



2018

# Lower Platte North Natural Resources District Voluntary Integrated Management Plan



Prepared by the:  
**Lower Platte North  
Natural Resources District**  
and

**Nebraska Department of  
Natural Resources**

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## 1.0 AUTHORITY AND EFFECTIVE DATE

This Integrated Management Plan was voluntarily prepared for, and adopted by, the Board of Directors of the Lower Platte North Natural Resources District (District) and the Nebraska Department of Natural Resources (Department). It was developed in consultation with its Stakeholder Advisory Committee and in accordance with the Nebraska Ground Water Management and Protection Act. The Act assigns the Department and the District the responsibilities and authority for management of groundwater, surface water, and their hydrologically connected areas in accordance with the Nebraska Groundwater Management and Protection Act, N.R.S. Chapter 46, Article 7.

This IMP was adopted by the Lower Platte North Natural Resources District on June 11, 2018 and by the Nebraska Department of Natural Resources on June 13, 2018. The IMP became effective on July 15, 2018.

## 2.0 INTRODUCTION

In the Lower Platte North Natural Resources District (District), sustainable water resources are critically important. Water users include domestic, agriculture, industry, recreation, and wildlife; all such users rely on readily available water resources. The protection of this invaluable resource is paramount to preserving the standard of living, environmental health, and community vitality for District residents and future generations (Figure 1).

The drought of 2012 highlighted the fragile and finite nature of the District's groundwater and surface water supplies. The drought caused shortages that were experienced by irrigators, domestic users, and public water suppliers alike. The shortages were not confined to groundwater or surface water; rather, they affected the resource as a whole due to the complex hydrologic connectivity between ground and surface water: the use of one water source affects the other.

In the state of Nebraska, the District oversees the monitoring and regulation of groundwater (Figure 2), and the Department oversees the

monitoring and regulation of surface water (Figure 3).



**Figure 1. A District sponsored field trip teaches students about the protection of water resources.**



The District's Board of Directors recognized the need for joint management of groundwater and surface water and initiated development of a voluntary integrated management plan (IMP) with the Department.

This voluntary IMP provides the framework for joint management of groundwater and surface water, recognizing that the two water sources are hydrologically connected. This framework enables the District and the Department to coordinate management actions and the monitoring of groundwater and surface water, in order to better protect water resources for future generations.



