4	12:05	3.42	12:11	4.58	12:30	3.80	12:2	20	3.94	12:15	4.68	12:50	3	12:55	0.59	12:00	0.95	12:03		0.01
1998	24	11	4.21	13:00	4.5	13:10	3.56	13:45	4.70	13:15	4.00			4.09	13:25	4.85	14:00	3.13	14:05	0.58	13:01	0.95	13:05		
1998 1998	1 17	12 12	4.3	12:45	4.6		3.42		4.78		4.12			4.22		4.94		3.28		0.58					
1998	23	12	4.28 4.55	12:05 12:40	4.58 5		3.68 3.95		4.78		4.10			4.21		4.95		3.28		0.58		1.09		1	
1999	4	1	4.75	12:40	5.35		4.18		4.95 5.15		4.30 4.50			4.44 4.60		5.15 5.35		3.48		0.56		0.00			
1999	14	1	4.6	13:45	5.1		3.92		5.03		4.30			4.40		5.1		3.65 3.45		0.46		0.98			
1999	27	1	4.58	13:40	5.1						,,,,,,			4.37		5.09		3.41							
1999	10	2	4.55	10:00	5											5.13									
1999	17	2	-	12:50	5.18		4.05		5.05		4.42			4.48		5.25		3.54							
1999 1999	25 11	2	4.5	12:00			3.82		4.95		4.25			4.30		5.1		3.40							
1999	7	3 4	4.5 3.95	15:00 14:31	5 4.33		3.90		4.95		4.27			4.34		5.18		3.45							
1999	12	4	4.4	12:06			3.14 3.72		4.42 4.80		3.57 4.10			3.70		4.41		2.80				1.25			
1999	28	4	3.85	10:30			2.80		3.34		3.40			4.15 3.33		4.94 3.88		3.22 2.23		1.10		1.25	11	0.8	
1999	5	5	2.65	10:30			2.05		2.72		2.00			2.40		2.7		1.20		1.30		1.25		0.0	
1999	12	5	4.42	14:50			3.59		4.72		3.90			3.94		4.66		2.90		0.69		1			
1999	25	5	4.45	9:35	4.88		3.73		4.10		4.03			4.74		4.95		3.18							
1999	2	6	3.30	13:27	3.65		2.20		3.51		2.65			2.70		3		1.65							
1999 1999	10 14	6 6	4.56	6:00			3.75		4.78		4.55			4.10		5		3.17		20.0					
1999	24	6	3.82 4.32	9:25 9:00			2.65		4.07		3.20			3.18		3.65		2.10		0.40		0.04		1.25	
1999	1	7	2.82	12:10			3.52 1.95		4.50 2.75		3.70 2.08			3.85 2.30		4.75 2.5		2.91 1.10		0.21		0.61		1.20	
1999	6	7	4.35	9:30			3.43		4.63		3.83			3.80		4.45		2.70							
1999	14	7	4.88	12:10			4.30		5.12		4.53			4.65		5.43		3.61				Villa Villa			
1999	20	7	5.05	12:50			4.58		5.30		4.78			4.94		5.78		3.95							
1999	30	7	5.85	10:45			5.4		5.7		5.25			5.4		6.45		4.45							
1999	7	8	4.94	10:30			4.58		5.1		4.58			4.83		5.9		3.96							
1999	18	8	3.15	10:15			2.58		3.44		2.7			3.1		4.05		2.08							
1999 1999	25 31	ŏ o	5 5 30	10:45			4.25		5.28		4.6			4.62		5.4		3.6							
1999	31 13	o a	5.39 5.4	10:15 14:00			4.8		5.5		4.9			5		5.85		4							
1999	24	9	5.25	11:30			4.9		5.65		5.1			5.23		6.05		4.2							
1999	15	10	5.04	8.45			4.73 4.46		5.53 5.34		5 4.73			5.1 4.82		5.9 5.68		4.1 3.88							
1999	29	10	4.88	10:36			4.3		5.22		4.73			4.68		5.5		3.74							
1999	16	11	4.75	1400			4.15		0.22		7.0			4.55		5.35		3.58							
1999	23	12			5.25		4.15		5.11		4.45			4.5		5.28		3.55							
																						-			

YEAR DA	Y 1	MONTH	OW #98-WS hh:mm	OW #98-WM hb:mm	OW #98-WN hh:mm	OW #98-FS hh·mm	OW #98-FM hh:	mm OW #98-EN hh:mm	OW #09 NW bhimm	OW #98-NE hh:mm	P-Staff H	nh:mm	M Staff			
2000	19	1	4.65	5.14	3.98	5.02	4.32	4.4	5.18	3.46	N-Stall I	111.111111	W-Stail	hh:mm	E-Staff	hh:mm
2000	2	2	900		4	5	4.4	4.4	5.2	3.47						
2000	22	2	1200		3.55	4.72	3.97	4.05	4.85	2.15	0.29					
2000	28	2	1233	4.66	3.36	4.7	3.85	3.9	4.6	2.9	0.20					
2000	9	3	800	4.3	3.16	4.44	3.55		4.45	2.77						
2000	16	3	730	4.65	3.52	4.68	3.9	3.95	4.8	3.05			4			
2000	20	3	900	4.32	3.15	4.38	3.55	3.7	4.42	2.75						
2000	30	3	1100	4.75	3.6	4.7	3.98	4	4.8	3.08	0.57					
2000	6	4	1015	4.95		4.8	4.16	4.25	5.1	3.35						
2000	14	4	730	4.95	3.95	4.87	4.25	4.4	Y.							
2000	26	4	1500	4.75	3.82	4.7	4.04	4.21	5.18	3.35						
2000	2	- 5	1400	)	3.78	4.63	4	4.18	5.12	3.3	0.98					
2000	12	5	1300		4.22	4.8	4.25	4.55	5.46	3.65						
2000	25	5	1030		4.92	5.1	4.7	4.94	6	4.05						
2000	30	5	1300		4.38	4.95	4.45	4.7	5.7	3.8						
2000	9	6	833		4.85	5.35	4.9	5.16	6.15	4.3						
2000	16	6	940		5.1	5.45	5.1	5.4	6.48	4.58						
2000	27	6	1530		3.95	5.02	4.28	4.3	5.1	3.3						
2000	13	7	1000		4.3	5.25	4.6	4.68	5.5	3.71			13			
2000	24	7	1200		4.75	5.5	4.95	5.1	6	4.2						
2000	8	8	940		5.78	5.92	5.45	5.62	6.78	4.72						
2000	21	8	1000		5.7	5.95	5.55	5.75	6.9	4.9			j			
2000 2000	11	9	830		6.05	6.24	5.85	6.05	7.2	5.1						
2000	. 11	10	900	0.22	5.95	6.25	5.85	6.05	7.1	5.12						
2000	9	10	1000	Ј 6	5	5.4	4.95	5.2	6.3	4.35						

Table 8. Cottonwood Ranch Precipitation Data

DATE	PRECIPITATION (inches)	TIME	DATE	PRECIPITATION (inches)	TIME	DATE	PRECIPITATION (inches)	TIME
<u>1998</u>			1999			2000	Control of the state of the sta	
5/22/1998	4	10:45am	1/4/1999	trace		2/22/2000	0.5	12:00 noon
5/29/1998	0.1	9:00am	2/25/1999	0.1	12:00pm	2/28/2000	1.2	12:33pm
6/3/1998	0.4	7:00am	3/9/1999	0.2	1:00pm	3/3/2000	0.5	8:00am
6/5/1998	0	11:00am	3/22/1999	0	10:00am	3/8/2000	0.55	7:30am
6/8/1998	1.3	7:00am	3/29/1999	0.2	12:00pm	3/14/2000	0.3	6:30am
6/9/1998	- ) 0	11:00am	4/7/1999	1.4	2:31pm	3/20/2000	0.3	9:00am
6/10/1998	0.3	7:40am	4/12/1999	0	10:00am	3/30/2000	0.6	11:00am
6/11/1998	0.2	2:15pm	4/16/1999	1	12:00pm	4/18/2000	0.1	9:00am
6/14/1998	0	7:00am	4/21/1999	2.3	10:30am	4/26/2000	0.5	3:00pm
7/5/1998	1	8:00am	4/28/1999	0.8	10:30am	5/2/2000	0.6	2:00pm
7/7/1998	0.4	7:00am	5/3/1999	1	12:40pm	5/7/2000	0.3	8:00am
7/24/1998	0.4	8:00am	5/4/1999	1	10:00am	5/26/2000	1.4	10:00am
7/28/1998	1	9:48am	5/12/1999	0	2:45pm	6/20/2000	5.2	10:00am
7/30/1998	1.9	8:00am	5/25/1999	1.1	9:35am	6/23/2000	0.2	5:00pm
8/3/1998	8.0	11:00am	6/1/1999	3.2	10:55am	6/27/2000	0.1	3:30pm
8/5/1998	0	9:05am	6/2/1999	0	1:27pm	7/4/2000	1.9	11:00am
9/14/1998	1.0	11:00am	6/4/1999	0.25	8:20am	7/11/2000	0.5	2:40pm
9/29/1998	0	9:00am	6/10/1999	0.3	6:00am	7/31/2000	0.5	10:00am
11/5/1998	1.48	9:00am	6/14/1999	2.2	9:25am	8/18/2000	0.1	10:00am
11/10/1998	1.3	10:47am	6/19/1999	0.5	12:0pm	8/21/2000	0.2	10:00am
11/17/1998	0	11:58am	6/24/1999	0.1	9:00am	9/28/2000	1.0	9:00am
11/24/1998	0	1:00pm	6/28/1999	2.4	10:00am		1.0	o.ooaiii
12/17/1998	0	12:15pm	7/1/1999	1.6	12:10pm			
12/22/1998	trace		7/6/1999	0	9:30am			
			7/14/1999	0	12:10pm			
			7/20/1999	0.1	12:50pm			
			7/30/1999	0	10:45am			
			8/2/1999	1	10:00am			
			8/7/1999	0.8	10:30am			
			8/18/1999	1.8	10:15am			
			8/25/1999	0	12:00pm			
			8/31/1999	0	10:15am			
			9/3/1999	0.6	2:00pm			
			9/24/1999	0	11:30am			
			10/15/1999	0	8:45am			
			10/29/1999	0	10:30am			

Table 10. Cottonwood Ranch Water Application Data

Date	Time of Day	Flume	cfs	System Production
28-Oct-98	1:18pm	(feet)		(gallons/minute)
29-Oct-98	12:43pm	0.264	0.400	192.1
30-Oct-98	12:30pm	0.264	0.400	192.1
13-Nov-98	10:30am	0.468	0.400	461.2
17-Nov-98	12:01pm	0.432		
24-Nov-98	1:01pm	0.432	0.850	408.0
1-Dec-98	12:45pm	0.42	0.814	390.8 461.2
17-Dec-98	12:05pm	0.468	0.961 0.961	461.2
22-Dec-98	12:40pm	0.264	0.400	192.1
22 000 00	12.40piii	0.204	0.400	192.1
4-Jan-99		0	0	0
13-Jan-99		0	0	0
27-Jan-09		0	0	0
17-Feb-99		0	0	0
25-Feb-99		0	0	0
7-Apr-99		0.12	0.120	57.5
12-Apr-99		0.27	0.414	198.8
28-Apr-99		0	0	0
5-May-99		0.576	1.320	633.6
12-May-99		0.27	0.414	198.8
25-May-99		0.228	0.320	153.5
2-Jun-99 14-Jun-99		0.36	0.643	308.7
24-Jun-99		0.45	0.905	434.3
1-Jul-99		0.6	1.405	674.5
6-Jul-99		0.6 0.57	1.405 1.299	674.5
20-Jul-99		0.36	0.643	623.5 308.7
7-Aug-99		0.50	0.043	0
18-Aug-99		0	0	0
24-Aug-99		0	0	0
31-Aug-99		0	. 0	0
13-Sep-99		0	0	0
24-Sep-99		0	0	0
8-Mar-00	12:33pm	0.46		
9-Mar-00	8:00am	0.46		
16-Mar-00	7:30am	0.34		
20-Mar-00	9:00am	0.42		
30-Mar-00	11:00am	0.42		
6-Apr-00	10:15am	0.4		
14-Apr-00	7:30am	0.42		
26-Apr-00	3:00pm	0.46		
2-May-00	2:00pm	0.46		
12-May-00	1:00pm	0.54		
2000 average		0.45	0.905	434.3
				0.9cfs or 434 gals/min

Table 12. Wyoming Site Observation Well and Staff Gage Data Depth to Water (feet)

			OBSERVA	TION WE	ELLS							S <sup>-</sup>	TAFF GAGES				DI	VER STAGE
Date	Time		OW #2	OW #3	OW #4	OW #5	OW #6	OW #7	OW #8	OW #9	OW #10	OW #11	SG 1(Wet E)	SG 2(Wet W)	SG 3(SIE)	SG 4(SI M)	SG 5(SI W)	at Kearney (ft)
44 100 14 00	•	Stick up	3.20	3.30	4.12	4.96	3.12	3.68	4.05	3.28	3.38	3.96					(,	
11/23/1998 12/3/1998			6.28	5.05	4.43	5.43	4.32	5.62	5.95	5.31	5.42	0.01						
12/10/1998			6.1 6.19	5.05 4.98	4.4 4.41	5.11 5.44	4.34 4.34	5.64 5.6	6.0 6.0	5.36 5.39	5.46 5.52	6.01 6.015						3.76 3.76
12/18/199			6.15	4.99	4.35	5.39	4.3	5.53	5.96	5.47	5.36	6.0			1			3.78
12/29/199	8			4.22	3.78	4.92	3.88	5.08	5.59	5.21	5.31	5.43			į.			5.05
1/8/199					4.05	5.15	4.08	5.27	5.75	5.37	5.36	5.67						4.59
1/15/199			4.88	3.91	3.57	4.77	3.68	4.83	5.4	5.12	5.15	5.22	0	0	0.4	0.3	0.38	5.57
1/22/199 1/28/199			5.75	4.46	3.8	4.9	3.84	4.86	5.44	5.14	5.15	5.55	0	0 '				4.2
2/8/199			6.1 6.27	4.86 5.01	4.26 4.43	5.34 4.5	4.23 4.34	5.48 5.57	5.87 5.9	5.32	5.39 5.46	5.87 5.99	0	0	0.3	0.19	0.25	3.9
2/17/199			6.05	5.01	4.43	5.48	4.31	5.54	5.96	5.39 5.45	5.56	5.95	0	0	/ 0 0	0 0	0	3.84 3.82
2/24/199			6.12	5.88	4.29	5.39	4.21	5.47	5.83	5.42	5.45	5.9	0	0	0	0	0	3.71
2/26/199	9		6.09	4.83	4.02	4.22	4.08	5.48	5.92	5.56	5.5	5.68	0	2.18	2.16	1.18	0.35	3.78
3/1/199			6.18	4.98	4.34	5.3	4.29	5.57	5.92	5.51	5.48	5.94	0	1.5	0.46	0	. 0	3.76
3/3/199			6.39	5.27	4.66	5.6	5.76	6.07	7.75	6.0	5.81	6.47	0	2.16	2.06	1.08	0	3.82
3/9/199 3/15/199			6.32	5.09	4.49	5.54	4.4	5.64	6.01	5.59	5.64	6.03	0	1.08	0	. 0	0.6	
3/16/199			6.24 6.39	4.96 5.23	4.34 4.39	5.25 4.43	4.3 5.11	5.45 5.97	5.83 7.43	5.44	5.45	5.91 6.25	0	1.12	0	0	0.22	3.69
3/17/199			6.35	5.23	4.35	5.88	4.29	5.61	7.43 5.91	5.74 5.5	5.65 5.54	5.91	0	2.14 2.1	2.38 1.88	1.38 0	0.2	3.57 3.15
3/22/199			6.34	5.06	4.51	5.45	4.4	5.61	6.01	5.5	5.52	6.05	0	0.82	0.19	0	0	3.7
3/23/199	9 16:30		6.7	5.23	4.35	4.78	4.32	5.73	6.0	5.51	5.55	5.95	0	1.96	0	0.94	1.92	3.67
3/30/199			6.28	5.1	4.51	5.44	4.41	5.69	6.06	5.51	5.621	6.07	0	0.7	0	0.26	2.2	3.73
4/1/199			6.49	5.44	4.74	4.89	5.94	6.33	7.98	6.14	5.98	6.59	0	2.15	0.6	1.32	2.34	3.73
4/5/199			6.26	4.72	4.03	4.93	3.8	4.76	3.84	5.88	5.91	5.53	0.28	1.36	0	0.1	1.08	3.64
4/6/199 4/20/199			6.21 6.3	4.56	3.78	4.71	3.52	4.48	4.98	4.73	4.74	5.275	0.32	1.46	0	0.26	1.2	3.63
4/20/199			6.32	4.94 5.05	5.23 4.42	4.25 5.39	4.01 4.62	5.37 5.6	5.61 6.51	4.91 5.09	4.94 5.03	5.795 6.19	0.1 0	0.18 0.7	0 0.1	0.18	0.35	3.59 3.59
4/30/199			6.17	4.91	5.26	6.39	4.16	5.45	5.73	5.19	5.1	5.85	0	0.7	0.1	0.18	1.3 0.5	3.8
4/30/199			6.16	5.02	4.48	5.54	4.8	5.68	6.81	5.3	5.29	6.3	0	2.12	0.2	0.16	1	3.8
5/10/199			4.83	3.97	3.54	4.71	3.59	4.95	5.27	4.69	4.77	5.2	0.22	1.16	0	0.06	1.7	5.4
5/12/199			3.92	3.52	3.04	4.28	3.34	4.73	5.14	4.46	4.52	4.82	0.1	1	0	0	1.36	6.5
5/24/199			5.75	4.51	3.85	4.94	3.77	5.42	5.41	4.79	4.82	5.46	0.1	0.3	0	0	0.98	3.8
6/3/199 6/11/199			4.26	4.0	3.35	4.34	3.21	4.58	4.85	4.39	4.35	4.94	0.1	0.25	0	0	0.86	4.67
6/17/199			4.68 5.84	3.52 4.48	2.86 3.69	3.89 4.58	2.71 3.87	4.09 4.84	4.29 5.15	3.9 4.49	3.95 4.58	4.46 5.29	0.7 0.68	0.86 0.8	0	0.42	2.6 1.8	5.25 4.6
6/24/199			5.34	4.33	3.83	5.04	3.81	5.05	5.46	4.45	4.52	5.49	0.00	0.25	0	0.0	0.9	4.75
7/2/199			4.28	3.28	2.55	3.61	2.66	3.85	4.32	4.05	4.1	4.24	1.6	1.39	0.2	1.38	2.55	5.6
7/28/199			6.88	5.88	5.75	6.38	5.21	5.88	7.1	6.28	5.99	6.2	0.06	0.09	0	0	0.6	3.05
8/4/199			6.75	5.86	5.33	6.73	5.68	5.46	7.2	6.15	5.59	6.0	0	0	0	0	0	3.35
8/13/199			5.36	4.43	4.11	5.3	4.24	5.14	6.02	5.74	5.86	6.04	0.4	0.3	0	0	1.4	4.6
8/24/199 9/9/199			6.06	5.0 5.13	4.39	5.46	4.58	5.51	6.16	6.23	5.91	6.04	0.78	0.56	0	0	0.9	4.36
9/16/199			6.03 5.62	5.12 4.8	4.59 4.43	6.13 5.74	4.99 4.68	5.96 5.76	6.66 6.41	6.47 6.32	6.38 6.26	6.56 6.4	0 0	0	0	0	0	3.9 4.32
9/23/199			5.59	4.62	4.32	5.56	4.55	5.5	6.3	6.22	5.13	5.65	0	0	0	0	0	4.47
9/29/199			5.83	4.84	4.48	5.0	4.59	5.67	6.31	6.13	6.19	6.32	0	0	Ō	0	0	4.18
10/7/199	99 15:30		5.81	4.82	4.43	5.68	4.68	5.62	6.33	5.95	6.14	6.11	0	0	0	0	0	4.4
10/15/199			5.98	4.98	4.56	5.75	4.63	5.68	6.33	6.05	6.12	6.25	0	0	0	0	0	4.02
11/1/199			4.85	5.78	4.38	5.68	4.53	5.58	6.33	5.75	6.01	6.08	0	0	0	0	0	4.08
11/12/199 11/29/199			5.89	5.79 5.85	4.38	5.47	4.44	5.56	6.19	5.71	5.92	6.03	0	0	0	0	0	4
12/15/199			6.03 6.12	5.81	4.42 4.66	5.56 5.65	4.42 4.58	5.56 5.68	6.18 6.16	5.62 5.65	5.76 5.48	6.02 6.21	0	0	0	0	0	3.96 3.88
1/10/200			6.15	5.85	4.65	5.66	4.6	5.69	6.16	5.62	5.5	6.2	0	0	0	0	0	4.15
2/9/200			6.04	5.87	4.57	5.58	4.4	5.58	6.03	5.41	5.53	6.12	0	0	0	0	0	4.12
2/25/200			5.76	4.65	3.8	5.6	3.41	4.21	4.95	4.63	4.61	5.2	0.42	0.52	0.84	0.05	0	4.25
3/2/200			5.94	4.88	4.48	5.45	4.17	5.32	5.71	5.2	5.25	5.93	0.02	0	0	0	0.02	4.15
3/23/200			5.06	5.1	4.43	5.38	4.16	5.38	5.67	5.12	5.17	5.96	0	0	0	0	0.02	4.12
5/11/200			5.42	5.45	4.77	5.75	4.51	5.81	6.14	5.46	5.47	6.31	0	0	0	0	0	3.8
6/19/200 7/6/200			6.83	5.92	5.28	6.48	5.14	6.3	6.72	6.18	6.2	6.85	0	0	0	0.7	0	3.13
8/14/200			5.06 7.23	5.68 6.47	4.52 5.86	4.88 7.08	4.25 6.1	5.46 6.95	5.9 7.72	5.65	5.6	5.96 7.54	0.48 0	0.6 0	1.5	0.7	0	3.87
9/29/200			6.97	5.47	6.52	6.81	7.27	6.78	7.72	6.99	6.95	7.5 <del>4</del> 5.7	0	0	0	0	0	2.88 2.9
			S.12.		717.8	0.01		5.75	(.72	0.00	0.00	0.7	v	J				

## Table 14. Wyoming Site Water Application Data

Date	Time of Day	Hours Pumped	Gallons Pumped	Gates Open
			(based on 1014 gpm)	
17-Feb-99		1.1	66,935	All
25-Feb-99		24.7	1,502,999	All
2-Mar-99	10:15 AM	23.5	1,429,979	All
16-Mar-99		27.3	1,661,210	All
22-Mar-99	12:15 PM	14.8	900,582	All
29-Mar-99	- 12:30 PM	3.7	225,145	Wetland gate closed
30-Mar-99	1:00 PM	26.3	1,600,360	All
2-Apr-99		5.1	310,336	All
20-Apr-99	2:30 PM	2.1	127,785	Wetland gate closed
30-Apr-99	11:52 AM	3.8	231,230	Wetland/created slough gate partially closed, natural slough opened
10-May-99	9:30 AM	4.1	249,485	Natural slough-3/4 created slough-1/4
3-Jun-99	9:15 AM	5.6	340,761	Natural slough-3/4 created slough-1/4
Totals		142.1	8,646,807	

Table15. Sandhill crane use of wet meadow sites 1997-2000

	1997		1998		1999		2000	
	Number Visits	Average # Sandhill Cranes						
GIWF	11	40.1	29	8.7	43	37.7	30	56.7
WYO	O <sub>i</sub>	N/A	0	N/A	27	7.6	1	0
CWR	7	55.9	7	25.4	6	626.7	14	0

Table 16. Breeding birds on wet meadow sites.