**Figure 2. Groundwater monitoring is conducted by the District.**



**Figure 3. Surface water monitoring is conducted by the Department.**

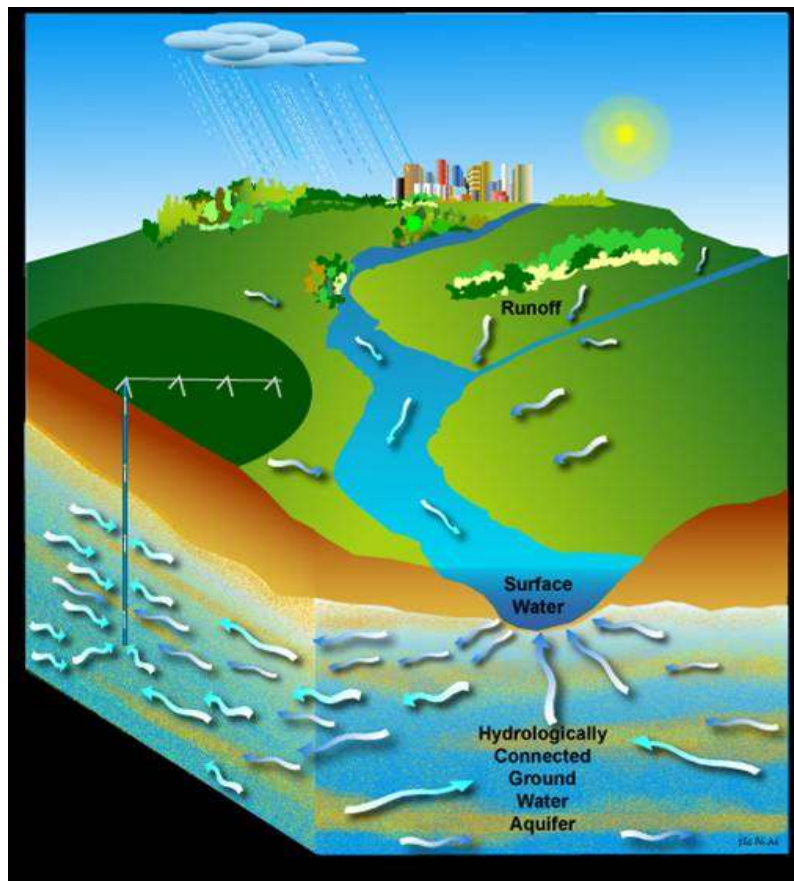
### 3.0 BACKGROUND

#### 3.1 Fully Appropriated Basins Evaluation

In 2004, the Nebraska Legislature adopted LB962, which requires the Department to annually evaluate the long-term water balance of hydrologically connected river basins and subbasins. The Department report entitled “Annual Evaluation of Availability of Hydrologically Connected Water Supplies” (Annual Report) conveys the results of this evaluation. Through this Fully Appropriated Basins (FAB) evaluation, a river basin or subbasin is considered “fully-appropriated” when current uses of hydrologically connected water supplies will, in the reasonably foreseeable future, cause:

- The surface water supply to be insufficient to sustain, over the long-term, the beneficial or useful purposes for which existing natural-flow or storage appropriations were granted and the beneficial or useful purposes for which, at the time of approval, any existing instream appropriation was granted;
- The streamflow to be insufficient to sustain, over the long-term, the beneficial uses from wells constructed in aquifers dependent on recharge from the river or stream involved; or
- Reduction in the flow of a river or stream sufficient enough to cause noncompliance by Nebraska with an interstate compact or decree, other formal state contract or agreement, or applicable state or federal laws.

The Department identifies “hydrologically connected areas” (Figure 4) as part of the annual Fully Appropriated Basins evaluation. These are defined as the geographic areas where a groundwater well would deplete river flow by at least ten percent of the water pumped over a 50 year period, known as the “10/50 area”.



**Figure 4. Diagram showing the hydrologically connected concept. The stream supplies a portion of its available flow to the underlying aquifer; the aquifer intersects the stream and contributes groundwater to stream flow.**

## 3.2 Integrated Management Plans

### **Relation to FAB Evaluation**

If the Department has designated or determined a river basin or subbasin to be fully appropriated based upon criteria in §§ 46-713 and 46-714, the affected NRD(s) must develop an Integrated Management Plan (IMP) with the Department. This is a joint water quantity management plan developed and implemented by the Department and the NRD(s). A District may also voluntarily develop an IMP based upon § 46-715(1)(b). The purpose of an IMP is to manage the river basin or subbasin to achieve and sustain long term balance between water uses and water supplies. Neb. Rev. Stat. §§ 46-715 to 46-717 and subsections (1) and (2) of 46-718 describe the process by which the IMP is developed and implemented.

### **Mandatory Components of an IMP**

Neb. Rev. Stat. § 46-715(2) specifies five mandatory components that are included in each IMP. These components enable effective implementation of the IMP in order to fulfill the purpose of maintaining and achieving a balance between hydrologically connected groundwater and surface water. These components are:

- Clear goals and objectives with a purpose of sustaining a balance between uses and supplies so that economic viability, social and environmental health, safety and welfare of the basin/subbasin is achieved and maintained,
- A map clearly delineating the geographic extent of the IMP,
- One or more groundwater controls,
- One or more surface water controls, and
- A plan to gather and evaluate data, information, and methodologies to implement the IMP, increase understanding of the surface water and hydrologically connected groundwater system, and test the validity of information and conclusions upon which the IMP is based.