Densities expressed as birds/100acres

			Cotto	onwood R	anch			
	1997		1998		1999		2000	
5	N	Density	N	Density	N	Density	N	Density
Northern Bobwhite		1	1	3.9				
Ring-necked Pheasant					1	3.9	1	3.9
Killdeer .	2	7.7	1	3.9				
Upland Sandpiper	1	3.9	1	3.9	1	3.9	2	7.7
Mourning Dove	5	19.3			9	34.8	8	30.9
Eastern Kingbird	2	7.7						
Sedge Wren	7	27.1	1	3.9	6	23.2	2	7.7
Yellow Warbler	1	3.9						
Common Yellowthroat	4	15.5	1	3.9	2	7.7	1	3.9
Dickcissel	1	3.9	23	88.9	11	42.5	26	100.5
Grasshopper Sparrow					4	15.5	1	3.9
Bobolink	2	7.7	5	19.3			1	3.9
Red-winged Blackbird	49	189.4	11	42.2	19	73.4	37	143
W. Meadowlark	2	7.7	4	15.5	1	3.9	3	11.6
Brown-headed Cowbird	9	34.8	6	23.2	7	27.1		
American Goldfinch	1	3.9			2	7.7	2	7.7
TOTAL	86	332	54	209	63	244	84	325
# of Species	13		10		11		.11	
# ac sampled	25.6		25.6		25.6		25.6	

			W	yoming S	ite			
	1997		1998		1999		2000	
	N	Density	N	Density	N	Density	N	Density
Mallard					1	5.2		
Ring-necked Pheasant	1	5.2		//				
Killdeer	3	15.6			3	15.6	2	10.4
Sedge Wren	1	5.2	2	10.4			3	15.6
Common Yellowthroat			4	20.8				
Dickcissel			9	46.8			3	15.6
Grasshopper Sparrow	6	31.2			12	62.4	4	20.8
Song Sparrow			1	5.2				
Bobolink	21	109.2	22	114.4	13	67.7	17	88.4
Red-winged Blackbird	1	5.2	1	5.2	7	36.4	26	135.2
W. Meadowlark	6	31.2	3	15.6	4	20.8	2	10.4
Brown-headed Cowbird	3	15.6	6	31.2			2	10.4
TOTAL	42	218	48	250	40	208	59	307
# of Species	8		8		6		8	
# ac sampled	19.2		19.2		19.2		19.2	

8			Grand	Island We	ellfield	Nitra de Santa y de		
	1997		1998		1999		2000	
	N	Density	N	Density	N	Density	N	Density
Upland Sandpiper	2	6.2	4	12.4				
Common Yellowthroat							1	3.1
Dickcissel	1	3.1	6	18.6			3	9.3
Grasshopper Sparrow	10	31	9	27.9	6	18.6	6	18.6
Bobolink	37	114.7	50	155	29	89.9	23	71.3
Red-winged Blackbird	13	40.3	3	9.3	7	21.7	5	15.5
E. Meadowlark	1	3.1			1	3.1		
W. Meadowlark	11	34.1	1	3.1	5	15.5	3	9.3
Brown-headed Cowbird	23	71.3	11	34.1	13	40.3	5	15.5
TOTAL /	98	304	85	264	61	189	46	143
# of Species	8		8		6		7	
# ac sampled	32		32		32		32	

Table 17. Fall migratory birds seen at the wet meadow sites 1997-2000

Species Green-winged Teal Northern Harrier Sharp-shinned Hawk Cooper's Hawk Red-tailed Hawk American Kestrel Ring-necked Pheasant Unkown Rail Killdeer Common Snipe Mourning Dove Belted Kingfisher Northern Flicker Horned Lark Black-billed Magpie American Crow House Wren Sedge Wren Eastern Bluebird American Robin American Robin American Pipit Spragues Pipit European Starling Vesper Sparrow Grasshopper Sparrow Grasshopper Sparrow Song Sparrow Song Sparrow Song Sparrow Red-winged Blackbird Western Meadowlark Brown-headed Cowbird American Goldfinch American Goldfinch	1999 2000	1997	1998	1999	2000	1997	1998	1999	0000
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Magpie  ow  bird  bird  oit  arling  row  carrow  r Sparrow  barrow  w  Blackbird  delowlark  ed Cowbird  ow  light  ligh					1			5	
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bird bin bit arling row barrow c Sparrow N Blackbird adowlark ed Cowbird blinch	2								
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48			3	2		9	1		
Brown-headed Cowbird American Goldfinch	10 51	63	37	2	30	က	2	36	
American Goldfinch			2						
	5	7							
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# Species 7 2	7 11	8	6	1	7	Ç	4	4	7

Table 18. Incidental observations of birds on the wet meadow sites

Adjust September October November				January		F	ebruary	1	N.	March			April	I		May	Ī	JI.	une		July		T -	August		_	Cost	ab a -	-	0-4			Jovemh	er T		_	
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Common   April   Comm			15		2	Υ			y			Y		Y			3			V GIVVE	1410	CVVR	GIVVE	VVYO	CWR	GIWF	WYO	CWR	GIWF	WYO	CWR	GIWF	VVTO	CAAK	IWF	WYO	CWR
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Part	Belted-Kingfisher	Ceryle alcyon																			X									x				C. Service		Toronto	BLANK SER
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Short-billed Dowitcher   Limnodromus griseus   X																Х		Х		X	X	T	T				-				X						1000
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Snow Goose   Chen caerulescens								Х													_		1						1		1			16.03	1988		
Sprague's Pipit         Anthus spragueii         Image: Control of the							1	<u> </u>		-+				$\overline{}$					_	$\dashv$	_	+	+	-	<b> </b>	1	1	1	1	+-		1	1	(574539)			
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Upland Sandpiper         Bartramia longicauda         X			+-	-	-	-															X		-	-		-	_		_		-	1-			1205 GEN.	C Days	1995
Vesper Sparrow         Poocetes gramineus         X <t< td=""><td></td><td></td><td></td><td>_</td><td>-</td><td>-</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>X</td><td></td><td>X</td><td></td><td></td><td></td><td></td><td>X</td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>BACKER!</td><td>CORNELS OF</td><td>2000</td><td></td></t<>				_	-	-									X		X					X	X											BACKER!	CORNELS OF	2000	
Western Kingbird         Tyrannus verticalis         X	Upland Sandpiper											X						X	X	X	X		X							.00	-			問題	No. of the		
Western Meadolark         Sturnella magna         X <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Х</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td><td></td><td>1000</td><td>及器間</td><td></td><td></td></t<>														Х																X				1000	及器間		
Western Meadolark         Sturnella magna         X <t< td=""><td></td><td>Transport reading lie</td><td></td><td></td><td>X</td><td></td><td></td><td></td><td>1</td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td><td>X</td><td></td><td>X</td><td></td><td></td><td>X</td><td></td><td>X</td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>NAME OF</td><td>35</td><td>100</td><td>1</td></t<>		Transport reading lie			X				1		X						X		X			X		X	X									NAME OF	35	100	1
White-crowned Sparrow Zonotrichia leucophrys X X X Wild Turkey Meleagris gallopavo X X X X X X X X X X X X X X X X X X X		Tyrannus verticalis																																		· CONTRACTOR OF THE PARTY OF TH	
Wild Turkey Meleagris gallopavo X	Western Kingbird		1	1	T				X			Х			X			X	X X				X						Х	X	X			X	HYS-	GREEK	1^
	Western Kingbird Western Meadolark	Sturnella magna	1	-				· X	Х		X	Х			X			Х	Х				Х						Х	Х	Х	1		X			<u></u>
	Westem Kingbird Westem Meadolark White-crowned Sparrow	Sturnella magna Zonotrichia leucophrys						X			Х	X			X			X	Х				Х						Х	Х	X			X			^

Table 19. Foliage Invertebrates

(per 600 swee		GIWF			GIW		WYO	WYO	CWR	CWR	CW
ARACHNIDA		1997	1998	1999	2000	1997	1999	2000		1999	200
Phalangida	Spiders and Ticks										
Salticidae	Daddy long legs	6					2		1	1	2
The state of the s	Jumping spider	1		2			2		1		2
Tetragnathidae	Long-jawed spider	1	7	3	1		27	2	7	11	1
Thomisidae	Crab spider	4	6	15	36		8	27	31	14	11
Ixodidae	Lone star tick	1			1		2		"	1.7	7.1
11105051	Unknown spider	4	11	3	2			5	7	2	2
INSECTA									<u> </u>		
COLEOPTERA	Beetles										
Cantharidae	Soldier beetle	1		10		1					
Carabidae	Ground beetle	1	1								
Cerambycidae	Long-horned beetle	2	1							-	
Chrysomeiidae	Leaf beetles	18	16	1	2	6	14		42	5	
Cincindelidae	Tiger Beetle			1	_	"	17		42	2	
Cleridae	Clerid Beetle			1		1					
Coccinellidae	Ladybird beetles	1		1		ł	2	24		_	
Curculionidae /	Weevils		1	4	1	l	2	31		9	
Dytiscidae	Predaceous Diving Beetle					ļ	2			3	1
Elateridae	Click beetle						2				
Fulgoridae	Lanternflies	14		2		-	_				
Histeridae	Hister beetle	17		2		7	5		4	21	
Lampyridae	Fireflies		2	4		1					
Meloidae	Blister beetle		2		4					1	
Ptinidae	Spider beetle	1		1	1	1				1	
Scarabaeidae	Scarab Beetle	1		1	-	I					
Staphylinidae	Rove beetle				1	1					
,	Unknown adults	1		_	1	00.00					
DIPTERA	OTINIOWIT AUDIOS	-		3		7			4	11	_ 1
Asilidae	Robberfly		_								
Pipunculidae		2	3	1	1			1	2		
	Big-headed fly			1	5			1			
Stratiomyidae	Soldier fly			1				- 1			
Syrphidae Fabanidae	Flower fly				1						
	Deer flies and Horse flies	2	1								
Tipilidae	Crane Fly				1			1			
Midges	Midge	l						1			
	Unknown fly adults	180	61	119	128	9	36	30	94	109	
	Unknown fly larvae	11		3	5		2	-	54	6	5
phemeroptera	Mayflies										
phemeridae	Mayfly			1				1		1	
IEMIPTERA	True Bugs										
nthodoridae	Flower bug					4		- 1			
Coreidae	Leag footed bug					5			1		
1iridae	Plant bugs				ı			- 1	5		•
labidae	Damsel bugs	8		3	3	1	5	1	1	11	3
entatomidae	Stinkbugs	ε	44	9		1	9		4		2
leduviidae	Assassin bugs	2		1			3		4	16	1
cutellidae	Shield bugs	4						- 1			
	Immature bugs			1			2		2		
	Unidentified bugs				1		2				
OMOPTERA	Bugs				-			-+			
phididae	Aphid			7	1						
ercopidae	Spittlebugs	5	5	2	- 1					4	1
icadellidae	Leafhopper	100	34								
YMENOPTERA	Ants, Wasps, Bees	100	34	74	50	38	83	14	153	68	18
raconidae	Paracsitic wasp	1									
ormicidae	Ants		10	4.7	. 1				4		
alictidae	Sweat bee	40	13	14	1	9	14		19	1	
ohecidae	Wasp			1	- 1		2	1			
Direcidae	- 22000			1				- 1			
PIDOPTERA	Unknown microwasp	1	4	10	4		12	1		7	4
	Butterflies/Moths										
ortiidae	Wooly Bear moth				1						
ambidae	Sodwebworms				1				6		
eometridae	Looper moth larvae	1	3						9		
hingidae	Sphinx moth larvae								1		
	Unknown lep. Larvae	9	9	1	2	19	3				ا ر
	Unknown moth			1	1		6	3		2	3
EUROPTERA					-		J	3		2	
rysopidae	Green lacewing			2							
								-		3	
DONATA			1				_				
DONATA penagrionidae	Damsel flv				1		2	- 1			2
enagrionidae	Damsel fly Grasshoppers, etc.										
enagrionidae RTHOPTERA	Grasshoppers, etc.	224				Control					
enagrionidae RTHOPTERA rididae	Grasshoppers, etc. Grasshoppers	334	59	18	4		14		21	70	12
enagrionidae RTHOPTERA rididae ttigoniidae	Grasshoppers, etc. Grasshoppers Katydid	334	59		4		14 14			70 15	
enagrionidae RTHOPTERA rididae ttigoniidae ECOPTERA	Grasshoppers, etc. Grasshoppers Katydid Stoneflies	334	59	96	- 1						12
enagrionidae RTHOPTERA rididae ttigoniidae ECOPTERA known stoneflies	Grasshoppers, etc. Grasshoppers Katydid Stoneflies Stone fly	334	59		- 1						12
enagrionidae RTHOPTERA rididae ttigoniidae ECOPTERA	Grasshoppers, etc. Grasshoppers Katydid Stoneflies Stone fly Thrips	334	59	96	- 1						12
enagrionidae RTHOPTERA rididae ttigoniidae ECOPTERA known stoneflies	Grasshoppers, etc. Grasshoppers Katydid Stoneflies Stone fly	334	59	96	- 1						12

## Table 20. Pit-trapping Captures Average trapping period - 6 traps for 12 days

	CWR 1997	CWR 1999	CWR 2000	GIWF 1997	GIWF 1999	GIWF 2000	WYO 1997	WYO 1999	WYO 2000
COLEOPTERA						2000	1337	1333	2000
Bostrichidae			1				I		
Cantharidae					1	1	1		
Carabidae	9	11	4	l	155	20	1	0	20
Cicindelidae	1	1	1		1	20	ĺ	8	38
Curculionidae	1	1	1	1	1				
Dytiscidae	1				313				
Elateridae .			1	ĺ	4	1		3	
Erotylidae !	1		31		4	1			
Histeridae		2	01		4				
Hydrophylidae	1	1			4		ļ	6	
Lampyridae		i -			3			_	
Pedilidae	ı	•	3		3			3	
Scarabaeidae		3	9		32	•			
Silphdae		4	7		1	3		13	2
Staphylinidae	1	1	42	5				9	32
Unknown beetle larvae	1		19	4	7	1		2	
COLLEMBOLA	<del>                                     </del>		18			3			37
Springtails	1	3	13	2					
DIPTERA		<u> </u>	13	2				4	
Unidentified Diptera	1	5	10						
HEMIPTERA		3	10		1			46	4
Miridae									
Pentatomidae	Į.							1	
Reduvidae					1				
HOMOPTERA			1						
Cicadellidae		40							
Fulgoridae	l	18	1		8			19	1
HYMENOPTERA					52			2	
Formicidae	40	•							
Pompilidae	19	9	44	36	4			14	8
Unidentified wasp		8			1			5	
LEPIDOPTERA			1			1			
Unidentified lep. Larva									
NEUROPTERA								1	1
ACCOUNT MANAGEMENT DUST ACCOUNTS ON									
Corydalidae ORTHOPTERA								2	
Acrididae			1					-	
V. A		1	1		7.	1		6	3
Gryllidae		45	9		11	1		79	1
ARACHNIDA Fisher spider									
Fisher spider					4	1		2	
Mesostigmata			.		62			5	
Phalangida		27	1		1	1		1	
Spiders	86	62	21	44	23	28	21	63	19
Tick						1			130-50
Unknown mite			1						
CHILOPODA	1		1	2					
DIPLOPODA				1					2
ISOPODA	* * *								
Sowbugs	111	1	1	11	5	62		9	73
MOLLUSCA									
Snails		1	1		5			3	
Oliogochaeta									
Earthworms	2			8	2		4		
VERTEBRATES									
Leopard frog		1						2	
Spade-footed toad		4						2	I
Short-tailed shrew	1	1					1		
							1		

### Table 21. Soil Invertebrates

(using Burlese-Tullgren funnel, average number/soil core)

#### **Grand Island Well Field**

		Transe	ct 1							Trans	sect 2													Transec	ct 3			Transect 4  2 Q2 Q2 Q3 Q3 Q3 Q3 Q4 Q4 Q4 Q4 Q5 Q5 Q5 Q5 Q1 Q1 Q1 Q1 Q1 Q2 Q2 Q2 Q3 Q9												J. Cold V	S Plant of			41.2		n V 3		A MARIE TO SELECT		
		Q1 0	Q1 Q1	Q1	Q2 Q	2 Q2	Q2 Q	2 Q3	Q3 Q3	Q1	Q1 Q	1 Q1	Q2 Q2	Q2 (	22 Q3	Q3 Q:	3 Q3 (	Q4 Q4	Q4 Q	Q5	Q5 Q	5 Q5	Q6 Q6	Q1 Q	1 Q1	Q1 Q2	Q2 Q	2 Q2	Q3 Q3	3 Q3 (	Q3 -Q4	04 0	4 04 (	05 05	05 0	1 1 O1	01 01	01 0	2 02 0	2 02	Q3 Q3	03 03	04.04	Proceedings of			Swale	Sampling	3	digital services.
		97 9	8 99	0	97 9	3 99	0 9	98	99 0	97	98 9	9 0	97 98	99	0 97	98 99	0 9	97 98	99 0	97	98 9	9 0	99 0	97 98	8 99	0 97	98 9	9 0	97 98	3 99	0 97	98 99	9 0	97 98	99 (	0 97	98 99	0 97	7 98 9	9 0	97 98	99 0	07 00	Q4 Q4 99 0	Q5 Q5	Q5 Q5	5 S1 S	W S1	S2 S3	SE % Specie
Acrina Pr	Prostigmata					1			1							1														1		1		37 30	33 (	0   31	20 22	0 31	30 3	5 0	17	1	97 98	99 0	97 98	99 0	99	0 0	0 0	0 Composit
Acrina Cr	Cryptostigmata	4	7 1	1	6		1 1	4		8	11		7 14		3	1 1	1	26 2		34	6			5 5	i		6	1 7	1	1		1.1		12 13		111	2		9	1	4		23				2			0.76
Acrina Me	Mesostigmata	6		1	1		1 4	5	4	1	16		12	9		1	1	31 1		6	5		1	8 5	i	1 1	3	13	5		2	3	1	16		2 1	2	1		. 1	2				19			3	6	22.72
Arachnida Sr	Spider		1				1																						-		_	٠,	•	10		-	2				-	1	1	6 3		11 38		2 2	5	18.31
Coleoptera Br	Beetle larvae	1	1	1		1				1										-1				12		9	-	1				4		3 1		1 1		1		5	1									0.23
Coleoptera C	Carabid larva									1								1																											1	1	1	3		3.42
Coleoptera Sr	Scarab beetle	1								1																	,	1								i i											1			0.15
Coleoptera Ca	Cantharid Beetle	9																																																0.15
Collembola Sp	Springtail	1	1 1	3	4		3	3		7	18 1	1	9	1	2 4	2		11	1		6	1	3	6 9	)	9	6	9	2	1	3 /	1			2	-1	1 7		5		14	1		2 2						0.08
Diplura Ja	Japygid									1			4																						-		1		•		1			2 2	2	12 11		2 4	6	15.20
	Fly larvae	1																						1													•			1	1									0.38
Diptera FI	Fly larvae				1		•	(							1			8					1	1				1	1					2		12					1		5							0.08
Homoptera A	Aphid	1	1																															_		1									3					2.43
Homoptera Le	Leafhopper																							ŀ																	1									0.08
Hymenoptera Ar	Ant	1			14			1	1				4 1		1 16				1		1		1	1	2	1 1			1 3	5		1	1				1	277	1	1	2			0						1 0.08
Insecta In	Insect larvae															1					1			2	2							1	12.1	1						1						. 4		5	4	27.20
	Sowbug				1																															1					1						1			0.68
Mollusca Sr	Snail	1														-																									1				15					0.08
Nematoda N	Nematoda	1	1	1	1				1	2	1	1	17					3			4	1		1		4		3 2			1	1	1	3			5			2			18		13					1.14
Oligochaeta Ea	Earthworm									2			3					3		1				5					1	ı		1					2/0			9/2	1									5.55 1.22
Protura P	Proturans																										1														1									1.22

Wyomir	ng	Tran	sect	1										Tran	sect	2										1	
		Q1	Q1	Q1	Q1	Q2	Q2	Q2	Q2	Q3	Q3	Q3	Q3	Q1	Q1	Q1	Q1	Q2	Q2	Q2	Q2	Q3	Q3	Q3	Q3	Ex swale	% Spp.
		97	98	99	0	97	98	99	0	97	98	99	0	97	98	99	0	97	98	99	0	97	98	99	0	0	Comp
Acrina	Cryptostig													3					1	1		14				1	8.7
Acrina	Mesostig								2				2	8	3		1					11			1		12.2
Coleoptera	Beetle larvae		1																					1			0.9
Coleoptera	Coleoptera													1								1					0.9
Collembola	Springtail	12		1	2	1										6	2	3		1	2	6		2	1	1 1	17.5
Diptera	Fly larvae	1												1								2				1	1.3
Hymenoptera	Ant	1	1	1	2			9	1				1	1		38		1			22	12		9	2		43.2
Hymenoptera	Microwasp	1		1										1							880000	200.		- 20	-		0.4
Hymenoptera	Wasp	1					1																				0.4
Insecta	Insect larvae	1					1																				0.4
Isopoda	Sow bug	ì												l										1			0.4
Lepidoptera	Moth pupa	i												1				,					1			I	0.4
Mollusca	Snail				1									1												į.	0.9
Nematoda	Nematoda	4		5					1			4		1				5				7					11.8
Protura	Protura																	- 7	1								0.4

#### Cottonwood Ranch

		-		_		-		_				_	_	-	-																										
		Tran	_																		Tran	sect:	2																		
		Q1	Q1	Q1	Q1	Q2	Q2	Q2	Q2 Q	3 Q:	Q3	Q	3 Q4	Q4	Q4	Q4	Q5	Q5	Q5	Q5	Q1	Q1	Q1	Q1	Q2	Q2	Q2	Q2	Q3	Q3	Q3	Q3	Q4	Q4	Q4	Q4	Q5	Q5	Q5	Q5	% Spp. Composition
		97	98	99	0	97	98	99	0 9	7 98	99	0	97	98	99	0	97	98	99	0	97	98	99	0	97	98	99	0	97	98	99	0	97	98	99	0	97	98	99	0	
Acrina	A/Prostig			2				2																											7				2		2.784
Acrina	Cryptostig	63	2	2	1	3	2	1	4	1		1	9	7		8	1			2		2	1	7	6	12	2			5		1	1	7	4		3			3	34.48
Acrina	Mesostig	1	3		8	1	9		5	5		2	1	4		1									1	2							5	5		3	4		1	5	13.92
Acrina	Tick																	1																							0.214
Arachnida	Spider	1					1																												1						0.428
Coleoptera	Beetle larvae	1			1											1																									0.428
Coleoptera	Beetle	1														1																				20					0.214
Coleoptera	Rove Beetle	1		1							1				1								1												1						1.071
Coleoptera	Tenebrionidae				1																																				0.214
Collembola	Springtail	1	4	7	4		1	7	3			1		8	4	8	2		5	2	1		4		3	21	4			2	3		1	35	1	1	6		4	5	31.48
Diplura	Japygid	1					1	3												-					- 5	70.0	2							-			7			-	1.285
Diptera	Fly larvae	l l																							3		-										1				0.857
Hymenoptera	Ant	1					3										4	1			2			8	•																3.854
Insecta	Insect larvae								1												-			Ü							2										0.642
Isopoda	Sowbug		1																		l										-										0.214
Lepidoptera	Lep. Larva				1																																				0.214
Nematoda	Nematoda	2		2		1	5	1		1	7		1						8	4							3				5		4	4			1				7.495
Protura	Proturans	1		-			-							4							1						3				3		1.	4							0.214

# Table 22. Aquatic Invertebrates at Grand Island Wellfield Dip Netting - sampled on May 30, 2000 in SW slough

	No. of Individuals
ARACHNIDA	
Unknown Spiders	13
Unknown Mite	1
INSECTA	
COLEPTERA	0
Dytiscidae larvae	2
Coccinellidae	3
Coccinellidae larvae	1
Scarabaeidae	1
COLLEMBOLA	
Springtails	26
DIPTERA	
Culicidae larvae	48
Unknown Diptera	13
HEMIPTERA	
Notonectidae	1
Cicadellidae	35
Nabidae	3
HOMOPETERA	
Aphidae	1
Fulgoridae	1
ORTHOPTERA	
Acrididae	4
MOLLUSCA	
Unknown snails	48
Unknown pupae (mostly diptera)	30
Unknown tadpoles	27

Table 23. Butterflies Observed and Collected

Cottonwoo	d Ranch		1997	1998-slough	1998-cropland	1999	2000	% Species
GENUS	SPECIES	COMMON NAME	25-Jul	18-Jul	18-Jul	9-Aug	8-Aug	Composition
Amblyscirtes	vialis	Roadside skipper	(	1		X		0.21
Ancyloxypha	numitor	Least skipperling				24	1	5.21
Atalopedes	campestris	Sachem				1		0.21
Celestrina	ladon	Spring azure				15		3.13
Cercyonis	pegala	Wood nymph				2		0.42
Charidryas	gorgone	Gorgone crescentspot		1		17	1	3.96
Colias	eurytheme	Orange sulphur	4	4	13	20	18	12.29
Colias	philodice	Clouded sulphur	1				1	0.42
Danaus	plexippus	Monarch			1	6		1.46
Everes	comyntas	Eastern tailed blue		2	3		4	1.88
Hemiargus	isola	Reakirk's blue				6		1.25
Junonia	coenia	Buckeye	14			5	1	4.17
Limenitis	archippus	Viceroy				2	3	1.04
Lycaeides	melissa	Melissa blue					1	0.21
Lycaena	hyllus	Bronze copper	1			2		0.63
Nathalis	iole	Dwarf yellow				3	3	1.25
Papilio	glaucus	Eastern tiger swallowtail		3	1			0.83
Papilio '	polyxenes	Eastern black swallowtail		3	1	4		1.67
Phyciodes	tharos	Pearly crescentspot		1	1	1	1	0.83
Pieris	rapae	Cabbage butterfly		200	2	23	30	53.13
Polygonia	interrogationis	Question mark				2	1	0.63
Pontia	protodice	Checkered white			1		1	0.42
Pterourus	glaucus					2		0.42
Pyrgus	communis	Common checkered skipper	1			4	8	2.71
Speyeria	idalia	Regal fritillary	1			1		0.42
Vanessa	atalanta	Red admiral				2	1	0.63
Vanessa	cardui	Painted lady					2	0.42
Vanessa	virginiensis	American painted lady				1		0.21
No. butterflies obs	served		22	215	23	143	77	1
No. observers			1	1	1	1	1	1
No. hours			1	1.5	1.5	2	1	1
No. species seen			6	8	8	21	16	t
No. butterflies obs	served/observer	hour	22	143	15	72	77	

	and Well Fie		1997	1997	1998	1998	1999	1999	2000	2000	% Species
GENUS	SPECIES	COMMON NAME	14-Jul	19-Jul	7-Jul	18-Jul	15-Jul	7-Sep	15-Jul	16-Aug	Composition
Anaea	andria	Goatweed butterfly				1		1	1		0.08
Ancyloxypha	numitor	Least skipperling				1			3		0.11
Asterocampa	celtis	Hackberry butterfly				1		5	4		0.28
Atalopedes	campestris	Sachem	1	3			1		2	1	0.22
Atrytone	logan	Delaware skipper	1		1	1				28	0.84
Celestrina	ladon	Spring azure	1	7	5	47		2		21	2.29
Celestrina	argiolus	Spring azure	1				75				2.09
Cercyonis	pegala	Wood nymph	402	217	378	156	223		46	48	40.97
Charidryas	gorgone	Gorgone crescentspot	1			Z -	2		6		0.22
Colias	eurytheme	Orange sulphur	22	21	34	45	87	58	32	38	9.39
Colias	philodice	Clouded sulphur	12	6	8	6	14	3	6	6	1.70
Danaus	plexippus	Monarch	27	24	5	9	4		8	34	3.09
Enodia	anthodon	Northern pearly eye	1		1					3	0.11
Epargyneus	clarus	Silver spotted skipper	1		1	2	4				0.20
Euptoieta	claudia	Variegated fritillary	1		1				2		0.08
Everes	comyntas	Eastern tailed blue	12	10	230	45	17	48	13		10.45
Hemiargus	isola	Reakirk's blue	1		6	4	7		6		0.64
Hesperiidae	spp.	Skipper (unidentified)	1				4				0.11
Junonia	coenia	Buckeye	1	1			8		24	3	1.03
Libytheana	bachmanii	Snout butterfly				2					0.06
Limenitis	archippus	Viceroy	1	3		6	2		4	3	0.50
Limenitis	arthemis	Red-spotted purple	1							1	0.03
Lycaena	hyllus	Bronze copper	1	1		2					0.08
Megisto	cymela	Little wood satyr	1				2		2		0.11
Nathalis	iole	Dwarf yellow				1	1	8			0.28
Papilio	cresphontes	Giant swallowtail					1	3	1	5	0.28
Papilio	glaucus	Eastern tiger swallowtail		1				2	-	12	0.42
Papilio	polyxenes	Eastern black swallowtail	1			1			2	1	0.11
Phoebis	sennae	Cloudless giant sulfur							_	1	0.03
Pholisora	catullus	Sootywing	1							3	0.08
Phyciodes	tharos	Pearly crescentspot	19	16	15	5	18		8	74	4.32
Pieris	rapae	Cabbage butterfly	1		5	9	8	4	3	8	1.06
Poanes	hobomok	Hobomok skipper	1		_	-			3		0.08
Polites	peckius	Yellowpatch skipper	1				1		5	9	0.42
Polites	orignes	Crossline skipper	1		1		2		3	3	0.42
Polites	thermistocles	Tawny-edged skipper	6	41	1	3	_	~	1	2	1.51
Polygonia	comma	Comma	1	12.7	2	11	6		ū	2	0.53
Polygonia	interrogationis	Question mark	2		-	19	4		2	2	0.53

Grand Isl	land Well Fi	eld (continued)	1997	1997	1998	1998	1999	1999	2000	2000	% Species
GENUS	SPECIES	COMMON NAME	14-Jul	19-Jul	7-Jul	18-Jul	15-Jul	7-Sep	15-Jul	16-Aug	Composition
Satyrium	calanus	Banded hairstreak						1			0.03
Satyrium	acadica	Acadica hairstreak	1		6	11		1			0.50
Speyeria	cybele	Great spangled fritillary	1	1		1	2			2	0.17
Speyeria	idalia	Regal fritillary	115	62	24	61	7		26	9	8.47
Strymon	melinus	Gray hairstreak						4		18	0.61
Vanessa	atalanta	Red admiral	2	2		3	1		8	1	0.47
Vanessa	cardui	Painted lady	1	1	2	2					0.17
Vanessa	virginiensis	American painted lady	1							66	1.87
No. butterflies	observed		626	420	729	481	513	147	263	409	1
No. observers			2	2	2	2	1	1	1	1	l
No. hours			4	2	2	3	3	2	2	5	
No. species se	een		17	18	20	29	27	14	27	28	}
No. butterflies	observed/observe	er hour	78	105	182	80	171	73	132	82	1

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Wyoming			1997	1998	1999	2000	% Species
GENUS	SPECIES	COMMON NAME	15-Jul	18-Jul	13-Aug	18-Jul	Composition
Anaea	andria	Goatweed butterfly			1		0.42
Ancyloxypha	numitor	Least skipperling			3		1.26
Atalopedes	campestris	Sachem			4		1.67
Colias	eurytheme	Orange sulphur	6	13	19	6	18.41
Danaus	plexippus	Monarch	1		6		2.93
Euptoieta	claudia	Variegated fritillary	1				0.42
Everes	comyntas	Eastern tailed blue	10	71	7	18	44.35
Hemiargus	isola	Reakirk's blue			4	17	8.79
Junonia	соепіа	Buckeye			1	2	1.26
Limenitis	archippus	Viceroy			1		0.42
Lycaena	hyllus	Bronze copper				1	0.42
Nathalis	iole	Dwarf yellow			3	4	2.93
Papilio	glaucus	Eastern tiger swallowtail		1			0.42
Papilio	polyxenes	Eastern black swallowtail				1	0.42
Pholisora	catullus	Sootywing			1		0.42
Phyciodes	tharos	Pearly crescentspot	4			1	2.09
Pieris	rapae	Cabbage butterfly		2			0.84
Polites	thermistocles	Tawny-edged skipper		1			0.42
Polygonia	interrogationis	Question mark	4				1.67
Pterourus	glaucus					1	0.42
Pyrgus	communis	Common checkered skipper	3	2	6	5	6.69
Speyeria	idalia	Regal fritillary	3				1.26
Strymon	melinus	Gray hairstreak		1		1	0.84
Vanessa	cardui	Painted lady		1	1	1	1.26
No. butterflies	observed		32	92	57	58	l
No. observers			1	1	1	1	1
No. hours			2	3	2	2	
No. species see	en		8	8	13	12	
No. butterflies of	bserved/observer	hour	16	31	29	29	l

SCIENTIFIC NAME		COMMON NAME	Wetland			
GENUS	SPECIES		Rating	GIWF	WYO	CWR
Agro.	hordeum				-	
Agrohordium				X		
Agropyron	spp.			X		
	caninum	Slender wheatgrass	FAC-	X		
Agropyron	elongatum	Tall wheatgrass			X	X
Agropyron .	hordeum	Wheat grass		X		
Agropyron	repens	Quackgrass	FAC	X		X
Agropyron	smithii	Western wheatgrass	FACU	X		
Agrostis	stolonifera	Redtop	FAC+	X	X	X
Allium	canadensis	Wild onion	FACU	X		
Amaranthus	retroflexus	Redroot pigweed	FACU			X
Ambrosia	artemisiifolia	Common ragweed	FACU		X	X
Ambrosia	trifida	Giant ragweed	FACW			Х
Amorpha	fruticosa	Indigobush	OBL	Х		
Andropogon	gerardii	Big bluestem	FAC-	X		
Apocynum	cannabinum	Hemp dogbane	FAC	X	X	X
Apocynum	sibiricum	Prairie dogbane	FAC		X	X
Asclepias	incarnata	Swamp Milkweed	OBL		X	X
Asclepias	speciosa	Showy milkweed	FAC	X		
Asclepias	sullivantii	Smooth milkweed	OBL	X		
Asclepias	syriaca	Common milkweed		X		X
Asclepias	verticillata	Whorled milkweed		X		^
Aster	ericoides	Many-flowered aster	FACU	X		
Aster	lanceolatus	Lance-leaved aster	FACW	X	X	Х
Aster	oblongifolia	Aromatic aster	IACVV	X		
Aster	praealtis	Willow leaf aster	FACW	X		
Astragalus	canadensis	Canada milkvetch	FACU			X
Bouteloua	gracilis	Blue grama	FACU			X
Bromus	spp.	Bromegrass		X		
Bromus	inermis	Smooth brome		X		
Bromus	japonicus			X	X	Χ
Calamagrostris		Japanese brome	FACU	X	X	
Calylophus	canadensis	Bluejoint grass	OBL	X		
Cannabis	serrulatus					X
	sativa	Marijuana	FACU-		X	
Carduus	nutans	Musk thistle			X	
Carex	spp.	Sedges			X	X
Carex	brevior	Fescue sedge	FAC		X	
Carex	crawei	Sedge	FACW	X		
Carex	eleocharis	Sedge			X	
Carex	granularis	Meadow sedge	FACW	X		
Carex	pellita	Wooly sedge	OBL	X	Х	
Carex	praegracilis	Clustered field sedge	FACW	X	Х	
Carex	sartwellii	Sedge	OBL	X		
Carex	vulpinoidea	Fox sedge	OBL	X	Х	
Carex	emoryi	Emory's sedge	OBL	X		
Carex	tetanica	Sedge	FACW+	X		
Chenopodium	album	Lambsquarter	FAC	- <del>                                    </del>		
Chloris	verticillata	Windmill grass	17.0			X
Dicuta	maculata	Water hemloick	OBL			X
Cirsium	altissium	Tall thistle	UBL	X		
Dirsium Cirsium	flodmani		EAGU	X	X	
Dirsium		Flodman's thistle	FACU	X	X	
	vulgare	Bull thistle		X		
Conyza	canadensis	Marestail	FACU-	_		X
Cornus	drummondii	Rough leaved dogwood	FAC	X	X	X
Dactylus	glomerata	Orchard grass	FACU		Х	

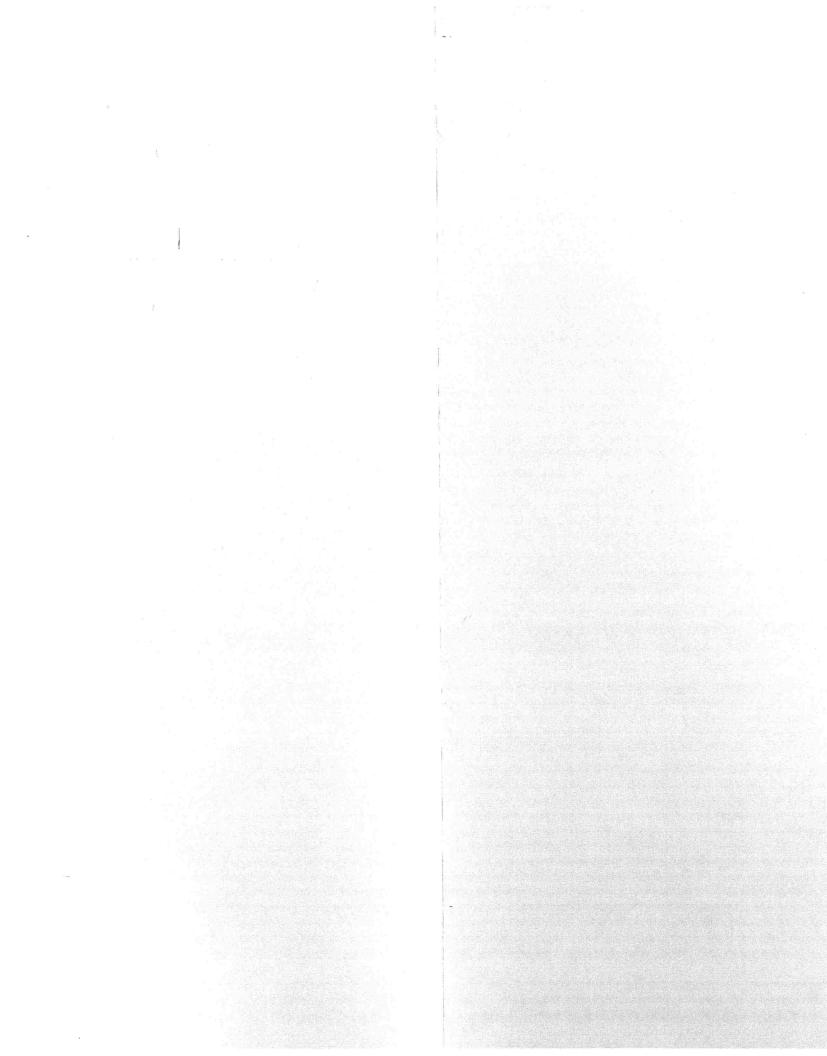
SCIENTIFIC NAME		COMMON NAME				
GENUS	SPECIES		Wetland	GIWF	WYO	CWR
D. I.			Rating			
Dalea	purpurea	Purple Prairie Clover				X
Descurainin	sophia	Herb-Sophia				X
Desmanthus	illinoiensis	Illinois bundleflower	FACU	X		X
Dichanthelium	acuminatum	Panic grass	FAC	X		
Dichanthelium	oligosanthes scribneriu		FACU			X
Echinochloa	crusgalli	Barnyard grass	FACW		X	X
Eleocharis	elliptica	Spike rush	FACW	X		
Eleocharis -	erythropoda	Spike rush	OBL	X		
Eleocharis	macrostachya	Spike rush	OBL	X		
Eleocharis	palustris	Spike sedge	OBL			X
Elymus Elymus	canadensis	Canada wild rye	FACU		·	X
	virginicus	Virginia wild rye	FAC	X		
Elytrigia '	repens	Quackgrass		X	X	
Equisetum	arvense	Field horsetail	FAC	X		
Equisetum	laevigatum	Smooth horsetail	FACW	X	X	X
Eriochloa	contracta	Priarie cupgrass	FACU	X		
Erigeron	philadelphicus	Philadelphia fleabane	FAC	X		
Erigeron	strigosus	Fleabane	FAC	X		
Eustoma	grandiflora	prairie gentian	FACW	X		
Festuca	arundinacea	Tall fescue	FACU	X	X	
Fraxinus	pennsylvanica	Green ash	FACW	X		X
Glyceria	striata	Fowl mannagrass	OBL	X		
Glycyrrhiza	lepidota	Wild licorice	FACU	X		X
Helenium	autumnale	Sneezeweed	FACW	X		
Helianthus	spp.				Х	
Helianthus	annuus	Common sunflower	FACU			X
Helianthus	grosseserratus	Sawtooth sunflower	FACW	X		
Helianthus	maximiliana	Maximilian's sunflower				X
Hordeum	jubatum	Foxtail barley	FACW	X	X	X
Hypoxis	hirsuta	Yellow stargrass	FACW	X		
Juncus	balticus	Baltic rush	OBL	X		
Juncus	dudleyi	Dubley rush	FAC	X		
Juncus	torreyi	Torrey's rush	FACW	X		
Juncus	interior	Inland rush	FAC	X	X	
Juniperus Kochia	virginiana	Eastern red cedar	FACU-	X	Х	
	scoparia macranths	Firebush	FACU			X
Koeleria		Junegrass Wild lettuce		X		
Lactuca	serriola		FAC	X	X	X
Leersia Linaria	oryzoides	Rice cutgrass Toadflax	OBL			X
	spp. lanceolata	Fogfruit	ODI	X		
Lippia Lobelia			OBL	X	X	X
Lobelia	siphilitica	Blue lobelia	OBL	X		
3 497 1499 1440 1440 1440 1440 1440 1440 1440	spicata	Palespike lobelia	FAC	X		
Lycopus	corniculatus	Birdsfoot trefoil	FACU	X		
Lycopus	americana	American bugleweed	OBL	X		X
Lycopus	asper	Rough bugleweed	OBL	X		X
Lysimachia	ciliata	Loosestrife	FACW	X		
Lysimachia	thyrsiflora	Tufted lossstrife	OBL	X		
Lythrum	spp.	Wingod loss	051			X
Lythrum	alatum	Winged loosestrife	OBL	X		
Medicago	lupulina	Black medick	FAC	X	X	X
Medicago	sativa	Alfalfa	- In the second	X	X	X
Melilotus	alba	White sweet clover	FACU	X	X	X
Melilotus	officinalis	Yellow sweet clover	FACU		X	X
Mentha	arvensis	Field Mint	FACW	X		
Muhlenbergia	asperifolia	Scratchgrass		X		