Neb. Rev. Stat. § 46-715(3) outlines additional IMP components that provide a process for economic development opportunities and economic sustainability. The IMP, in conjunction with District rules and regulations and Department rules, regulations, and statutes, establishes procedures to meet the requirements of § 46-715(3). In this way, economic development in the river basin or subbasin may continue, so long as existing surface and groundwater users are not adversely affected by the new uses.

Neb. Rev. Stat. § 46-715(4) describes the purpose of groundwater control(s) and surface control(s) that are to be included in each IMP. The controls should be consistent with the goals and objectives of the plan, protect existing ground and surface water users in hydrologically connected areas, and be sufficient to ensure the state will remain in compliance with any applicable interested water compact or other formal contract or agreement. The allowable surface water controls are listed in Neb. Rev. Stat. § 46-716, and the allowable groundwater controls listed in Neb. Rev. Stat. § 46-739.

### **Stakeholder Process**

Neb. Rev. Stat. § 46-717(2) outlines the stakeholder process that is an integral part of IMP development. It states the specific stakeholder interests that the District and the Department shall consult during the preparation of the IMP. These interest groups are:

- Irrigation districts,
- Reclamation districts,
- Public power and irrigation districts,
- Mutual irrigation companies,
- Canal companies, and
- Municipalities.

Other water users and stakeholders that are deemed appropriate by the District or Department may be consulted during IMP development. The District and Department are required to solicit public comments and opinions through public meetings and other means.

### **3.3 Voluntary Integrated Management Plans**

LB764, enacted in 2010 and codified at Neb. Rev. Stat. § 46-715(1)[b], authorized NRDs to voluntarily develop an IMP with the Department to jointly manage groundwater and surface water uses and supplies in areas that have not been designated as fully appropriated. The voluntary IMP process is an opportunity for NRDs and the Department to work together to protect existing water uses by proactively managing the growth of water use in an effort to avoid such a designation. A voluntary IMP is developed in the same way as a mandated IMP; it utilizes the same statutory framework as discussed in Section 3.2.

### **3.4 Lower Platte Basin Water Management Plan**

In April 2013, the Department and the seven NRDs that make up the Lower Platte River Basin (Basin) formed the Lower Platte River Basin Coalition (Coalition). The Coalition members are:

- Upper Loup NRD,
- Lower Loup NRD,
- Upper Elkhorn NRD,
- Lower Elkhorn NRD,
- Lower Platte North NRD,
- Lower Platte South NRD,
- Papio-Missouri River NRD, and
- Nebraska Department of Natural Resources.

The Coalition's mission is to coordinate efforts to protect the long-term balance of the Basin's water uses and water supplies. The first action of the Coalition was to voluntarily develop a Lower Platte Basin Water Management Plan (Basin Plan).



For Basin Plan development, a technical committee, management committee, and Board were formed, and a team of consultants was hired to conduct analyses and coordinate meetings. Over the course of four years, eleven technical committee meetings, eleven management committee meetings, three board meetings, and three workshops were held. Several large-scale technical analyses were conducted and the results were used to inform the discussion throughout the development process. Through these activities, a framework for coordinated management of water uses and supplies was established; the policies and practices therein will be implemented through individual IMPs.

The agreed upon Basin Plan was adopted in October 2017. The Basin Plan operates on a five-year increment schedule, with the first increment beginning July 1, 2016 and ending December 31, 2021. The Basin Plan may be accessed on the District's or the Department's websites.

#### 4.0 PUBLIC PARTICIPATION PROCESS

In accordance with Neb. Rev. Stat. § 46-717(2), this voluntary IMP was developed collaboratively by the District and the Department. It was created in consultation with a diverse stakeholder group that consisted of the following general interest groups (see Appendix B for a complete list of participants):

- Agriculture,
- Industry,
- Municipal water supply,
- Environmental,
- Recreation,
- County and city officials, and
- Technical advisors.

A private consultant was hired to assist in the planning process; specifically, to facilitate stakeholder meetings and provide technical analyses. The consultant conducted a water balance study, the results of which were used to inform stakeholders through the public participation process. The full report, entitled "Lower Platte North Natural Resources District Water Balance Study" (2014), is available upon request from the District.