SCIENTIFIC NAME		COMMON NAME				
GENUS	SPECIES		Wetland	GIWF	WYO	<u>CWR</u>
			Rating			
Nepeta	cataria	Catnip	FACU			X
Panicum	virgatum	Switchgrass	FAC	X		X
Phalaris	arundinacea	Reed canary grass	FACW+	X		X
Phleum	pratense	Timothy grass	FACU	X		
Phyla	lanceolata	Fogfruit	OBL	X		
Physalis	virginina	common ground cherry		X		X
Plantago	major	Common plantain	FAC	X		
Poa -	compressa	Canada bluegrass	FACU	X		
Poa	pratensis	Kentucky bluegrass	FACU	X	X	X
Polygonum	spp.	Smartweed			X	
Polygonum	amphibium	Water smartweed	OBL	X		
Polygonum	areanastrum	Common knotweed		X	X	
Polygonum	cocciniium	Smartweed	OBL			X
Polygonum	lapathifolium	Pale smartweed	OBL	X		
Polygonum	percicaria	Lady's-thumb	OBL		X	X
Potentilla	recta	Sulfur cinquefoil		X		
Prunella	vulgaris	Selfheal	FAC	X		
Rorippa	palustris	Bog yellow cress	OBL	X	X	
Rosa	arkansana	Wild rose	FAC	X		
Rudbeckia	hirta	Brown-eyed susan	FACU	X		X
Rumex	spp.					Х
Rumex	altissimus	Pale dock	FAC			X
Rumex	crispis	Curly dock	FACW	X	X	X
Sambucus	canadensis	Elderberry	FAC	X		
Scirpus	spp.	Bulrush				X
Scirpus	maritimus	Saltmarsh bulrush	OBL			X
Scirpus	pungens	Bulrush	OBL	X	X	X
Scirpus	validus	Soft stem bulrush	OBL			X
Senecio	plattensis	Priaire ragwort	FACU	X		
Setaria	glauca	Yellow foxtail	FAC			X
Sisyrinchium	montanum	Blue-eyed grass	FAC	x	X	
Smilacina	stellata	Solomon's seal	FAC	X		
Solanum	rostratum	Buffalo burr				X
Solidago	canadensis	Canada goldenrod	FACU	X	X	X
Solidago	gigantea	Giant goldenrod	FACW	X		X
Solidago	rigida	Ridgid goldenrod	FACU	X		
Sorghastrum	nutans	Indiangrass	FACU	X		
Spartina	pectinata	Prairie cordgrass	FACW	X		X
Sphenopholis	obtusata	Wedgegrass	FACW	X		
Sporobolis `	cryptandrus	Sand dropseed	FACU-	X		
Taraxacum	officinale	Dandelion	FACU	X	X	X
Toxicodendron	radicans	Poison ivy	FACU	X		
Tragopogon	dubius	False goatsbeard		X		
Trifolium	hybridum	Alsike clover	FACU	X		
Trifolium	pratense	Red clover	FACU	X	X	
Trifolium	repens	White clover	FACU	X	X	
Triticum	aestivum	Wheat				X
Typha	latifolia	Cattail	OBL			X
Verbena	hastata	Blue vervain	FACW	X		
Verbena	stricta	Hoary vervain		X	X	
Vernonia	baldwinii	Western ironweed	FACW-		X	
Vernonia	faciculatum	Ironweed	FAC	X	X	
Viola	pratincola	Violet	FAC-	X		
Xanthium	strumarium	Cocklebur	FAC			X
Zea	mays	Com			-	X

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Table 25. Vegetation Composition for GIWF Site 1997-2000

SCIENTIFIC NAME COMMON NAME Wetland Rating T1Q1 T1Q2 T1Q3 T2Q1 T2Q2 T2Q3 T2Q4 T2Q5 T3Q1 T3Q2 T3Q3 T3Q4 T3Q5 T4Q1 T4Q2 T4Q3 T4Q4 T4Q5 Sum % Grasses hordeum 0.0 0.0 0.0 0.0 4.0 0.7 Agrohordium spp. Agropyron caninum Slender Wheatgrass Agropyron smithii Western Wheatgrass FACU 1.0 0.2 Agropyron FAC repens Quackgrass Agrostris stolonifera FAC+ Redtop Andropogon gerardii Big Bluestem Bouteloua gracilis Blue grama 1.0 Bromus japanicus Jap. Brome Bromus inermis Smooth Brome **Bromus** SDD. Annual Brome Clamagrostris canadensis OBL Blueiointgrass acuminatum FAC Panicgrass Virginia Wild Rye FAC virginicus Elytrigia Quackgrass Festuca arundinacea Tall fescue FACU Glyceria striata Mannagrass Hordeum iubatum Foxtail barley FACW Koeleria macrantha Junegrass Muhlenbergia asperifolia Scratchgrass Panicum virgatum Switchgrass 3 7.0 Phalaris arundinacea Reed canarygrass Phleum pratense Timothy grass FACU Poa arida Plains bluegrass Poa Canada bluegrass compressa FACU pratensis FACU K. Blue 3 2 2 2 2 1 2 2 2 1 2 1 1 3 Sorghastrum Indian Grass FACU Spatina pectinata Priarie Cordgrass FACW 4.0 0.5 Sphenopholis obtusata Wedgegrass FACW 3.0 Sprobolus cryptandrus sand dropseed FACU-**Forbs** Allium wild onion FACU 5.0 Amorpha fruticosa False indigo Apocynum cannabinum Dogbane 1 24.0 Asclepias incarnata Swamp Milkweed Asclepias speciosa Showy Milkweed Asclepias sullivantii Smooth Milkweed OBL Asclepias syriaca Common milkweed Asclepias verticillata Whorled milkweed Aster ericoides White aster Aster lanceolata Panicled aster Aster oblongifolia Aromatic aster praealtis Willowleafed aster FACW Circuta Spottedwater hemlock OBL Cirsium flodmani Cirsium vulgare tall thistle Cirsium altissium Tall thistle Cornus drummondi FAC Dogwood Desmanthus illioensis bundleflower FACU Erigeron philadelphicus Erigeron strigosus Daisy fleabane Eriochloa contracta Prairie cupgrass FACU Eustoma grandiflorum Prairie gentian FACW 0.0 pensylvanica Fraxinus Green ash FACW Glycrrhiza lepidota Wild licorice FACU Helenium autumnale Sneezeweed 0.0 1.0 10.0 Helianthus grosseserratus Sawtooth sunflowe Hypoxis hirsuta Yellow stargrass FACW Juniperus virginiana Red cedar FACU-FAC Lactuca serriola Prickly lettuce 1.0 spp. Toadflax 1.0 Lippia lanceolata Fogfruit 0.0 0.0 7.0 0.0 Lobelia spicata palespike lobelia Lotus corniculatus birds-foot trefoil FACU Lycopus americana American bugleweed OBL Rough bugleweed OBL Lycopus asper FACW Lysmachia ciliata Yellow lossestrife Lysmachia thyrsiflora tufted loosestrife OBL Lythrum alatrium 0.0 15.0 9.0 Medicago lupulina Black medic Medicago sativa Alfalfa FACU Melilotus alba W. sweetclover 4.0 Mentha arvensis FACW Field mint 0.0 Phyla lanceolata Fog fruit Physallis virginiana ground cherry Plantago Common plantain 0.0 0.0 0.0 4.0 Polygonum amphibium Polygonum arenstrum Common knotweed Polygonum lanathifolium Pale smartweed Potentilla recta cinquefoil 0.0 Prunella FAC vulgaris seif-heal 2 1 2 3 1 Rorripa palustrus mustard OBL FAC arkansana wild rose 1.0 Rudbeckia black-eyed-susan FACU 9.0 Rumex crispus 2.0