The District and Department held seven stakeholder meetings between 2014 and 2017 to solicit public input regarding the direction of the voluntary IMP and gain insight about goals, objectives, and action items that would become an integral part of the Basin Plan. In the interim, the District and the Department held multiple coordination meetings to carefully evaluate and consider stakeholder recommendations, and from this, incrementally develop the IMP. Upon IMP completion, an open house was held (March 2018) to inform and engage the public; there, the completed IMP was presented and discussed. Stakeholders were encouraged to attend the open house and provide their insight as community leaders in the voluntary IMP development process. Following the open house, and pursuant to Neb. Rev. Stat. §§ 46-718 and 46-743, a public hearing was held to take testimony for District and Department consideration prior to adoption of the voluntary IMP.

## 5.0 MAP AND DESCRIPTION OF THE IMP AREA

### 5.1 Map of the Integrated Management Plan Area

The geographic area of the voluntary IMP occurs as two distinct control areas: a Surface Water Control Area (SWCA) and a Groundwater Control Area (GCA). Regulatory actions implemented by the Department shall be limited to the SWCA, defined as the drainage basin of the Platte River and its tributaries within the District. Regulatory actions implemented by the District shall be limited to the GCA; this area was defined as a part of previous Department studies and overlaps a portion of the SWCA. The GCA and SWCA are shown, in detail, in Figure 5. The District and Department recognize that as increased understanding of hydrologically connected areas becomes available through new data, models, and analyses, the defined control areas may change. Any changes to the voluntary IMP control areas require agreement between the District and Department, in addition to a statutorily defined public noticing period and public hearing (see Section 12.0 Review Process and Modifications).

### 5.2 Land Use and Land Cover

The District land area covers approximately one million acres. The predominant land covers are cultivated crops (irrigated and dryland) with smaller areas of grassland, developed (urban) land, and other land covers (Table 1, Figure 6). Nearly half of the cultivated crops are irrigated by groundwater, surface water, or both. The distribution of irrigated crops by water source is shown in Figure 7. Of the cultivated crops, 97 percent of the acres are farmed as corn or soybeans.

Land Cover	Acres	Percent (%)
Dryland agricultural crops	379,990	37
Irrigated agricultural crops	369,720	36
Grassland	133,510	13
Developed (urban) land	51,350	5
Other land cover (woodlands, water, etc.)	92,430	9
<b>Total land</b>	<b>1,027,000</b>	