Sambucus	canadensis	Common olderhom.	E40																				
Senecio	plattensis	Common elderberry Ragwort	FAC FACU																1			1.0	0.2
Sisyrinchium	montanum	Blue-eyed grass	FAC			1	1	4	4	4	4									á	-	0.0	0.0
Smilacina	stellata	false Solomon's seal				1		1	1	1	1				-		1	1	1	1	1	11.0	1.8
Solidago	candensis		FAC			1	1		1						1							4.0	0.7
Solidago		Canada goldenrod	FACU				3															3.0	0.5
Solidago	gigantea	giant goldenrod	FACW	1														1		1		3.0	0.5
Taraxacum	rigida officinale	Ridgid goldenrod	FACU																			0.0	0.0
		Dandelion	FACU				1		1	1	1	1			1	1	1					8.0	1.3
Toxicodendron		poison ivy	FACU				1															1.0	0.2
Tragopogon	dubius	goatsbeard			1			2							1							4.0	0.7
Trifolium	hybridum	Alsike clover	FACU	(0)	100		8															0.0	0.0
Trifolium	pratense	red clover	FACU	1	1	2	1		2	2	1	2	1	3	1	1	3	1		1		23.0	3.9
Trifolium	repens	White clover	FACU											127								0.0	0.0
Verbena	hastata	Blue Vervain	FACW																			0.0	0.0
Verbena	stricta	Howary Vervain					1				1											2.0	0.3
Vernonia	fasciculata	Ironweed	FAC	1			1		1		1	1		2				1			2	10.0	1.7
Viola	pratincola	Prairie violet	FAC-		1	1		1	1	1		1	1	1		1				1		10.0	1.7
Sedges	ì																						
Carex	aurea ;	Sedge																				0.0	0.0
Carex	crawei	Sedge	FACW	3	3	2	2	2	2	2	1	1	2	1	1	2	1	1			1	27.0	4.5
Carex	emoryi	Emory's sedge	OBL									2	1	1	1		1	2			1	9.0	1.5
Carex	granularis	Meadow sedge	FACW																			0.0	0.0
Carex	pellita	sedge	OBL	1					3		2											6.0	1.0
Carex	praegracilis	clustered field sedge	<b>FACW</b>		1			1													1		0.5
Carex	sartwellii	Sedge	OBL																			0.0	0.0
Carex	tetanica	Sedge	FACW+				2															2.0	0.3
Carex	vulpinoidea	Fox sedge	OBL				1												1		1	3.0	0.5
Eleocharis	erythropoda	Spike rush	OBL				1		2		1											4.0	0.7
Eleocharis	macrostachya	spike rush	OBL																			0.0	0.0
Eleocharis	elliptica	Spike rush	FACW																			0.0	0.0
Equisetum	arvensis	smooth horsetail	FAC						1				1				1				1	4.0	0.7
Equisetum	laevigatum	Smooth horsetail	FACW	2	2	2	1	2	1	1	1	1	1	1	1	2	3	1		1	1	24.0	4.0
Juncus	balticus	Baltic rush	OBL	-	-	-		-		1						~		1	1		36	3.0	0.5
Juncus	dudleyi	Dudley rush	FAC												2			2			4		
Juncus	interior	Inland rush	FAC				1				1				2			2			4	2.0	1.3 0.3
Juncus	torreyi	Torrey's rush	FACW																			0.0	
Scirpus	pungens	Bulrush	OBL				1		1		1			1								4.0	0.0
Sum	P-1.3-1.1		ODC				,							,								595.0	0.7 100.2
1998																						555.0	100.2
SCIENTIFIC N	AME	COMMON NAME	Wetland																				
GENUS	SPECIES		Rating	T1Q1	T1Q2	T1Q3	T2Q1	T2Q2	T2Q3 T	2Q4 T	2Q5 T	3Q1 T	3Q2 T	3Q3 T	3Q4 T	3Q5 T	4Q1 T	4Q2 T	4Q3 T	4Q4	T4Q5	Sum	%
				98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98		Contrib.
Grasses																			1				
Agro.	hordeum																	2				2.0	0.2
Agrohordium	spp.																					0.0	0.0
Agropyron	caninum	Slender Wheatgrass	FAC-																			0.0	0.0
	smithii																					0.0	
Agropyron	SITHUM	Western Wheatgrass	FACU																			0.0	0.0
Agropyron	repens	Quackgrass	FACU FAC																				0.0
		The same of the second			3	5	4	5	5	6	4		3	5	4	3	3	3	3	5		0.0	
Agropyron	repens	Quackgrass	FAC		3	5 3	4	5 4	5 4	6 3	4		3 5	5 5	4 2	3	3	3	3 2	5 3		0.0	0.0
Agropyron Agrostris	repens stolonifera	Quackgrass Redtop	FAC FAC+		3																	0.0 0.0 61.0 48.0	0.0 6.9 5.4
Agropyron Agrostris Andropogon	repens stolonifera gerardii	Quackgrass Redtop Big Bluestem	FAC FAC+		3											3						0.0 0.0 61.0 48.0 0.0	0.0 6.9 5.4 0.0
Agropyron Agrostris Andropogon Bouteloua	repens stołonifera gerardii gracilis	Quackgrass Redtop Big Bluestem Blue grama	FAC+ FAC-	3	3																	0.0 0.0 61.0 48.0 0.0 2.0	0.0 6.9 5.4 0.0 0.2
Agropyron Agrostris Andropogon Bouteloua Bromus	repens stołonifera gerardii gracilis japanicus	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome	FAC+ FAC-	3		3	4	4	4	3	4		5	5	2	3	3	3		3		0.0 0.0 61.0 48.0 0.0 2.0 47.0	0.0 6.9 5.4 0.0 0.2 5.3
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus	repens stolonifera gerardii gracilis japanicus inermis	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome	FAC+ FAC-	3		3	4	4	4	3	4		5	5	2	3	3	3		3		0.0 0.0 61.0 48.0 0.0 2.0 47.0 0.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Bromus	repens stolonifera gerardii gracilis japanicus inermis spp.	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome	FAC+ FAC- FACU	3		3	4	4	4	3	4		5	5	2	3	3	3		3		0.0 0.0 61.0 48.0 0.0 2.0 47.0 0.0 2.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Bromus Clamagrostris	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass	FAC+ FAC- FACU	3	6	2	4	3	4	3	2		3	5	2	2	3	3		3		0.0 0.0 61.0 48.0 0.0 2.0 47.0 0.0 2.0 14.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Bromus Clamagrostris Dicanthelium	repens stokonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass	FAC FAC+ FACU OBL FAC	3	6	2	4	3	4	3	2		3	3	2	2	3	6		3 2		0.0 0.0 61.0 48.0 0.0 2.0 47.0 0.0 2.0 14.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Bromus Clamagrostris Dicanthelium Elymus	repens stokonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye	FAC FAC+ FACU OBL FAC	3	6	2	3	3	3	3 3	2		3	5	2	2	3	3		3		0.0 0.0 61.0 48.0 0.0 2.0 47.0 0.0 2.0 14.0 0.0 20.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens	Quackgrass Redtop Big Bluestem Blue grama Jap, Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass	FAC FAC+ FACU OBL FAC FAC	3	6	2	3	3	3	3	2		3	3	2	2	3	6		3 2		0.0 0.0 61.0 48.0 0.0 2.0 47.0 0.0 2.0 14.0 0.0 20.0 4.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca	repens stokonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue	FAC FACU OBL FAC FACU OBL OBL		6	2	3	3	3	3 3	2		3	3	4	2	3	6	2	3 2 2		0.0 0.0 61.0 48.0 0.0 2.0 47.0 0.0 2.0 14.0 0.0 20.0 4.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria	repens stokonifera gerardii gracilis japanicus inermis spon canadensis acuminatum virginicus repens arundinacea striata	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass	FAC+ FAC+ FACU OBL FAC FAC FACU	3	6	2	3	3	3	3 3 2 2 2	2		3	3	2	2	3	6		3 2 2		0.0 0.0 61.0 48.0 0.0 2.0 47.0 0.0 2.0 14.0 0.0 20.0 4.0 0.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Hordeum	repens stokonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass	FAC FACU OBL FAC FACU OBL OBL		6	2	3	3	3	3 3	2		3	3	4	2	3 3 2	6	2	3 2 2		0.0 0.0 61.0 48.0 0.0 2.0 47.0 0.0 2.0 14.0 0.0 20.0 4.0 0.0 10.0 6.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Festuca Glyceria Hordeum Koeleria	repens stokonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass	FAC+ FAC- FACU OBL FAC FACU OBL FACU		6	2	3	3	3	3 3 2 2 2	2		5 3 2 2	3	4	3 2 4	3 3 2 2	6	2	3 2 2		0.0 0.0 61.0 48.0 0.0 2.0 47.0 0.0 2.0 14.0 0.0 4.0 0.0 10.0 6.0 2.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass	FAC FACU  OBL FAC FACU  FACU  OBL FAC FACU  FACU  FACU  FACU  FACU  FACW  FACW	2	6	2	3	3 2 2	3 2 2	3 2 2 2	2 2 2		3	2 2	2	2	2 2 2	6	2	3 2 2		0.0 0.0 61.0 48.0 0.0 2.0 47.0 0.0 14.0 0.0 4.0 0.0 10.0 6.0 2.0 7.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 2.3 0.5 0.0 1.1 0.7 0.0
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum	repens stokonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Viriginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Scratchgrass Reed canarygrass	FAC FACU OBL FAC OBL FACW FACW FACW FACW FACW FACW FACW FACW		6	2	3	3	3	3 3 2 2 2	2		5 3 2 2	3	4	3 2 4	3 3 2 2	6	2	3 2 2 2 2		0.0 0.0 61.0 48.0 0.0 2.0 14.0 0.0 20.0 4.0 0.0 20.0 4.0 0.0 30.0 30.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0 1.1 0.7 0.2
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum Phalaris	repens stokonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Reed canarygrass Timothy grass	FAC FACU  OBL FAC FACU  FACU  OBL FAC FACU  FACU  FACU  FACU  FACU  FACW  FACW	2	6	2	3	3 2 2	3 2 2	3 2 2 2	2 2 2		5 3 2 2	2 2	2	3 2 4	2 2 2	6	2	3 2 2		0.0 0.0 61.0 48.0 0.0 2.0 14.0 0.0 20.0 4.0 0.0 10.0 6.0 2.0 7.0 30.0 3.0	0.0 6.9 5.4 0.0 0.2 5.3 0.2 1.6 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elynus Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum Phalaris Phleum	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Reed canarygrass Plains bluegrass	FAC FACU OBL FACU OBL FACW FACW FACW	2	6	2 2	3	3 2 2	3 2 2	3 2 2 2 2	2 2 2		5 3 2 2	2 2	2	3 2 4	2 2 2	6	2 5	3 2 2 2 2 3		0.0 0.0 61.0 48.0 0.0 2.0 47.0 0.0 20.0 4.0 0.0 10.0 6.0 2.0 7.0 30.0 30.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.3 0.0
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum Phalaris Phleum Poa	repens stokonifera gerardii gracilis japanicus inermis spens canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Reed canarygrass Timothy grass	FAC FACU  OBL FAC FACU  OBL FAC FACU  FACU  FACU  FACU  FACW  FACW  FACW  FACU  FACU  FACU  FACU  FACU	2	6 2	2	2	4 3 2 2	2 2 3	3 2 2 2	2 2 2		5 3 2 2	2 2	2	3 2 4	2 2 2 2	3 6 2 2	2 2 5	3 2 2 2 2		0.0 0.0 61.0 48.0 0.0 2.0 47.0 0.0 20.0 4.0 0.0 20.0 4.0 0.0 2.0 7.0 30.0 30.0 9.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.3
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum Phalaris Pha Poa Poa Poa	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa pratensis	Quackgrass Redtop Big Bluestem Blue grama Jap, Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Reed canarygrass Timothy grass Plains bluegrass Canada bluegrass K. Blue	FACU OBL FACU OBL FACW FACW FACU FACU FACW FACU FACU FACU FACU	2	6	2 2	3	3 2 2	3 2 2	3 2 2 2 2	2 2 2		5 3 2 2	<ul><li>3</li><li>2</li><li>2</li><li>2</li></ul>	2	3 2 4	2 2 2	6	2 5	3 2 2 2 2 3		0.0 0.0 0.0 48.0 0.0 2.0 47.0 0.0 2.0 14.0 0.0 0.0 0.0 0.0 30.0 30.0 30.0 9.0 9.0 25.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.3 0.0 0.2
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum Phalaris Phieum Poa Poa Sorghastrum	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa pratensis nutans	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Timothy grass Plains bluegrass Canada bluegrass Canada bluegrass K. Blue Indian Grass	FAC FACU OBL FAC OBL FACW FACU FACU FACU FACU FACU FACU FACU FACU	2 4 3	6 2	2 2 2	2	4 3 2 2	4 3 2 2 3	3 3 2 2 2 2	2 2 2 3		<ul><li>5</li><li>3</li><li>2</li><li>2</li><li>2</li></ul>	5 3 2 2 2	2 2 3	3 2 4 3	2 2 2 2	3 6 2 2	2 2 5	3 3 2 2 2 2 3 3		0.0 0.0 61.0 48.0 0.0 2.0 47.0 0.0 0.0 14.0 0.0 0.0 10.0 6.0 2.0 30.0 30.0 30.0 30.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.3 0.0 0.2
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum Phalaris Phleum Poa Poa Poa Sorghastrum Spatina	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa pratensis nutans pectinata	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Reed canarygrass Plains bluegrass Canada bluegrass K. Blue Indian Grass Priarie Cordgrass	FACU OBL FACU OBL FACU OBL FACW FACW FACW FACW FACW FACW FACW FACU FACU FACU FACU FACU FACU FACU FACU	2	6 2	2 2	2	4 3 2 2	2 2 3	3 2 2 2 2	2 2 2		5 3 2 2	<ul><li>3</li><li>2</li><li>2</li><li>2</li></ul>	2	3 2 4	2 2 2 2	3 6 2 2	2 2 5	3 2 2 2 2 3		0.0 0.0 61.0 0.0 2.0 47.0 0.0 20.0 14.0 0.0 20.0 10.0 6.0 2.0 7.0 30.0 9.0 25.0 25.0 33.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.3 0.0 1.0 2.3
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum Phalaris Phleum Poa Poa Poa Sorghastrum Spatina Sphenopholis	repens stokonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa pratensis nutans pectinata obtusata	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virignia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Reed canarygrass Timothy grass Plains bluegrass Canada bluegrass K. Blue Indian Grass Priarie Cordgrass Wedgegrass	FACU FACU FACU FACU FACU FACU FACU FACU	2 4 3	6 2	2 2 2	2	4 3 2 2	4 3 2 2 3	3 3 2 2 2 2	2 2 2 3		<ul><li>5</li><li>3</li><li>2</li><li>2</li><li>2</li></ul>	5 3 2 2 2	2 2 3	3 2 4 3	2 2 2 2	3 6 2 2	2 2 5	3 3 2 2 2 2 3 3		0.0 0.0 61.0 48.0 0.0 2.0 14.0 0.0 2.0 10.0 0.0 0.0 0.0 3.0 0.0 3.0 0.0 2.0 7.0 30.0 3.0 9.0 9.0 9.0 9.0 9.0 9.0 9.0 9.0 9.0 9	0.0 6.9 5.4 0.0 0.2 5.3 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.3 0.0 1.0 2.8 0.0
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum Phalaris Phleum Poa Poa Sorghastrum Spatina Sphenopholis Sprobolus	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa pratensis nutans pectinata	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Reed canarygrass Plains bluegrass Canada bluegrass K. Blue Indian Grass Priarie Cordgrass	FACU OBL FACU OBL FACU OBL FACW FACW FACW FACW FACW FACW FACW FACU FACU FACU FACU FACU FACU FACU FACU	2 4 3	6 2	2 2 2	2	4 3 2 2	4 3 2 2 3	3 3 2 2 2 2	2 2 2 3		<ul><li>5</li><li>3</li><li>2</li><li>2</li><li>2</li></ul>	5 3 2 2 2	2 2 3	3 2 4 3	2 2 2 2	3 6 2 2	2 2 5	3 3 2 2 2 2 3 3		0.0 0.0 61.0 0.0 2.0 47.0 0.0 20.0 14.0 0.0 20.0 10.0 6.0 2.0 7.0 30.0 9.0 25.0 25.0 33.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.3 0.0 1.0 2.3
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum Phalaris Phleum Poa Poa Sorghastrum Spatina Sphenopholis Sprobolus Forbs	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa pratensis nutans pectinata obtusata cryptandrus	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Reed canarygrass Timothy grass Plains bluegrass K. Blue Indian Grass Priarie Cordgrass Wedgegrass sand dropseed	FAC FACU OBL FACU OBL FACW FACU FACU FACU FACU FACU FACU FACU FACU	2 4 3	6 2	2 2 2	2	4 3 2 2	2 2 2 2	3 3 2 2 2 2	2 2 2 3		5 3 2 2 2 2	2 2 2 2	2 2 3	3 2 4 3	2 2 2 2	3 6 2 2	2 2 5	3 3 2 2 2 2 3 3		0.0 0.0 61.0 48.0 0.0 2.0 0.0 2.0 14.0 0.0 20.0 4.0 0.0 20.0 30.0 9.0 9.0 0.0 25.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.3 0.0 1.0 2.8 0.0 0.0 0.2
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum Phalaris Phleum Poa Poa Poa Sorghastrum Spatina Sphenopholis Sprobolus Forbs Allium	repens stolonifera gerardii gracilis japanicus inermis spyp- canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa pratensis nutans pectinata obtusata cryptandrus canadensis	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Reed canarygrass Timothy grass Plains bluegrass K. Blue Indian Grass Priarie Cordgrass Wedgegrass sand dropseed wild onion	FACU OBL FACU OBL FACU OBL FACW FACW FACW FACW FACW FACU FACU FACU FACU FACU FACU FACU FACU	2 4 3	6 2	2 2 2	2	4 3 2 2	4 3 2 2 3	3 3 2 2 2 2	2 2 2 3		<ul><li>5</li><li>3</li><li>2</li><li>2</li><li>2</li></ul>	5 3 2 2 2	2 2 3	3 2 4 3	2 2 2 2	3 6 2 2	2 2 5	3 3 2 2 2 2 3 3		0.0 0.0 0.0 0.0 0.0 2.0 0.0 2.0 0.0 20.0 4.0 0.0 20.0 4.0 0.0 20.0 6.0 30.0 30.0 30.0 30.0 30.0 30.0 30.0 60	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.0 1.0 2.8 0.0 0.0 1.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum Poa Poa Poa Sorghastrum Spatina Sphenopholis Sprobolus Forbs Allium Amorpha	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa pratensis nutans pectinata obtusata cryptandrus canadensis fruticosa	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Fooxtail barley Junegrass Scratchgrass Switchgrass Reed canarygrass Timothy grass Plains bluegrass Canada bluegrass K. Blue Indian Grass Wedgegrass Wedgegrass sand dropseed wild onion False indigo	FACU  OBL FACU  OBL FACW  FACU  FACU  FACU FACU FACU FACU FACU F	2 4 3 5	6 2	2 2 2 2	2 2 3	4 3 2 2	2 2 2 2 2	3 3 2 2 2 2 2 2	2 2 2 3		5 3 2 2 2 2	2 2 2 2 2	2 2 3	3 2 4	2 2 2 3	2 2 3 3	2 2 5	3 3 2 2 2 2 3 3		0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0 0.7 0.2 0.8 3.4 0.3 0.0 0.2 0.3 0.3 0.0 0.3 0.0 0.0 0.0 0.0 0.0 0.0
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Muhlenbergia Panicum Poaleria Poa Poa Sorghastrum Spatina Sphenopholis Sprobolus Forbs Allium Amorpha Apocynum	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa pratensis nutans pectinata obtusata cryptandrus canadensis fruticosa cannabinum	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panitograss Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Timothy grass Plains bluegrass Canada bluegrass K. Blue Indian Grass Priarie Cordgrass Wedgegrass sand dropseed wild onion False indigo Dogbane	FACU FACU FACU FACU FACU FACU FACU FACU	2 4 3	6 2	2 2 2	2	4 3 2 2	2 2 2 2	3 3 7 2 2 2 2	2 2 2 3		5 3 2 2 2 2	2 2 2 2	2 2 3	3 2 4 3	2 2 2 2	3 6 2 2	2 2 5	3 3 2 2 2 2 3 3		0.0 0.0 0.0 0.0 0.0 0.0 2.0 0.0 2.0 0.0 2.0 0.0 0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.3 0.0 1.0 2.8 0.2 3.7 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum Phalaris Phaleum Poa Poa Sorghastrum Spatina Sphenopholis Sprobolus Forbs Allium Amorpha Apocynum Asclepias	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa pratensis nutans pectinata obtusata cryptandrus canadensis fruticosa cannabinum incarnata	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Timothy grass Plains bluegrass K. Blue Indian Grass Priarie Cordgrass Wedgegrass sand dropseed wild onion False indigo Dogbane Swamp Milkweed	FACU FACU FACU FACU FACU FACU FACU FACU	2 4 3 5	6 2	2 2 2 2	2 2 3	4 3 2 2	2 2 2 2 2	3 3 2 2 2 2 2 2	2 2 2 3		5 3 2 2 2 2	2 2 2 2 2	2 2 3	3 2 4	2 2 2 3	2 2 3 3	2 2 5	3 3 2 2 2 2 3 3		0.0 0.0 0.0 0.0 0.0 2.0 0.0 2.0 0.0 14.0 0.0 20.0 4.0 0.0 20.0 4.0 0.0 20.0 6.0 0.0 20.0 6.0 0.0 20.0 6.0 0.0 20.0 6.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.0 1.0 2.8 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum Phalaris Phleum Poa Poa Sorghastrum Spatina Sphenopholis Sprobolus Forbs Allium Amorpha Apocynum Asclepias Asclepias	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa pratensis nutans pectinata obtusata cryptandrus canadensis fruticosa cannabinum incarnata speciosa	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Viriginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Reed canarygrass Timothy grass Plains bluegrass Canada bluegrass K. Blue Indian Grass Priarie Cordgrass Wedgegrass sand dropseed wild onion False indigo Dogbane Swamp Milkweed Showy Milkweed	FACU FACU FACU FACU FACU FACU FACU FACU	2 4 3 5	6 2	2 2 2 2	2 2 3	4 3 2 2	2 2 2 2 2	3 3 2 2 2 2 2 2	2 2 2 3		5 3 2 2 2 2	2 2 2 2 2	2 2 3	3 2 4	3 3 2 2 2 2 3	3 6 2 2 3 3	2 2 2 3	3 3 2 2 2 2 3 3		0.0 0.0 0.0 0.0 0.0 2.0 0.0 2.0 0.0 2.0 0.0 0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.0 1.0 2.8 0.0 0.0 1.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum Phalaris Phleum Poa Poa Sorghastrum Spatina Sphenopholis Sprobolus Forbs Allium Amorpha Apocynum Asclepias Asclepias Asclepias	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa pratensis nutans pectinata obtusata cryptandrus canadensis fruticosa cannabinum incarnata speciosa sullivantii	Quackgrass Redtop Big Bluestem Blue grama Jap, Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Reed canarygrass Timothy grass Plains bluegrass Canada bluegrass K. Blue Indian Grass Prianie Cordgrass Wedgegrass sand dropseed wild onion False indigo Dogbane Swamp Milkweed Showy Milkweed Showy Milkweed Smooth Milkweed	FACU FACU FACU FACU FACU FACU FACU FACU	2 4 3 5	6 2	2 2 2 2	2 2 3	4 3 2 2	2 2 2 2 2	3 3 2 2 2 2 2 2	2 2 2 3		5 3 2 2 2 2	2 2 2 2 2	2 2 3	3 2 4	2 2 2 3	2 2 3 3	2 2 5	3 3 2 2 2 2 3 3		0.0 0.0 0.0 0.0 0.0 2.0 0.0 2.0 0.0 14.0 0.0 20.0 4.0 0.0 20.0 4.0 0.0 20.0 6.0 0.0 20.0 6.0 0.0 20.0 6.0 0.0 20.0 6.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.3 0.0 1.0 2.8 0.2 3.7 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elynus Elytrigia Festuca Glyceria Muhlenbergia Panicum Poa Poa Sorghastrum Spatina Sphenopholis Sprobolus Forbs Allium Amorpha Apocynum Asclepias Asclepias Asclepias Asclepias Asclepias	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa pratensis nutans pectinata obtusata cryptandrus canadensis fruticosa cannabinum incarnata speciosa sullivantii syriaca	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Timothy grass Timothy grass Plains bluegrass Canada bluegrass K. Blue Indian Grass Priarie Cordgrass Wedgegrass sand dropseed wild onion False indigo Dogbane Swamp Milkweed Smooth Milkweed Common milkweed	FACU FACU FACU FACU FACU FACU FACU FACU	2 4 3 5	3	2 2 2 2	2 2 3	4 3 2 2	2 2 2 2 2	3 3 2 2 2 2 2 2	2 2 2 3		5 3 2 2 2 2	2 2 2 2 2	2 2 3	3 2 4	3 3 2 2 2 2 3	3 6 2 2 3 3	2 2 2 3	3 3 2 2 2 2 3 3		0.0 0.0 0.0 0.0 0.0 2.0 0.0 2.0 14.0 0.0 2.0 0.0 6.0 2.0 3.0 0.0 3.0 0.0 2.0 6.0 2.0 6.0 6.0 6.0 6.0 6.0 6.0 6.0 6	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.3 0.0 1.0 0.7 0.0 0.7 0.0 0.7 0.0 0.7 0.0 0.7 0.0
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum Phalaris Phileum Poa Poa Sorghastrum Spatina Sphenopholis Sprobolus Forbs Allium Amorpha Apocynum Asclepias Asclepias Asclepias Asclepias Asclepias	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa pratensis nutans pectinata obtusata cryptandrus canadensis fruticosa cannabinum incarnata speciosa sullivantii syriaca verticillata	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Scratchgrass Switchgrass Timothy grass Plains bluegrass K. Blue Indian Grass Priarie Cordgrass Wedgegrass sand dropseed wild onion False indigo Dogbane Swamp Milkweed Showy Milkweed Smooth Milkweed Common milkweed Whorled milkweed	FACU FACU FACU FACU FACU FACU FACU FACU	2 4 3 5	3	2 2 2 2 2	2 2 2	4 3 2 2	2 2 2 2 2	3 2 2 2 2 2 2	2 2 2 2 2 4		5 3 2 2 2 2	2 2 2 2 2 2	2 3 2 2	3 2 4	3 3 2 2 2 2 2 3	2 2 3 3 2 2	2 2 2 3	3 3 2 2 2 2 3 3		0.0 0.0 0.0 0.0 0.0 2.0 0.0 2.0 0.0 14.0 0.0 20.0 4.0 0.0 20.0 4.0 0.0 20.0 6.0 30.0 30.0 30.0 30.0 0.0 0.0 0.	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.3 0.0 1.0 2.8 0.0 0.0 0.7 0.0 0.0 0.7 0.7
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum Phalaris Phleum Poa Poa Sorghastrum Spatina Sphenopholis Sprobolus Forbs Allium Amorpha Apocynum Asclepias	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia compressa pratense arida compressa pratensis nutans pectinata obtusata cryptandrus canadensis fruticosa cannabinum incarnata speciosa sullivantii syriaca verticiltata ericoides	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Reed canarygrass Timothy grass Plains bluegrass Canada bluegrass K. Blue Indian Grass Priarie Cordgrass Wedgegrass sand dropseed wild onion False indigo Dogbane Swamp Milkweed Smooth Milkweed Common milkweed Whorled milkweed White aster	FACU  FACU	2 4 3 5	3	2 2 2 2	2 2 3	4 3 2 2	2 2 2 2 2	3 3 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 3		5 3 2 2 2 2	5 3 2 2 2 2 2 2	2 2 3	3 2 4	3 3 2 2 2 2 2 2	3 6 2 2 2 2 2 2	2 2 5 3 2 2 2	3 3 2 2 2 2 3 3		0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.3 0.0 1.0 2.8 0.2 3.7 0.0 0.0 0.7 0.0 3.1 0.0 0.7 0.0 0.7 0.0 0.7 0.0 0.7 0.0 0.7 0.0 0.2 2.6
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum Phalaris Phleum Poa Poa Sorghastrum Spatina Sphenopholis Sprobolus Forbs Allium Amorpha Apocynum Asclepias	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa pratense arida compressa pratense fruticosa cannabinum incarnata speciosa sullivantii syriaca verticillata ericoides lanceolata	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Reed canarygrass Timothy grass Plains bluegrass Canada bluegrass K. Blue Indian Grass Priarie Cordgrass Wedgegrass sand dropseed wild onion False indigo Dogbane Swamp Milkweed Smooth Milkweed Common milkweed White aster Panicled aster	FACU FACU FACU FACU FACU FACU FACU FACU	2 4 3 5	3	2 2 2 2 2	<ul><li>4</li><li>3</li><li>2</li><li>2</li><li>2</li><li>2</li></ul>	4 3 2 2 2	2 2 2 2 2 2	3 2 2 2 2 2 2	2 2 2 3 4		5 3 2 2 2 2	5 3 2 2 2 2 2 2 2	2 2 2	3 2 4	3 3 2 2 2 2 2 3	2 2 3 3 2 2	2 2 2 3	3 3 2 2 2 2 3 3		0.0 0.0 0.0 0.0 0.0 2.0 0.0 2.0 0.0 0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.3 0.0 1.0 2.8 0.2 3.7 0.0 0.0 0.7 0.0 0.0 0.7 0.0 0.7 0.0 0.7 0.0 0.2 2.6 1.1
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum Poa Poa Sorghastrum Spatina Sphenopholis Sprobolus Forbs Allium Amorpha Apocynum Asclepias	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa pratensis nutans pectinata obtusata cryptandrus canadensis fruticosa cannabinum incarnata speciosa sullivantii syriaca verticiltata ericoides lanceolata oblongifolia	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panitograss Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Reed canarygrass Timothy grass Plains bluegrass Canada bluegrass K. Blue Indian Grass Priarie Cordgrass Wedgegrass sand dropseed wild onion False indigo Dogbane Swamp Milkweed Showy Milkweed Showy Milkweed Common milkweed White aster Panicled aster Aromatic aster	FACU FACU FACU FACU FACU FACU FACU FACU	2 4 3 5	3	2 2 2 2 2	2 2 2	4 3 2 2 2 2	2 2 2 2 2	3 3 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 3 3 4		5 3 2 2 2 2	5 3 2 2 2 2 2 2	2 3 2 2	3 2 4	3 3 2 2 2 2 2 2 2 2 2 2 2	3 6 2 2 2 2 2 2	2 2 5 3 2 2 2	3 3 2 2 2 2 3 3		0.0 0.0 0.0 0.0 0.0 2.0 0.0 2.0 0.0 2.0 0.0 0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.3 0.0 1.0 0.7 0.0 0.7 0.0 0.7 0.0 0.7 0.0 0.7 0.0 0.7 0.0 0.7 0.0 0.7 0.0 0.7 0.0 0.7 0.1 1.6
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum Phalaris Phileum Poa Poa Sorghastrum Spatina Sphenopholis Sprobolus Forbs Allium Amorpha Apocynum Asclepias	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa pratensis nutans pectinata obtusata cryptandrus canadensis fruticosa cannabinum incarnata speciosa sullivantii syriaca verticillata ericoides lanceolata oblongifolia praealtis	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Reed canarygrass Timothy grass Plains bluegrass K. Blue Indian Grass Priarie Cordgrass Wedgegrass sand dropseed wild onion False indigo Dogbane Swamp Milkweed Showy Milkweed Smooth Milkweed Common milkweed Whorled milkweed Whorled milkweed White aster Panicled aster Aromatic aster Willowleafed aster	FACU FACU FACU FACU FACU FACU FACU FACU	2 4 3 5	3	2 2 2 2 2	<ul><li>4</li><li>3</li><li>2</li><li>2</li><li>2</li><li>2</li></ul>	4 3 2 2 2	2 2 2 2 2 2	3 3 2 2 2 2 2 2 2 2 2 2 2	2 2 2 3 4		<ul><li>5</li><li>3</li><li>2</li><li>2</li><li>2</li><li>2</li><li>2</li><li>2</li><li>2</li></ul>	5 3 2 2 2 2 2 2 2	2 2 2	3 2 4	3 3 2 2 2 2 2 2 2 2 2 2 2	3 6 2 2 2 2 2 2	2 2 5 3 2 2 2	3 2 2 2 2 3 3 4		0.0 0.0 0.0 0.0 0.0 2.0 0.0 2.0 0.0 2.0 0.0 0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.3 0.0 1.0 2.8 0.0 0.0 0.7 0.7
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum Phalaris Phleum Poa Poa Sorghastrum Spatina Sphenopholis Sprobolus Forbs Allium Amorpha Apocynum Asclepias	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa pratensis nutans pectinata obtusata cryptandrus  canadensis fruticosa cannabinum incarnata speciosa sullivantii syriaca verticillata ericoides lanceolata oblongifolia praeatlis maculata	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Reed canarygrass Timothy grass Plains bluegrass K. Blue Indian Grass Prairie Cordgrass Wedgegrass sand dropseed wild onion False indigo Dogbane Swamp Milkweed Smooth Milkweed Common milkweed Whorled milkweed Willowleafed aster Aromatic aster Willowleafed aster Spottedwater hemlock	FACU FACU FACU FACU FACU FACU FACU FACU	2 4 3 5	3	2 2 2 2 2 2	2 2 2 2 2	4 3 2 2 2 2 2	2 2 2 2 2 2	3 3 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 3 3 4		5 3 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2	3 2 4 3 2 2	3 3 2 2 2 2 2 2 2	3 6 2 2 3 3 2 2 2 2 2 2 2	2 2 5 3 2 2 2	3 3 2 2 2 2 2 3 3 4		0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.3 0.0 1.0 0.7 0.0 0.7 0.0 0.7 0.0 0.7 0.0 0.7 0.0 0.7 0.0 0.7 0.0 0.7 0.0 0.7 0.0 0.7 0.1 1.6
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum Poa Poa Sorghastrum Spatina Sphenopholis Sprobolus Forbs Allium Amorpha Apocynum Asclepias Asclepias Asclepias Asclepias Aster Aster Aster Aster Circuta Cirsium	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa pralensis nutans pectinata obtusata cryptandrus canadensis fruticosa cannabinum incarnata speciosa sullivantii syriaca verticillata ericoides lanceolata oblongifolia praealtis maculata flodmani	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panitograss Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Switchgrass Timothy grass Plains bluegrass Canada bluegrass K. Blue Indian Grass Priarie Cordgrass Wedgegrass sand dropseed wild onion False indigo Dogbane Swamp Milkweed Smooth Milkweed Smooth Milkweed Smooth Milkweed Common milkweed Whorled milkweed Whorled milkweed Whorled aster Aromatic aster Villowleafed aster Spottedwater hemiock Flodman's thistite	FACU FACU FACU FACU FACU FACU FACU FACU	2 4 3 5	3	2 2 2 2 2	<ul><li>4</li><li>3</li><li>2</li><li>2</li><li>2</li><li>2</li></ul>	4 3 2 2 2 2	2 2 2 2 2 2	3 3 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 3 3 4		<ul><li>5</li><li>3</li><li>2</li><li>2</li><li>2</li><li>2</li><li>2</li><li>2</li><li>2</li></ul>	5 3 2 2 2 2 2 2 2	2 2 2	3 2 4	3 3 2 2 2 2 2 2 2 2 2 2 2	3 6 2 2 2 2 2 2	2 2 5 3 2 2 2	3 2 2 2 2 3 3 4		0.0 0.0 0.0 0.0 0.0 2.0 0.0 2.0 0.0 2.0 0.0 0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.3 0.0 1.0 2.8 0.0 0.0 0.7 0.7
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum Poa Poa Sorghastrum Spatina Sphenopholis Sprobolus Forbs Allium Amorpha Apocynum Asclepias	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa pratensis nutans pectinata obtusata cryptandrus canadensis fruticosa cannabinum incarnata speciosa sullivantii syriaca verticillata ericoides lanceolata oblongifolia praealtis maculata flodamani vulgare	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Timothy grass Plains bluegrass Canada bluegrass Canada bluegrass Wedgegrass Wedgegrass sand dropseed wild onion False indigo Dogbane Swamp Milkweed Showy Milkweed Showy Milkweed Common milkweed Whorled milkweed Whorled milkweed Whorled aster Aromatic aster Willowleafed aster Spottedwater hemlock Flodman's thistle tall thistle	FACU FACU FACU FACU FACU FACU FACU FACU	2 4 3 5	3	2 2 2 2 2 2	2 2 2 2 2	4 3 2 2 2 2 2	2 2 2 2 2 2	3 3 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 3 4		5 3 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2	3 2 4 3 2 2	3 3 2 2 2 2 2 2 2	3 6 2 2 3 3 2 2 2 2 2 2 2	2 2 5 3 2 2 2	3 3 2 2 2 2 2 3 3 4		0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.3 0.0 0.7 0.7
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Hordeum Koeleria Muhlenbergia Panicum Phalaris Phleum Poa Poa Sorghastrum Spatina Sphenopholis Sprobolus Forbs Allium Amorpha Apocynum Asclepias Asclepias Asclepias Asclepias Asclepias Aster Aster Aster Circuta Cirsium Cirsium	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa pratensis nutans pectinata obtusata cryptandrus canadensis fruticosa cannabinum incarnata speciosa sullivantii syriaca verticillata ericoides lanceolata oblongifolia praealtis maculata flodmani vulgare altissium	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virignia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Reed canarygrass Timothy grass Plains bluegrass Canada bluegrass K. Blue Indian Grass Priarie Cordgrass Wedgegrass sand dropseed wild onion False indigo Dogbane Swamp Milkweed Smooth Milkweed Common milkweed Whorled milkweed Whorled milkweed Whorled milkweed Whorled milkweed Whorled milkweed Whorled milkweed Fiodman's thistle tall thistle Tall thistle	FACU FACU FACU FACU FACU FACU FACU FACU	2 4 3 5	3	2 2 2 2 2 2	2 2 2 2 2	4 3 2 2 2 2 2	2 2 2 2 2 2	3 3 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 3 3 4		5 3 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2	3 2 4 3 2 2	3 3 2 2 2 2 2 2 2	3 6 2 2 3 3 2 2 2 2 2 2 2	2 2 5 3 2 2 2	3 3 2 2 2 2 2 3 3 4		0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.3 0.0 1.0 0.0 0.7 0.0 0.0 0.7 0.0 0.7 0.0 0.7 0.0 0.1 1.6 0.5 0.0 0.7 0.0 0.2 2.6 1.1 1.6 0.5 0.2 2.3
Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Muhlenbergia Panicum Phalaris Phleum Poa Poa Sorghastrum Spatina Sphenopholis Sprobolus Forbs Allium Amorpha Apocynum Asclepias Asclepias Asclepias Asclepias Asclepias Asclepias Aster Aster Aster Aster Circium Cirsium Cirsium Cornus	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa pratensis nutans pectinata obtusata cryptandrus  canadensis fruticosa cannabinum incarnata speciosa sullivantii syriaca verticillata ericoides lanceolata oblongifolia praealtis maculata flodmani vulgare altissium drummondi	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Reed canarygrass Timothy grass Plains bluegrass Canada bluegrass K. Blue Indian Grass Prianie Cordgrass Wedgegrass sand dropseed wild onion False indigo Dogbane Swamp Milkweed Smooth Milkweed Common milkweed Whorled milkweed Flodman's thistle tall thistle Tall thistle Dogwood	FACU FACU FACU FACU FACU FACU FACU FACU	2 4 3 5	3	2 2 2 2 2 2	2 2 2 2 2	4 3 2 2 2 2 2	2 2 2 2 2 2 2	3 3 2 2 2 2 2 2 2 2 2	2 2 2 2 2 4		5 3 2 2 2 2 2 2	5 3 2 2 2 2 2 2 2 2 2	2 2 2 2 2	3 2 4 3 2 2 2	3 3 2 2 2 2 2 2 2 2	3 6 2 2 2 2 2 2 2 2	2 2 5 3 2 2 2	3 3 2 2 2 2 3 3 4		0.0 0.0 0.0 0.0 0.0 2.0 0.0 2.0 0.0 14.0 0.0 20.0 14.0 0.0 20.0 14.0 0.0 20.0 14.0 0.0 20.0 14.0 0.0 20.0 14.0 0.0 20.0 14.0 0.0 20.0 14.0 0.0 20.0 14.0 0.0 20.0 14.0 0.0 20.0 14.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.3 0.0 1.0 0.7 0.7
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Agropyron Agrostris Andropogon Bouteloua Bromus Bromus Clamagrostris Dicanthelium Elymus Elytrigia Festuca Glyceria Muhlenbergia Panicum Phalaris Phleum Poa Poa Sorghastrum Spatina Sphenopholis Sprobolus Forbs Allium Amorpha Apocynum Asclepias Asclepias Asclepias Asclepias Asclepias Asclepias Aster Aster Aster Aster Circium Cirsium Cirsium Cornus	repens stolonifera gerardii gracilis japanicus inermis spp. canadensis acuminatum virginicus repens arundinacea striata jubatum macrantha asperifolia virgatum arundinacea pratense arida compressa pratensis nutans pectinata obtusata cryptandrus  canadensis fruticosa cannabinum incarnata speciosa sullivantii syriaca verticillata ericoides lanceolata oblongifolia praealtis maculata flodmani vulgare altissium drummondi	Quackgrass Redtop Big Bluestem Blue grama Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass Virginia Wild Rye Quackgrass Tall fescue Mannagrass Foxtail barley Junegrass Scratchgrass Switchgrass Reed canarygrass Timothy grass Plains bluegrass Canada bluegrass K. Blue Indian Grass Prianie Cordgrass Wedgegrass sand dropseed wild onion False indigo Dogbane Swamp Milkweed Smooth Milkweed Common milkweed Whorled milkweed Flodman's thistle tall thistle Tall thistle Dogwood	FACU FACU FACU FACU FACU FACU FACU FACU	2 4 3 5	3	2 2 2 2 2 2	2 2 2 2 2	4 3 2 2 2 2 2	2 2 2 2 2 2 2	3 3 2 2 2 2 2 2 2 2 2	2 2 2 2 2 4		5 3 2 2 2 2 2 2	5 3 2 2 2 2 2 2 2 2 2	2 2 2 2 2	3 2 4 3 2 2 2	3 3 2 2 2 2 2 2 2 2	3 6 2 2 2 2 2 2 2 2	2 2 5 3 2 2 2	3 3 2 2 2 2 3 3 4		0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0 6.9 5.4 0.0 0.2 5.3 0.0 0.2 1.6 0.0 2.3 0.5 0.0 1.1 0.7 0.2 0.8 3.4 0.3 0.0 0.0 0.7 0.0 0.0 0.7 0.0 0.7 0.0 0.7 0.0 0.7 0.0 0.7 0.0 0.2 2.6 1.1 1.6 0.5 0.2 2.3 0.2 0.2 0.2 0.0