**Table 1. Major land covers in the District.**

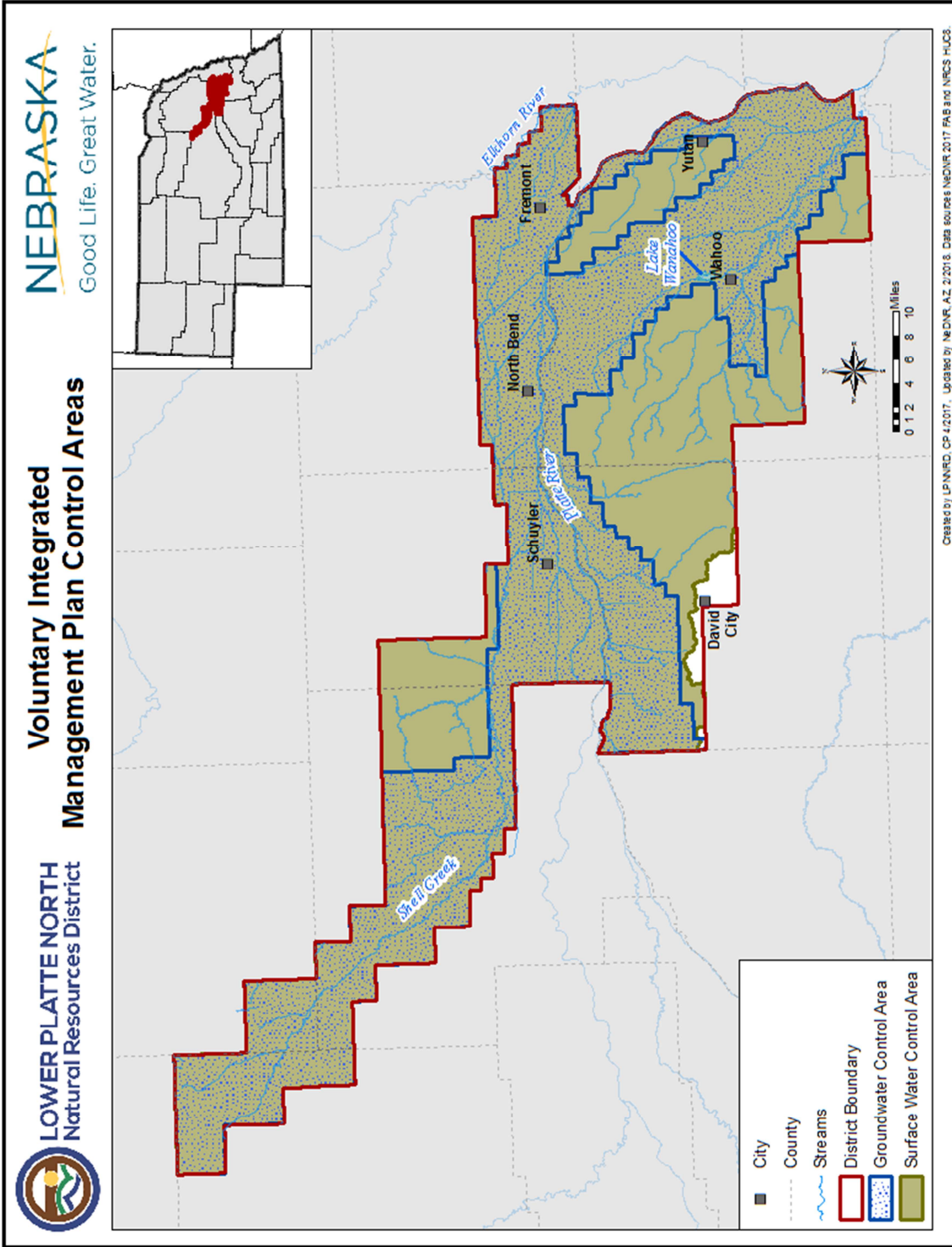


Figure 5. Geographic areas of the voluntary IMP.