Erigeron Eriochloa Eustoma Fraxinus	strigosus contracta grandiflorum pensylvanica	Daisy fleabane Prairie cupgrass Prairie gentian Green ash	FAC FACU FACW FACW			2		2	2	2	2						2.0 2.0 2.0	0.5 0.2 0.2 0.2																												
Glycrrhiza Helenium Helianthus Hypoxis Juniperus Lactuca	lepidota autumnale grosseserratus hirsuta virginiana serriola	Wild licorice Sneezeweed Sawtooth sunflower Yellow stargrass Red cedar Prickly lettuce	FACU FACW FACW FACU- FAC				2 2		2			2					2.0 0.0 0.0 6.0 2.0	0.0 0.2 0.0 0.0 0.7 0.2																												
Linaria Lippia Lobelia Lotus Lycopus Lycopus	spp. lanceolata spicata corniculatus americana asper	Toadflax Fogfruit palespike lobelia birds-foot trefoil American bugleweed Rough bugleweed	OBL FAC FACU OBL OBL	3 2	2		2 2 2 2			2		2 2 3			2 2	2	0.0 10.0 15.0 6.0	0.0 0.0 1.1 1.7 0.7 0.6																	the state of the s											
Lysmachia Lysmachia Lythrum Medicago Medicago	ciliata thyrsiflora alatrium lupulina sativa	Yellow lossestrife tufted loosestrife loostrife Black medic Alfalfa	FACW OBL OBL FAC	- 4	.3	2 .	3 3	3 2	2	2	2	2 2	3	2		2	0.0 2.0 2.0 37.0	0.0 0.2 0.2 4.2 0.0			ter																									
Melilotus Mentha Phyla Physallis Plantago	alba arvensis lanceolata virginiana major	W. sweetclover Field mint Fog fruit ground cherry Common plantain	FACU FACW OBL FAC	2	2 2	2	2 3	3 2	2	2		2 2 2 2 2	2	3	3	2 2	30.0 5.0 9.0 8.0 0.0	3.4 0.6 1.0 0.9 0.0							f										The second secon											
Polygonum Polygonum Polygonum Potentilla Prunella Rorripa	amphibium arenstrum lapathifolium recta vulgaris palustrus	Water smartweed Common knotweed Pale smartweed cinquefoil self-heal mustard	OBL OBL FAC OBL		2			2				2	2	2			4.0 0.0 0.0 6.0	0.0 0.5 0.0 0.0 0.7																	To expense of the control of the con											
Rosa Rudbeckia Rumex Sambucus Senecio	arkansana hirta crispus canadensis plattensis	wild rose black-eyed-susan dock Common elderberry Ragwort	FAC FACU FACW FAC FACU	3	2		2	2 2	2	3 2	2	2	2 2		2 2		0.0 21.0 7.0 0.0	0.0 0.0 2.4 0.8 0.0 0.0																												
Sisyrinchium Smilacina Solidago Solidago Solidago Taraxacum Toxicodendr	montanum stellata candensis gigantea rigida officinale on radicans	Blue-eyed grass false Solomon's seal Canada goldenrod giant goldenrod Ridgid goldenrod Dandelion poison ivy	FAC FACU FACW FACU FACU FACU FACU			2	2 2		2			2					0.0 2.0 2.0 0.0 6.0	0.7 0.0 0.2 0.2 0.0 0.7																												
Tragopogon Trifolium Trifolium Trifolium Verbena Verbena Vernonia	dubius hybridum pratense repens hastata stricta fasciculata	goatsbeard Alsike clover red clover White clover Blue Vervain Howary Vervain Ironweed	FACU FACU FACW FACW	2 2 2	2 3 2	2	2	3 3 2 2 2 3		2	2		2 5	4	2	2	2.0 34.0 10.0 0.0	0.0 0.2 3.9 1.1 0.0 0.0																												
Viola Sedges Carex Carex Carex Carex	pratincola aurea crawei emoryi granularis	Prairie violet  Sedge Sedge Emory's sedge Meadow sedge	FACW OBL				2 2			2		2					0.0 2.0 0.0	1.4 0.0 0.2 0.0																												
Carex Carex Carex Carex Carex	pellita praegracilis sartwellii tetanica vulpinoidea	sedge sedge clustered field sedge Sedge Sedge Fox sedge	FACW OBL FACW+ OBL FACW+	2				2	3			3	2	2	3	2	13.0 4.0 0.0 0.0	0.2 1.5 0.5 0.0 0.0																												
Eleocharis Eleocharis Eleocharis Equisetum Equisetum Juncus	erythropoda macrostachya elliptica arvensis laevigatum balticus	Spike rush spike rush Spike rush smooth horsetail Smooth horsetail Baltic rush	OBL OBL FACW FAC FACW OBL	2 2	2 3		3	2 2 3 3	2	2	2	2		2	2 2 3	2	27.0	0.5 0.2 1.0																												
Juncus Juncus Juncus Scirpus Sum	dudleyi interior torreyi pungens	Dudley rush Inland rush Torrey's rush Bulrush	FAC FAC FACW OBL			2		2 2 2 2 2				2	2 2 2	2			0.0 10.0 19.0 12.0 882.0	0.0 1.1 2.2 1.4																												
SCIENTIFIC GENUS		COMMON NAME	Wetland Rating		Q1 Avg.	T1Q2 T	Γ1Q2 Αν	g. T1Q3	T1Q3 Av	g. T2Q1	T2Q1 A	vg. T2G	2 T2Q2	Avg. T	2Q3 T2	Q3 Avg	j. T2Q4	T2Q4 Av	rg. T2Q:	5 T2Q5 Av	/g. T3Q	1 T3Q1 Av	/g. T3Q	2 T3Q2 A	Avg. T3G	Q3 T3Q:	3 Avg. T	Г3Q4 Т3	Q4 Avg	T3Q5 T	3Q5 Av	g. T4Q1	T4Q1	Avg. T	4Q2 T40	2 Avg.	T4Q3 T4	Q3 Av	g. T4Q4	T4Q4	Avg. T4	4Q5 T4Q 19A 99B	5 Avg.	Sum	% Contib.	
Grasses Agro.	hordeum			99A 99	)B mp	99A 9	39B mp	99A	99B m	p 99A	99В п	1p 99/	4 990	mp s	9A 9	9B mp	99A	99B m	p 99A	99B m	ip 99A	1 T3Q1 Av A 99B m	ip 99 <i>i</i>	A 99B	mp 99/	A 99B	3 mp	99A 99	B mp	99A 9	99B m	p 99A	99B	mp 9	99A 99I	3 mp	99A 55	, <u></u>		2				0.0	0.0	
Agrohordiun Agropyron Agropyron Agropyron Agrostris Andropogor Bouteloua	caninum smithii repens stolonifera	Slender Wheatgrass Westem Wheatgras Quackgrass Redtop Big Bluestem Blue grama		0 ;	3 3		4 3 5 5		5 4 3 4	i L	5 2	4 2	2 2 2 3 2		4 4	4 4 4	3 5	5 4 5 5	4 2	4 3	3 2	2 3 3 3 3	3	2 3 5 5	3 5	2 5 4 2	5 4 2 3	3	2 2 2 3	2 4	4 4	3 2 4 2	3 4	3 3	3 3	3 3 4 4	2 4	5 3	4 2 4 2	4 3	3 3	3	4 4	0.0 0.0 58.0 63.0 0.0	0.0 0.0 4.7 5.1 0.0	
Dicantheliur		Jap. Brome Smooth Brome Annual Brome Bluejointgrass Panicgrass	OBL FAC	3	2 3	5			2 3		3		3 2 2 2 2		2	2 2	3	2 3	3 2	! 2		2 2 2		3 4	4		2 3				2 3			2			2 4		2 3 5 2 2	2	2	5	4 5	20.0	0.3	
Elymus Elytrigia	virginicus repens	Virginia Wild Rye Quackgrass	FAC			2	2		2 2	2 2	2	2	2 2	2	2	2 2		2 2	2	2 2	2										2	2 2	!	2	2	2				2	2					

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																				8									4		1-1-						17. 1		2 5 5,7			1	H
a arundinacea a striata ım jubatum a macrantha	Tall fescue Mannagrass Foxtail barley	FACU OBL FACW	3	2 3					2		2	2	2			4		2			2	2											V6-02 (1800)	2	2 2								10.
nbergia asperifolia m virgatum is arundinacea n pratense	Junegrass Scratchgrass Switchgrass Reed canarygrass Timothy grass	FAC FACW+ FACU		2 2 3 3				2	2 2	2 2	2 2 2	3	3 3		2 2		2	2	2 2 2	2 2 2	3 2	4 4 2 2	3	2 2 2 2	2	2 2	2 3 2 4	3 5	3 5	3	3 2	3	3 2	2		2	2 2			2	2	2 2 3 3	
arida compressa pratensis sistrum nutans pectinata opholis obtusata oryptandrus	Plains bluegrass Canada bluegrass K. Blue Indian Grass Priarie Cordgrass Wedgegrass sand dropseed	FACU FACU FACW FACW FACU-	2	0 3 0 2 4 4	3	3		2	3 3						2 2			2	3 3	3	2 2 3	2 2 2 2 2 3	2	2	2	2	2 2 2 2	3	2 3 4	2	2 2 2 4 2	2	2 2 2	2	2	2	2 2 2 2	2 2	2	2 2 2 2	2 2 2 2	2	0. 0. 2 20 2 28 6. 2 38 0.
canadensis na fruticosa um cannabinum as incarnata as speciosa	wild onion False indigo Dogbane Swamp Milkweed Showy Milkweed	FACU OBL FAC OBL FAC	3	3 3	2	2 2			2	2	2				2 2		2	2	2 2	. 2	2	2		2 2			2 2	2	2		2	. 2	2	2 2	2				2	2	2	2	0. 6. 0. 2 31 0.
as sullivantii as syriaca as verticillata ericoides lanceolata	Smooth Milkweed Common milkweed Whorled milkweed White aster Panicled aster	OBL FACU FACW					2			2	2	0	2 2	•	2 2		2	2				2		2 2		2	2	2	2	2		2	2	2	2 2		2 2	2	2	2 2		2 2	0. 0. 6. 2 10 2 30
oblongifolia praealtis maculata flodmani	Aromatic aster Willowleafed aster Spottedwater hemlog	FACW			2	2			2 2			2		2	2	2	2	2	2 2	2		2 2 2 2	2	2 2	2	2	2 2		2	2	2 2				2	2	2	2 2		2	2 2		2 34 0. 0. 4.
vulgare altissium drummondi hus illioensis	tall thistle Tall thistle Dogwood bundleflower	FAC FACU			2 2 2	2 2 2					2			2	2 2				2 2	, ,		2 2						•						2	2 2	2		2 2	2	2	2		2 26 0 2 8
philadelphicus strigosus contracta grandiflorum	Daisy fleabane Prairie cupgrass Prairie gentian	FAC FACU FACW					2		2			-				2							2		. 2	2	2	2	2 2			2 2		- 1	2 2	2		2 2		2		2 2	0
pensylvanica lepidota autumnale ls grosseserratu hirsuta	Green ash Wild licorice Sneezeweed s Sawtooth sunflower Yellow stargrass	FACW FACW FACW FACW								2			100-									2			2		2	2	2	2				2	2					2			1
s virginiana serriola spp. lanceolata	Red cedar Prickly lettuce Toadflax Fogfruit	FACU- FAC OBL			2	2 2			2	2	2	2	2	2	2	2	2	2	2	2	2	2		2 2	2 2		2	2	2		-		2 2 2		2 2			2 2		2	2 2	2 2	2 (
spicata corniculatus americana asper	palespike lobelia birds-foot trefoil American bugleweed Rough bugleweed	OBL	0	2 2	2	2 2			2	2	2	2	2 2										2	2 2	2	2	2	2	2	2	2		2 2	2	2				2	2		2 2	1 2 1
ia ciliata ia thyrsiflora alatrium o lupulina o sativa	Yellow lossestrife tufted loosestrife loostrife Black medic Alfalfa	FACW OBL OBL FAC			2	2 2	2 2	2	2 2		2	2 2	2 2	2	2 2	2			2	2		2							2		2		2		2 2		2	2 4	2	2	2 2		
alba arvensis Ianceolata virginiana	W. sweetclover Field mint Fog fruit ground cherry	FACU FACW OBL	0	2 2		_	-			2 2	2 2	•	£	2	2			2					2	2	2 2		2	2	2			2	2	2	2							2 2	(
major ım amphibium ım arenstrum ım lapathifolium	Common plantain Water smartweed Common knotweed Pale smartweed	OBL OBL																									2	2	2			2			2				2	2			
recta vulgaris palustrus arkansana iia hirta	cinquefoil self-heal mustard wild rose black-eyed-susan	FAC OBL FAC FACU		2 2 0 2			2	2							2		_					2			2		2		2					2	2							2 :	1 1 2 3
crispus is canadensis plattensis ium montanum	dock Common elderberry Ragwort Blue-eyed grass	FACW	2	2 2			2	2	2		2 2	2	2 2		2 2	2	2	2	2 2	2 2		2 2	2	2 2	2 2		2 2		2 2 2			2	2	To the second	2 2		2		2				1
a stellata candensis gigantea rigida	false Solomon's sea Canada goldenrod giant goldenrod Ridgid goldenrod	FACU FACW FACU							2	•	2																	*			2			2	2				2	2			
um officinale endron radicans gon dubius hybridum	Dandelion poison ivy goatsbeard Alsike clover	FACU	2	0 2					2 2														2	:	2					2 2		2	2		2 2						•		
pratense repens hastata stricta	red clover White clover Blue Vervain Howary Vervain	FACU FACW				2 2		2	2				2 2				2	2	2	2 2	2		2	3	2	2	2	2	2	2 2	2 2 2	2	2		3 3 2 2				2	2		2 2	2 2 2 2 2 2
fasciculata pratincola aurea crawei	Ironweed Prairie violet Sedge	FAC-	2	2 2	2	2			2	! 2	2	2	2								2	2 2 2	2	2 :	2 2	2	2 2	2		2 2	2	2	2		2 -					2			3 2
crawei emoryi granularis pellita	Sedge Emory's sedge Meadow sedge sedge	FACW	4 3				2		2 2	•	2	2	2	2	2	2						2										2			2								6 8 3

selea Folda Sachya Sach	clustered field sedge Sedge Sedge Fox sedge Spike rush Spike rush Spike rush Smooth horsetail Smooth horsetail Baltic rush Dudley rush Inland rush Torrey's rush Bulrush	FACW OBL FACW+ OBL OBL FACW FAC FACW OBL FACW OBL FAC FAC FAC FACW OBL		2 2 2	2	3	3				2	2	2	5	2	4	2	2 2	2 4	3 4 2 3	3 3 2 3	2	2 2 2	2	2 2	2	2 2	3 2 2 2 2	2	2 2 3	3 2		3	3 3	2 2 2	2 2 2	2	2	2	2	2	2	2 3	4.0 0.0 0.0 2 14.0 0.0 2 30.0 5.0 0.0 0.0 2 35.0 0.0 0.0 2 12.0 2 16.0 14.0	0.0 1.1 0.0 2.4 0.4 2.9 0.0 0.0 1.0 1.3
s g	COMMON NAME	Wetland Rating	T101 T1	Q1 Avg.	T1Q2 T	1Q2 Av	g. T1Q3	3 T1Q3	Avg. T	2Q1 T2	Q1 Avg.	T2Q2 T	T2Q2 Av	g. T2Q	3 T2Q3 A	Avg. T2	2Q4 T2	2Q4 AV	vg. T2Q	5 T2Q5	Avg. T	3Q1 T30	Q1 Avg. 1	T3Q2 T3	Q2 Avg.	T3Q3 T	3Q3 Avo	T3Q4	T3Q4 Av	va T30	5 T3O5	Ava TA	101 T40	01 Avg.	T4Q2 T4	Q2 Avg.	T403 T	[4O3 A	va T40	47101				1226.0	
1			20A 20	0B mp	20A 2	20B mp	20A	20B	mp	00A 0	OB mp	00A	00B m	p 00A	. 00B i	mp 0	0A 0	0B m	ip 00 <i>A</i>	A 00B	mp (	00A 00I	В тр	00A 00	В тр	00A (	0B mp	00A	00B m	np 00A	A 00B	mp 0	0A 001	3 mp	00A 0	B mp	00A	00B m	np 00/	4 14Q4 \ 00B	mp (	00A 00	Q5 AVg )B mp	Sum	% Contr
	Slender Wheatgrass Western Wheatgrass												1 1		1	1		1 1	1																					1	1				0.0 0.0 0.5
ra I	Quackgrass Redtop Big Bluestem	FAC+	3 :	3 3	4	3 4	3	5	4	3	3 3	2 3	1 2 4 4	1 ;	3 4	1 4	1 3	4	1	1 3 4	1 4	3	4 4	3	3 3	2 3	2 3 3			;	3 4	4	3	3 3	3	4 4	3	3	3	2 4	3	1 3	1 3 3	0.0 8.0 60.0	0.0 1.0 7.5
	Blue grama Jap. Brome	FAC-	1.01	•	3	3	3	*	4		3 3	2	3 3		+ 3	4	3	4	4	3 3	3	3	3 4	4	5 5	3	3 3	3	3	3 4	4 4	4	4	4 4	4	4 4	3	4	4	3 4	4	3	4 4	64.0	8.0
s	Smooth Brome Annual Brome Bluejointgrass	OBL	3	3 3	4	5 5		5	4	3	3 3	3	1 1		2 2	2	1	2	2	2 2												3								2	2		3 3	0.0	6.6 0.0 0.5
9	Panicgrass Virginia Wild Rye Quackgrass	FAC FAC											1 1									2	2								1	1			1	2 2	1	1	1	1 1	ī			8.0 0.0	1.0
	Tall fescue Mannagrass Foxtail barley	FACU OBL FACW		3 3						1	1		2		1 1	1	1		1												1	1								2	2			6.0 0.0	0.0 0.7 0.0 0.7
lia	Junegrass Scratchgrass Switchgrass	FAC		3 3			2	2	2		2 2		2 2	2	1 2	2		2	2	3	3		3 3				2 2	3	3	3		ij.		2 2	3	2 3		2	2	2	2			0.0	0.0 0.0 4.1
	Reed canarygrass Timothy grass Plains bluegrass	FACW+ FACU	3	3 3																																						2		15.0	1.9 0.0
sa -	Canada bluegrass K. Blue Indian Grass	FACU FACU	2	1 1 3 3	2	2	1		1	1	1	2	1 1	2	2	2	2	2	2			1	1			1	2 2				1 2 2	1 2	2	2	2	2	1	2	2	2	2	1	. 1	6.0 24.0 2.0	0.7 3.0
a 3	Priarie Cordgrass Wedgegrass sand dropseed	FACW FACW	3			2 2	. 2	2	2	2	3 3	1	1 1	Ē .	2 2	2	1	2	2	2	2	2	2			2	3 3	2	2	2	3 3	3	1	1				. 2		1 2				35.0 0.0	4.4 0.0
ารเร	wild onion False indigo	FACU OBL										1	্ৰ	1	2	2	1	1	1					1	1			2		2												1	1	8.0	
num a	Dogbane Swamp Milkweed	FAC OBL	3	2 3	1		2		2	1	1 1	1	1 1	1	1 2	2				2 2	2	1	1 1		1 1	2	2 2	2		2				1 1	1	1 1				1 1	1			22.0 0.0	0.0 2.7 0.0
	Showy Milkweed Smooth Milkweed Common milkweed	FAC OBL	1	1 1															_				1 1								1									1 1	1			0.0	0.2 0.0 0.4
s	Whorled milkweed White aster Panicled aster	FACU FACW			1	2 2	2	2	2 1	1	2 2		1 1	1	1	1	1	2	2 2 1	2	2 1		1 1		1 1	1	2 2					1	1	1 1	1	1 1	1	1	1 1	1 1	1 1	1	2 2 1 1	4.0 21.0 13.0	0.5 2.6 1.6
S	Aromatic aster Willowleafed aster Spottedwater hemloo	FACW ck OBL																																										0.0	0.0
	Flodman's thistle tall thistle Tall thistle	FACU					3	2	3	1	1 1	2	1 2	2	1	1	1	2	2			1	1 1	2	2 2	1	2 2				1	1 1					1	1	1					0.0	0.0
	Dogwood bundleflower Philadelphia fleabane	FAC FACU e FAC			1	1 1	2	2	2			1	1 1	1	3 3	3		2	2	1 1	1	1	1 1	1	1		2 2		1	1	1 2	2 2	2	2 2	1	1	1 3	2	3			1	1 1	4.0 24.0 1.0	3.0
1	Daisy fleabane Prairie cupgrass Prairie gentian	FAC FACU FACW															1		1	1 2	2 2	1	1																				1 1	0.0	0.0
anica	Green ash Wild licorice	FACW FACU								2	1 2												1 1																		1			0.0	0.5 0.0 0.5
erratus	Sneezeweed Sawtooth sunflower Yellow stargrass	FACW																														1 1												0.0	0.0
	Red cedar Prickly lettuce Toadflax	FACU- FAC		1 1	2	2 2	2			1	1		1	1	1 1	1						2	1 2 1 1	1	1 1		1 1	1		1			1	1 1	1	1	1 1			1	1	1	1	4.0 0.0 6.0	0.5
	Fogfruit palespike lobelia birds-foot trefoil	OBL FAC FACU	1	1 1	2	19	2				1 1	1		1			1		1				1 1		1 1		2 2						1	1 4										2.0 13.0 3.0	
	American bugleweed Rough bugleweed Yellow lossestrife	OBL OBL FACW	1		-	-				u <b>±</b> 6		,		-1	1	1				1 1	1 1			30			2 2	1		1														0.0	0.0
	tufted loocastrifa	OBI	2	-	2	0	<b>1</b> = 0.0		w <u>-</u>			1	1	1						1	1			8			2 2					<u>.</u> 021		٠	Sian			2	2			1	1 1	4.0	0.
	Black medic Alfalfa W. sweetclover Field mint	OBL FAC FACU FACW	1	1 1	1	1 1	2 1	2	2	1	1 1	1	2 :	2	1	1	1	1 2	1 2	1 2	1 2 2			2	1 2	2	2 2 2 2		1		1	1 1	1	1 1	1 1	1	1 1	1	1	1	1	1	2 2	22.0 1.0	0.5

Phyla	lanceolata	Fog fruit	OBL									1	1																																		
Physallis	virginiana	ground cherry		1		1						1 1	1																						1	1						1	1		1 1	4.0	0.5
Plantago	major	Common plantain	FAC																															2												20	0.2
Polygonum	amphibium	Water smartweed	OBL																											1	2 1	1		1							1	1	1	7	1 1	3.0	0.4
Polygonum	arenstrum	Common knotweed																													2 2		1													2.0	
Polygonum	lapathifolium	Pale smartweed	OBL																														1	3												1.0	0.1
Potentilla	recta	cinquefoil		1		1																																								0.0	0.0
Prunella	vulgaris	self-heal		1										1	2 2	1	1 1	2	2	2	2	2											1	1					-							1.0	
Rorripa -	palustrus	mustard		1		1																												3.					1		1 1	2	1	1	1	12.0	
Rosa	arkansana	wild rose	FAC																																											1.0	
Rudbeckia	hirta	black-eyed-susan	FACU						2	2	2			1	1 1						1	2 2		1	1								1	1					1			3-35				0.0	
Rumex Sambucus	crispus	dock	FACW	1	1	1																												5.52					1.0		1 2	1	2	1	1 1	11.0	
Senecio	canadensis plattensis	Common elderberry	FAC																																											1.0	
Sisyrinchium	( Comment of the control of the cont	Ragwort	FACU																																											0.0	
Smilacina	stellata	Blue-eyed grass false Solomon's seal	FAC FAC																																											0.0	
Solidago	candensis	Canada goldenrod	FACU																																		1									0.0	
Solidago	gigantea	giant goldenrod	FACU																				£.					1																		0.0	
Solidago	rigida	Ridgid goldenrod	FACU																									į			1 1											1	1			2.0	C00725541
Taraxacum	officinale	Dandelion .	FACU	2	4	2				100						1981	ng.									550																				0.0	
Toxicodendro		poison ivy	FACU	-		2					3	2 1	2	ı	-1	1	1		1	1						2	2						1	1			1 1	1						1	1	12.0	
Tragopogon	dubius	goatsbeard	17100	1		1																																								0.0	
Trifolium	hybridum	Alsike clover	FACU																																											1.0	
Trifolium	pratense	red clover	FACU	1		1 2	,	2	1		1	2 1	2			1	1 1		1	1 1	- 4	2 2		r	4	2	2									_										0.0	
Trifolium	repens	White clover	FACU			_	-	_				- '	-			1	' 1		•			2 2			141	1	1	2	2 2			1		1 2	2	2	3 3	3	100	2	2	1	1	1	1	26.0	3.2
Verbena	hastata	Blue Vervain	FACW																		1	2 2	E.	- 1	1	1	1												2		2 2		2			6.0	0.7
Verbena	stricta	Howary Vervain																						,								1	1	1										1	1 1	5.0	0.6
Vernonia	fasciculata	Ironweed	FAC	2	2	2			1	1	1	1 2	2	2	2 2	1	1 1			1 1	2	2 2		2	2			1	1			4	2	2			4									0.0	
Viola	pratincola	Prairie violet	FAC-																		1000			1	1			*.				1	2	1	1	1					2	. 2	2			19.0	
Sedges																																		•	10											3.0	0.4
Carex	aurea .	Sedge																																													
Carex	crawei .	Sedge	FACW	- Control			2	2	1	2	2					1	1						1	1 2	2	2	2		2 2					2	2 2	2	2 2	2 2	1	2	2 2	, 1	2			0.0 21.0	
Carex Carex	emoryi	Emory's sedge	OBL	3	3	3								2	1 2															1	1	ij								3 17 mg						6.0	
Carex	granularis pellita	Meadow sedge	FACW	-																											1	Fi .														1.0	
Carex	praegracilis	sedge clustered field sedge	OBL FACW	1		1															1	1																								2.0	
Carex	sartwellii	Sedge	OBL	-1																																										0.0	
Carex	tetanica	Sedge	FACW+																																											1.0	0.1
Carex	vulpinoidea	Fox sedge	OBL		1	1						1 1	1																					1 1		1										2.0	0.2
Eleocharis	erythropoda	Spike rush	OBL		-	-2			1		1	181																				2	1	2												40	
Eleocharis	macrostachya	spike rush	OBL								2																									~										1.0	
Eleocharis	elliptica	Spike rush	FACW				2	2				1	1	3	3	3	2 3		3	2 3	3	2 3	3							1	2 2	, ,	1	2	r	1	1	F. 54			45 P.					0.0	0.0
Equisetum	arvensis	smooth horsetail	FAC																																										100000000000000000000000000000000000000		
Equisetum	laevigatum 	Smooth horsetail	FACW			3	3 3	3	3		3			2	2	2	2 2		2	2 2	. 3	2 3	3	1	1	3	3	2	2 2			3	2	3 :	2 2	2	2 2	2 2	2	2	2 2	2 2	2	2	2 2	340	4.2
Juncus	balticus	Baltic rush	OBL																													-,-			_	_			8 29		C. Carlo					0.0	
Juncus	dudleyi	Dudley rush	FAC																																											0.0	0.0
Juncus Juncus	interior	Inland rush	FAC									1 1	1	1	1 1	1	1					2 2 2	2							2 1 1	2	2 2	2	2							2	2	2	1		12 0	15
Scirpus	torreyi pungens	Torrey's rush Bulrush	FACW OBL									1	1	_	_		2 2	!			3	2 3	3							1	1	1									2	2 2	2	2	2 2	110	14
Sum	pungens	Dulluali	OBL									1	1	2	2 2	1	1 1					2 2	2						2 2	1	v - 1	1												1	1	10 C	1.2
ou																																														804 0	99.2

Table 26. Vegetation Composition for CWR Site 1997-2000

SCIENTIFIC NAME COMMON NAME Wetland **GENUS** Rating T1Q1 T1Q2 T1Q3 T1Q4 T1Q5 T2Q1 T2Q2 T2Q3 T2Q4 T2Q5 Sum % 97 97 97 97 97 97 97 97 97 Contrib. Grasses Agropyron elongatum Intermediate wheatgrass 3 10 6.5 Agropyron spp. 6 5 27 17.5 FAC Agropyron repens Quackgrass 0 0 Agrostis stolenifera Redtop FAC+ 3 1.9 3 7 Smooth brome Bromus inermis 1.9 Chloris verticulata Windmill grass 3 4.5 ·oligosanthes Dichanthelium FACU Panicgrass 8 Δ 4 5.2 Echinocloa **FACW** cruṡgalli Barnyardgrass 0 0 canadensis Elvmus Canada wild rye FACU 0 Hordeum jubatum Foxtail barley **FACW** 1 0.6 Leersia oryzoides Rice cutgrass OBL 0 0 Panicum virgatum Switchgrass FAC 0 0 0 Phalaris arundinacea Reed Canarygrass FACW+ 0 Poa pratensis Kentucky blue grass FACU 3 1.9 Setaria glauca Yellow foxtail FAC 5 5 3.2 pectinata FACW 3 Spartina Prairie cordgrass 3 1.9 Triticum aestivum 0 0 Mays Com 4 1 Zea 4 17 11 Forbs Amaranthus retroflexus Pigweed FACU 1 2 1.3 artimisiafolia Ambrosia Annual rageweed FACU 0 0 Ambrosia trifida Giant ragweed FACW 0 0 **Apocynum** spp. Dogbane FAC 1 0.6 Common milkweed Asclepius syriaca 1 1 5 3.2 OBL Asclepius incarnata Swamp milkweed 0 0 Aster praealtis Willow leaf aster **FACW** 1 1 0.6 Aster lanceolata Lance-leaved aster **FACW** 0 0 Astragalus canadensis Canada milkvetch FACU 0 0 Calylophus serrulatus 0 0 Chenopodium album lambsquarters FAC 0 0 canadensis Marestail FACU-0 Conyza 0 Cornus drummondii Rough-leafed dogwood 0 FAC 0 Dalea Purple prairie clover 0 purperea 0 Descurainin Herb-Sophia 0 sophia 0 Illinois bundleflower FACU Desmanthus illinoensis 0 0 Fraxinus pensylvanica Green ash FACW 0 0 0 Glycyrrhiza lepidota Wild licorice FACU 0 Annual sunflower 3 Helianthus annual **FACU** 6 1 1 15 9.7 Helianthus maximilianii Max. Sunflower 1 0.6 FACU Kochia scoparia Mexican fireweed 0 0 Prickley lettuce Lactuca serriola FAC 0 0 Lippia lanceolata Fogfruit OBL 0 0 Lycopus americana Buggleweed OBL 3 3 1.9 0 Lycopus aster Rough bugleweed OBL 0 Lythrum spp. 0 FAC Medicago lupulina Black Medick 0 0 Medicago sativa Alfalfa 0 0 Melilotus alba White sweetclover FACU 0 0 Melilotus officinalis Yellow sweetclover **FACU** 0 0 Nepeta cataria Catnip FACU 0 0 2 2 Physalis virginiana Common ground cherry 1.3 OBL 0 Polygonum persicaria Lady's thumb 0 Polygonum coccinium Smartweed OBL 0 0 Rudbeckia Black-eyed susan FACU 0 hirta 0 FACW Rumex crispus Curly dock 4 2.6 Rumex altissimus Pale dock FAC 1 0.6 0 Rumex spp. 0 buffalobur Solanum rostratum 3 3 8 5.2 FACU 2 Solidago canadensis Canada goldenrod 1.3 Solidago gigantea Giant goldenrod **FACW** 0 0 Taraxacum officiale Dandelion FACU 0 0 Vernonia fasciculata Ironweed FAC 0 0 Cockelbur Xanthium strumarium FAC 0 0 Sedges Carex spp. Sedge 2 3 5 3.2 palustris OBL Eleocharis Spike sedge 0.6 FACW Equisetum laevigatum Smooth horsetail 3 3 1.9 Scirpus maritimus Saltmarsh bulrush OBL 0 0 Scirpus pungens Bulrush OBL 0 0 Bulrush 3 Scirpus spp. 4 7 4.5 validus OBL Scirpus Soft-stem 3 3 1.9 latifolia Cat-tail OBL 3 3 Typha 19 Sum 154 99

4	0	0	0	

199		82.00.330.00													
SCIENTIFIC NA GENUS	AME SPECIES	COMMON NAME	Wetland Rating	T1Q1	T1Q2	T1Q3	T1Q4	T405	7001	T000				i s	
	01 20120		Rating	99	99	99	99	T1Q5 99	12Q1 99	T2Q2 99	T2Q3 99	T2Q4 99	T2Q5 99	SUM	% Contrib.
Grasses			,							- 00	- 55		33	l	Contrib.
Agropyron Agropyron	elongatum	Intermediate wheatgrass Wheat			2	6	0+5			2	2		2	14	4.9
Agropyron	spp. repens	Quackgrass	FAC	6	5		2	5	6		4	5	5	38	13.4
Agrostis	stolenifera	Redtop	FAC+											0	0
Bromus	inermis	Smooth brome	IACT	2						2				0	0
Chloris	verticulata	Windmill grass		2						2				4 0	1.4
Dichanthelium	oligosanthes	Panicgrass	FACU											0	0
Echinocloa	crusgalli	Barnyardgrass	FACW						2					2	0.7
Elymus	-canadensis	Canada wild rye	FACU											0	0
Hordeum Leersia	jubatum oryzoides	Foxtail barley	FACW		3	2	6			2	5	2		20	7
Panicum	virgatum	Rice cutgrass Switchgrass	OBL FAC			2				_				2	0.7
Phalaris	arundinacea	Reed Canarygrass	FACW+							2				2	0.7
Poa	pratensis	Kentucky blue grass	FACU			2				3				0	0
Setaria	glauca	Yellow foxtail	FAC	2		_			2	3			2	5 6	1.8 2.1
Spartina	pectinata	Prairie cordgrass	FACW						_	2			4	2	0.7
Triticum	aestivum	•												ō	0
Zea Forbs	Mays	Com												0	0
Amaranthus	retroflexus	Pigweed	E4.011												
Ambrosia	artimisiafolia	Annual rageweed	FACU FACU	0										0	0
Ambrosia	trifida	Giant ragweed	FACU	2		3				2				2	0.7
Apocynum	spp.	Dogbane	FAC	2	2	2	2		2	2	2			5 12	1.8
Asclepius	syriaca	Common milkweed	1. SUITE-	2	3	2	2	2	2	2	2	2	2	21	4.2 7.4
Asclepius	incarnata	Swamp milkweed	OBL	2					_	-	-	-	2	2	0.7
Aster	praealtis	Willow leaf aster	FACW											0	0
Aster Astragalus	lanceolata	Lance-leaved aster	FACW							2				2	0.7
Calylophus	canadensis serrulatus	Canada milkvetch	FACU							2	2			4	1.4
Chenopodium	album	lambsquarters	FAC	2					0					0	0
Conyza	canadensis	Marestail	FACU-	2					2					4	1.4
Cornus	drummondii	Rough-leafed dogwood	FAC	2									,	0	0 0.7
Dalea	purperea	Purple prairie clover												0	0.7
Descurainin	sophia .	Herb-Sophia												0	0
Desmanthus	illinoensis	Illinois bundleflower	FACU							2	2	2	2	8	2.8
Fraxinus Glycyrrhiza	pensylvanica lepidota	Green ash Wild licorice	FACW											0	0
Helianthus	annuus	Annual sunflower	FACU FACU	3	4				•					0	0
Helianthus	maximilianii	Max. Sunflower	1 700	3	4				2					9	3.2
Kochia	scoparia	Mexican fireweed	FACU	2					2					0	0 1.4
Lactuca	serriola	Prickley lettuce	FAC	2	2				-					4	1.4
Lippia	lanceolata	Fogfruit	OBL			2								2	0.7
Lycopus	americana	Buggleweed	OBL											0	0
Lycopus Lythrum	asper spp.	Rough bugleweed	OBL			€				2				2	0.7
Medicago	lupulina	Black Medick	FAC							2				2	0.7
Medicago	sativa	Alfalfa	IAC							2				2	0.7
Melilotus	alba	White sweetclover	FACU	2										0 2	0 0.7
Melilotus	officinalis	Yellow sweetclover	FACU	2	2		2	2	2	2	2	2	2	18	6.3
Nepeta	cataria	Catnip	FACU							2	_	-	-	2	0.7
Physalis	virginiana	Common ground cherry		2				2						4	1.4
Polygonum Polygonum	persicaria coccinium	Lady's thumb	OBL			2								2	0.7
Rudbeckia	hirta	Smartweed Black-eyed susan	OBL FACU											0	0
Rumex	crispus	Curly dock	FACU	2		2			0	•				0	0
Rumex	altissimus	Pale dock	FAC	2		2			2	2			2	10	3.5
Rumex	spp.													0	0
Solanum	rostratum	buffalobur												0	0
Solidago	canadensis	Canada goldenrod	FACU						2			2	2	6	2.1
Solidago	gigantea	Giant goldenrod	FACW	-										0	0
Taraxacum Vernonia	officiale fasciculata	Dandelion Ironweed	FACU -	2	2			2	2	94		2	2	12	4.2
Xanthium	strumarium	Cockelbur	FAC FAC	2			4	C	2	3	_	_	2	7	2.5
Sedges	oa arriariarii	Concidu	IAC	2			4	6	2		5	5	4	28	9.9
Carex	spp.	Sedge													
Eleocharis	palustris	Spike sedge	OBL							2				0	0
Equisetum	laevigatum	Smooth horsetail	FACW			1				2				3	0.7 1.1
Scirpus	maritimus	Saltmarsh bulrush	OBL			.28	1			-				1	0.4
Scirpus	pungens	Bulrush	OBL				1			2	2			5	1.8
Scirpus	spp.	Bulrush												0	0
Scirpus Typha	validus latifolia	Soft-stem Cat-tail	OBL								*			0	0
Sum	Rationa	Jat-tali	OBL											0	0
														284	100

	ME_	COMMON NAME	Wetland		T/2-	***	=/-	T	TC -	Mc T	me e	We -	<b>To</b> -	_
SENUS	SPECIES		Rating	T1Q1				T1Q5		T2Q2			T2Q5	Sum %
Grasses				20	20	20	20	20	20	20	20	20	20	Contr
gropyron	elongatum	Intermediate wheatgrass			3	6					2		4	15 6.6
Agropyron	spp.	Wheat			0	U					_	2	-	2 0.9
Agropyron	repens	Quackgrass	FAC			1						-		1 0.4
Agrostis	stolenifera	Redtop	FAC+		2									2 0.9
Bromus	inermis	Smooth brome		2						2				4 1.8
Chloris	verticulata	Windmill grass												0 0
Dichanthelium	oligosanthes	Panicgrass	FACU											0 0
chinocloa	crusgalli	Barnyardgrass	FACW	560										0 0
lymus	canadensis	Canada wild rye	FACU	2	•				_					2 0.9
lordeum .eersia	jubátum	Foxtail barley	FACW OBL		3		4	1	2	2	4	3		19 8.4 0 0
eersia Panicum	oryzoides virgatum	Rice cutgrass Switchgrass	FAC											0 0
Phalaris	arundinacea	Reed Canarygrass	FACW+		2									2 0.9
Poa	pratensis	Kentucky blue grass	FACU		-									0 0
Setaria y	glauca	Yellow foxtail	FAC											0 0
Spartina	pectinata	Prairie cordgrass	FACW							5				5 2.2
Triticum	aestivum			2				2						4 1.8
Zea	Mays	Com												0 0
orbs	W 00 1 - 10 10 10													
Amaranthus	retroflexus	Pigweed	FACU		1			•					-	1 0.4
Ambrosia	artimisiafolia	Annual rageweed Giant ragweed	FACU		1			2					1	4 1.8 0 0
Ambrosia	trifida	Dogbane	FACW FAC		1		3	1		2	1	1	1	0 0 10 4.4
Apocynum Asclepius	spp. syriaca	Common milkweed	IAC	1		1	3	1	2	2	1	1	2	12 5.3
Asclepius Asclepius	incarnata	Swamp milkweed	OBL				0	•	-				2	0 0
Aster	praealtis	Willow leaf aster	FACW	1	1					2	1			5 2.2
Aster	lanceolata	Lance-leaved aster	<b>FACW</b>											0 0
Astragalus	canadensis	Canada milkvetch	FACU											0 0
Calylophus	serrulatus							1						1 0.4
Chenopodium	album	lambsquarters	FAC	-										0 0
Conyza	canadensis 	Marestail	FACU-	2				1				1		4 1.8
Cornus	drummondii	Rough-leafed dogwood	FAC										ž.	0 0
Dalea Dagurainin	purperea	Purple prairie clover Herb-Sophia		2				1						1 0.4 2 0.9
Descurainin Desmanthus	sophia illinoensis	Illinois bundleflower	FACU	2				1			1	2	2	6 2.7
Fraxinus	pensylvanica	Green ash	FACW									_	1	1 0.4
Glycyrrhiza	lepidota	Wild licorice	FACU								2			2 0.9
Helianthus	annuus	Annual sunflower	FACU	5	5				6		1	2		19 8.4
Helianthus	maximilianii	Max. Sunflower						1			1		1	3 1.3
Kochia	scoparia	Mexican fireweed	FACU											0 0
Lactuca	serriola	Prickley lettuce	FAC	3	2			1	1		1	1	1	10 4.4
Lippia	lanceolata	Fogfruit	OBL											0 0
Lycopus	americana	Buggleweed	OBL											0 0
Lycopus	asper	Rough bugleweed	OBL				7							0 0
Lythrum Medicago	spp. Iupulina	Black Medick	FAC					2			1	1	1	5 2.2
Medicago Medicago	sativa	Alfalfa	IAC					_			1			1 0.4
Melilotus	alba	White sweetclover	FACU		3			2			1	1		7 3.1
Melilotus	officinalis	Yellow sweetclover	FACU	2				.=.		1	1	1		5 2.2
Nepeta	cataria	Catnip	FACU					1						1 0.4
Physalis	virginiana	Common ground cherry						1						1 0.4
Polygonum	persicaria	Lady's thumb	OBL							24				0 0
Polygonum	coccinium	Smartweed	OBL							1		12		1 0.4
Rudbeckia	hirta	Black-eyed susan	FACU	_		^		1	_	-	1	1	1	4 1.8
Rumex	crispus	Curly dock	FACW	2	•	2			2	1			2	9 4
Rumex	altissimus	Pale dock	FAC		2	1								2 0.9
Rumex Solanum	spp. rostratum	buffalobur				. 1		1						1 0.4
Solidago	canadensis	Canada goldenrod	FACU	2	2			2	2	2	2	3	3	18 8
Solidago Solidago	gigantea	Giant goldenrod	FACW	-	-			_	-	_	_	J	1	1 0.4
Taraxacum	officiale	Dandelion	FACU					1				1	•	2 0.9
Vernonia	fasciculata	Ironweed	FAC					73				329		0 0
Xanthium	strumarium	Cockelbur	FAC	2	2		2	3			2	2	3	16 7.
Sedges														
Carex	spp.	Sedge								2				2 0.9
Eleocharis	palustris	Spike sedge	OBL											0 0
Equisetum	laevigatum	Smooth horsetail	FACW							2				2 0.
Scirpus	maritimus	Saltmarsh bulrush	OBL				2			2				2 0.
	pungens	Bulrush	OBL				3			3	2			8 3.
Scirpus														
Scirpus	spp.	Bulrush	OB											0 0
	spp. validus latifolia	Bulrush Soft-stem Cat-tail	OBL OBL								•			0 0

Table 27. Vegetation Composition for WYO Site 1997-2000

SCIENTIFIC		COMMON NAME	\A/- 411	1								1998							
GENUS	SPECIES	COMMON NAME	Wetland	T404	T400	=100	====	=		_				11 13			100		
GLN03	SPECIES		Rating	T1Q1 97	T1Q2	T1Q3	T2Q1	T2Q2	T2Q3	Sum	%	T1Q1	T1Q2	T1Q3	T2Q1	T2Q2	T2Q3	Sum	%
Grasses				91	97	97	97	97	97		Contrib.	98	98	98	98	98	98		Contrib.
Agropyron	elongatum	Intermediate Wheatgrass	FAC	5	6	3		6	2	22	05.0		12					0.0700000000	
Agrostris	stolonifera	Redtop	FAC+	5	0	3		6	3	23	25.8	6	6	6	6	6	6	36	22.5
Bromus	japanicus	Jap. Brome	FACU							0	0		2					2	1.3
Bromus	inermis	Smooth Brome	FACU			4			2	0	0							0	0
Dactylis	glomerata	Orchardgrass	FACU			3			3	1	7.9			2				2	1.3
Echinochloa	crusgalli	Barrier and the second	FACW			3			1	4	4.5			12			2	4	2.5
								=		. 0	0		2					2	1.3
Elytrigia	repens	Quackgrass	FAC							0	0							0	0
Festuca	arundinacea	Tall fescue	FACU			3			5	8	9			2				2	1.3
Hordeum	jubatum	Foxtail barley	FACW	_	. 12					0	0	2	7					2	1.3
Poa	pratensis	K. Blue	FACU	3	4	3		3	3	16	18	3	3	3	2	3	2	16	10
Forbs	,																		
Ambrosia	artemsiifolia	Annual Ragweed	FACU	200						0	0	2	2			2	2	8	5
Apocynum	spp.	Dogbane	FAC	1						1	1.1							0	0
Asclepias	incarnata	Swamp milkweed	OBL							0	0							0	0
Aster	lanceolata		FACW							0	0							0	0
Canabis	sativa		FACU-							0	0							0	0
Carduus	nutans	Musk Thistle								0	0							0	0
Cirsium	flodmani	Flodman's thistle	FACU	1	1					2	2.2		2		2			4	2.5
Cirsium	altisium	Tall thistle								0	0							0	0
Cirsium	spp.									0	0							0	0
Cornus	drummondi	Dogwood	FAC							0	0							0	0
Helianthus	spp.									0	0			2				2	1.3
Juniperus	virginiana	Red cedar	FACU-	1						1	1.1			2				2	1.3
Lactuca	serriola	Prickly lettuce	FACU	1						1	1.1							0	0
Lippia	lanceolata	Fogfruit	OBL							0	0		2					2	1.3
Medicago	lupulina	Black medic	FAC	1		1			1	3	3.4	2	2	2	4	3	3	16	10
Medicago	sativa	Alfalfa			1					1	1.1							0	0
Melilotus	alba	W. sweetclover	FACU							0	0							0	. 0
Melilotus	officinalis	Y. sweetclover	FACU			1			1	2	2.2	2		2			2	6	3.8
Polygonium	spp.	Smartweed								0	0		2					2	1.3
Polygonium	aernastrum	Knotweed	FACW							0	0		2					2	1.3
Polygonium	persiccaria	Lady's Thumb	OBL							0	0		2					2	1.3
Rorripa	palustrus		OBL							0	0		2					2	1.3
Rumex	crispus		FACW							0	0		2					2	1.3
Sisyrinchium	montanum	Blue-eyed grass	FAC			1				1	1.1							0	0
Solidago	canadensis	Canada goldenrod	FACU						1	1	1.1							0	0
Taraxacum	officinale	Dandelion	FACU							0	0	3	2			2		7	4.4
Trifolium	repens	White clover	FACU	3	3			3	3	12	13.5	3	=	2		2	2	9	5.6
Trifolium	pratense	Red clover	FACU	3		1			1	5	5.6	2	2	2				6	3.8
Verbena	stricta		FACU						-	0	0	_	_	_			2	2	1.3
Vernonia	baldwinii	Western Ironweed	FACW-							0	0	2						2	1.3
Vernonia	fasciculata	Ironweed	FAC	1						1	1.1	_	2					2	1.3
Sedges				•							3		_						
Carex	vulpinoidea	Fox sedge	OBL							0	0		2			2		4	2.5
Carex	brevior	. c. coago	FAC							0	0		2			-		2	1.3
Carex	pellita		OBL							0	0		2					2	1.3
Carex	praegracilis		FACW							0	0		2				2	2	1.3
Eleocharis	erythropoda		OBL							0	0						_	0	0
Equisetum	laevigatum	Scouring Rush	FACW							0	0						2	2	1.3
Juncus	interior	Socialing Ixusii	FACV							0	0						2	2	1.3
Scirpus										0	0		2					2	1.3
Sum	pungens		OBL							0	0		2					160	
Julii										89	99.8							100	101.2

1000

1999		00141401		1								2000									
SCIENTIFIC I		COMMON NAME	Wetland							1											
<u>GENUS</u>	SPECIES		Rating	T1Q1	T1Q2	T1Q3	T2Q1	T2Q2	T2Q3	Sum	%		T1Q1	T1Q2	T1Q3	T2Q1	T2Q2	T2Q3	Sum	%	
0				99	99	99	99	99	99	]	Contrib.		20	20	20	20	20	20		Contrib.	
Grasses	-1	Terrore corporation					6-5		100												
Agropyron	elongatum	Intermediate Wheat	FAC	5	6	4	5	4	3	27	20.8		6	5	5	4	5	5	30	33.7	
Agrostris	stolonifera	Redtop	FAC+							0	0						3		3	3.4	
Bromus	japanicus	Jap. Brome	FACU							0	0								0	0	
Bromus	inermis	Smooth Brome				2				2	1.5				1			2	3	3.4	
Dactylis	glomerata	Orchardgrass	FACU			2		2		4	3.1				2			1	3	3.4	
Echinochloa	crusgalli	Barnyardgrass	FACW							0	0								0	0	
Elytrigia	repens	Quackgrass	FAC							0	0	٠							0	0	
Festuca	arundinacea	Tall fescue	FACU	9.		. 3			4	. 7	5.4				3			3	6	6.7	
Hordeum	jubatum	Foxtail barley	FACW							0	0			1	Ü			3	1	1.1	
Poa	pratensis	K. Blue	FACU	3	2	2	3	3	2	15	11.5		2	3	2		2	2	12	13.5	
Forbs	p	5.00	17100	O	2	2	3	3	2	13	11.5		2	3	2		2	3	12	13.5	
Ambrosia	artemsiifolia	Annual Ragweed	FACU							0	0			7		•			•	0.0	
Apocynum	spp.	Dogbane	FAC							-	0					2			2	2.2	
Asclepias	incarnata	Swamp milkweed	OBL	2					0	0	0	20				2			2	2.2	
Aster	lanceolata	Swamp milkweed		2					2	4	3.1								0	0	
Canabis	sativa		FACW							0	0				1				1	1.1	
		Morale Things	FACU-	•						0	0					2			2	2.2	
Carduus	nutans	Musk Thistle	E1011	2	_					2	1.5								0	0	
Cirsium	flodmani	Flodman's thistle	FACU	2	2		3	2		9	6.9			1					1	1.1	
Cirsium	altisium	Tall thistle		2						2	1.5								0	0	
Cirsium	spp.									0	0								0	0	
Cornus	drummondi	Dogwood	FAC				2			2	1.5								0	0	
Helianthus	spp.									0	0								0	0	
Juniperus	virginiana	Red cedar	FACU-		2			2		4	3.1			1					1	1.1	
Lactuca	serriola	Prickly lettuce	FACU							0	0								0	0	
Lippia	lanceolata	Fogfruit	OBL							0	0								0	0	
Medicago	lupulina	Black medic	FAC	2	3	2	3	2	2	14	10.8			2	1	1		1	5	5.6	
Medicago	sativa	Alfalfa								0	0								0	0	
Melilotus	alba	W. sweetclover	FACU				2	2		4	3.1				1			1.	2	2.2	
Melilotus	officinalis	Y. sweetclover	FACU		2		2	2		6	4.6							2	2	2.2	
Polygonium	spp.	Smartweed								0	0								0	0	
Polygonium	aernastrum	Knotweed	FACW							0	0								0	0	
Polygonium	persiccaria	Lady's Thumb	OBL							0	0								0	0	
Rorripa	palustrus	Additional of the state of the	OBL							0	0								0	0	
Rumex	crispus		FACW							0	Ô					1	1		2	2.2	
	montanum	Blue-eyed grass	FAC							0	0						1.5		0	0	
Solidago	canadensis	Canada goldenrod	FACU		2					2	1.5								0	0	
Taraxacum	officinale	Dandelion	FACU		2		2	2		4	3.1					1			1	1.1	
Trifolium	repens	White clover	FACU				2	2 2	2	6	4.6			4		1			1	1.1	
Trifolium	pratense	Red clover	FACU	2	2	0	2	2	2 2					1	4			1	2		
Verbena	stricta	rted clovel		2	2	2		2	2	10	7.7				1		*:	1	0	2.2	
Vernonia	baldwinii	Mastan Instituted	FACU							0	0						4		0	0	
		Western Ironweed	FACW-					_		0	0						1		1	1.1	
Vernonia	fasciculata	Ironweed	FAC					2		2	1.5							1	1	1.1	
Sedges	5 000 Part + 200 Part									69									_		
Carex	vulpinoidea	Fox sedge	OBL							0	0								0	0	
Carex	brevior		FAC							0	0								0	0	
Carex	pellita		OBL							0	0								0	0	
Carex	praegracilis		FACW							0	0								0	0	
Eleocharis	erythropoda		OBL							0	0							1	1	1.1	
Equisetum	laevigatum	Scouring Rush	FACW	2		2				4	3.1				1			1	2	2.2	
Juncus	interior		FAC							0	0						1		1	1.1	
Scirpus	pungens		OBL							0	0						1		1	1.1	
Sum			A 5 5							130	99.9						•		89	99.4	The same
and a second of the Control of the C										100	00.0								50	55.4	

Table 28. Percent contribution of plant species on GIWF site within plant categories.

Category	1997	1998	1999	2000
Wetland	33.8	35.8	34.1	35.6
Intermediate	19.3	17.3	19.5	18.9
Upland	35.5	34.4	34.0	36.2
No Wetland Indicator	11.6	12.3	12.2	8.5
Total	100.2	99.8	99.8	99.2

Table 29. Percent contribution of plant species on CWR site within plant categories.

<u>Category</u>	<u>1997</u>	<u>1999</u>	2000
Wetland	15.8	21.9	25.1
Intermediate	4.4	23.6	19.4
Upland	19.4	25.3	33.3
No Wetland Indicator	59.4	29.2	21.9
Total	99.0	100.0	99.7

Table 30. Percent contribution of plant species on WYO site within plant categories.

Category	1997	1998	1999	2000
Wetland	0.0	19.4	6.2	13.3
Intermediate	32.5	36.4	34.6	43.7
Upland	58.3	41.5	54.6	39.0
No Wetland Indicator	9.0	3.9	4.5	3.4
Total	99.8	101.2	99.9	99.4

Table 31. Mammals observed and collected

			<b>GIWF</b>	<b>GIWF</b>	<b>GIWF</b>	GIWF	WYO	WYO	WYO	WYO	CWR	CWR	CWR	CWR
<b>Species Collecte</b>	d	Common Name	1997	1998				1998	1999	2000	0	1998		100 10 515161
Microtus	pennsylvanicus	meadow vole									1		1000	2000
Peromyscus	maniculatus	deer mouse	1	16				1				14	2	
Peromyscus	leucopus	white-footed mouse	8		2			3			2		_	
Rattus	norvegicus	Norway rat						-			_		1	
Reithrodontomys	megalotis	western harvest mouse		1										
Sorex	cinerus	masked shrew				1	1	3			1		1	

Other Mamma	Is Observed at S	ites	GIWF	WYO	CWR
Blarina	brevicauda	short-tailed shrew		×	х
Canis	latrans	coyote			x
Mephitis	mephitis	striped skunk	×		
Odocoileus	virginianus	white-tailed deer	×	x	Х
Procyon	lotor	raccoon			х
Sylvilagus	floridanus	eastern cottontail			Х

Table 32. Reptiles and amphibians observed and collected

			GIWF	<b>GIWF</b>	<b>GIWF</b>	GIWF	WYO	WYO	WYO	WYO	CWR	CWR	CWR	CWR
Species Obs	erved/Collected	Common Name	1998	1999	2000	TOTAL	1998	1999		TOTAL		1999		TOTAL
Bufo	woodhousei	Woodhouse's Toad	х			х	X	X	X	X	X		2000	
Chelydra	serpentina	Common Snapping Turtle					×	^	^	^	^	X		×
Eumeces	obsoletus	Great Plains Skink			x	×	^							1
Eumeces	septentrionalis	Prairie Skink	×		×	x								1
Pseudacris	triseriata	Western Striped Chorus Frog	x		x	x	x			×	х			
Rana	blairi	Plains Leopard Frog					x	×		×	X			×
Rana	catesbiana	Bull Frog		x		x	^	×	х		^	X		×
Rana	pipiens	Leopard Frog		Α.		^		^	1000	X			X	х
Scaphiopus	bombifrons	Plains Spadefoot Toad				1			X	x			X	Х
Storeria	dekayi	Redbelly Snake					X	X	X	X	X			х
	radix	Plains Garter Snake				1							X	х
- 10 PM	sirtalis	A CONTRACTOR OF CONTRACTOR CONTRA				1	Х		X	x			X	x
mamnophis	Sirtaiis	Red-sided Garter Snake				ı	X			х				i
		TOTALS	3	1	3	5	7	4	5	8	4	2	4	8