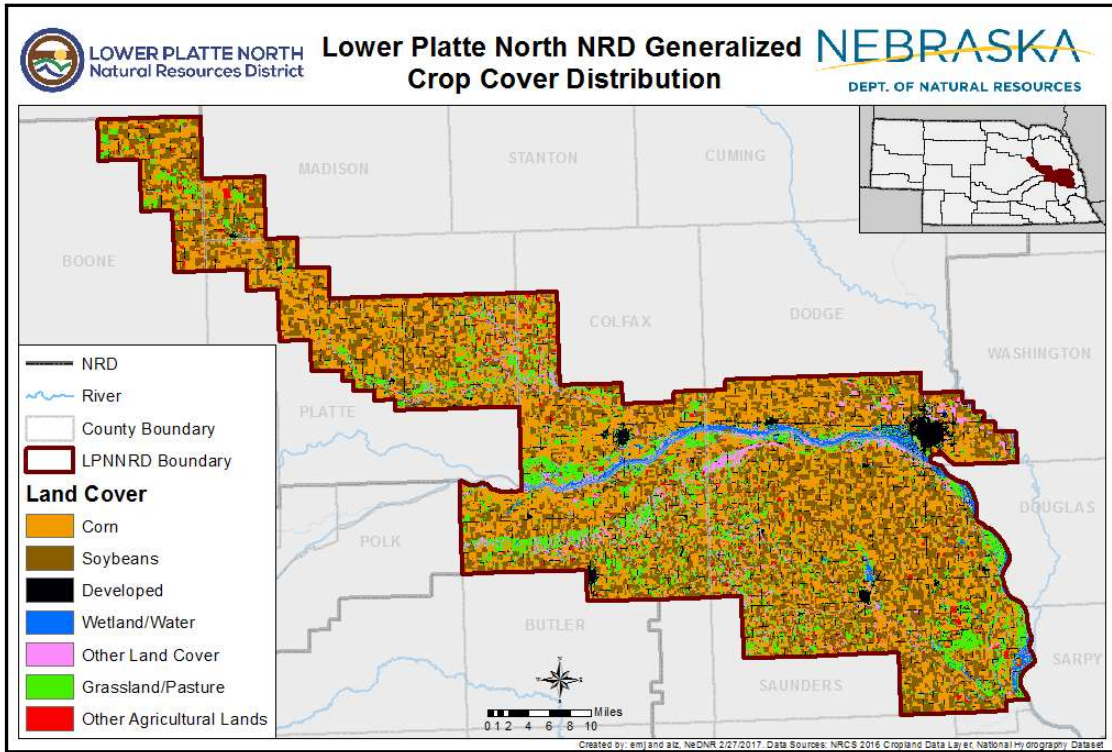


Figure 6. Major land cover types in the District.

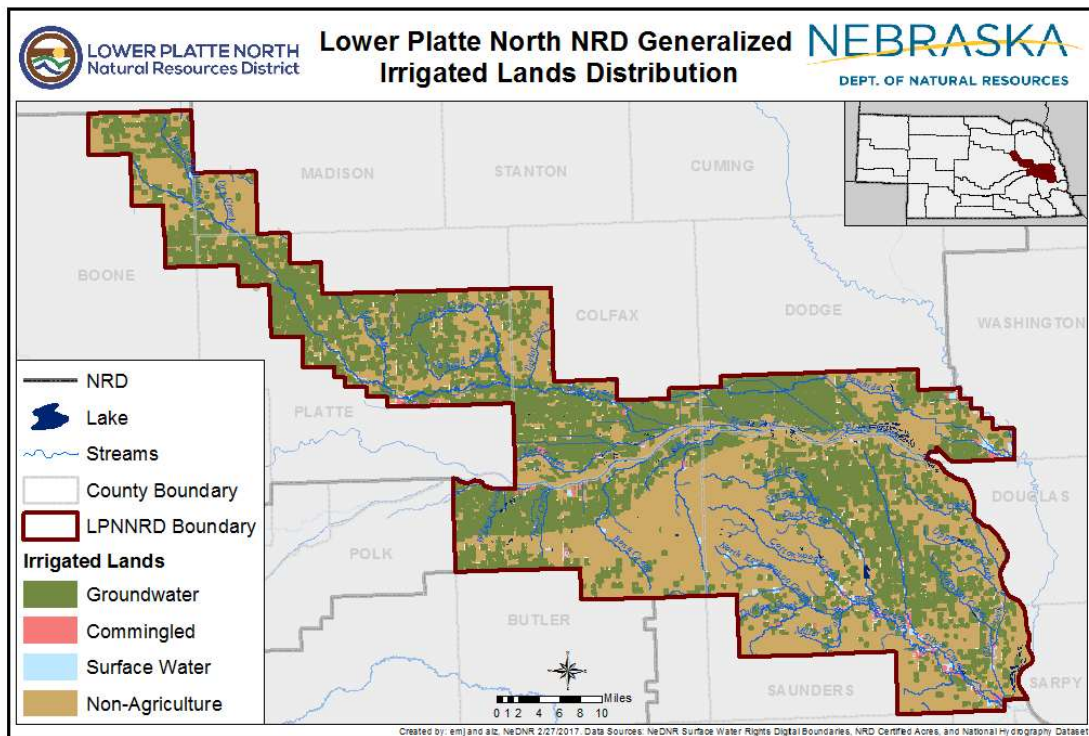


Figure 7. Irrigation distribution in the District.



## 5.3 Surface Water

### Local Hydrology

Over 98 percent of the District's surface water drains into the Platte River. Major surface water features in the District include the Platte River and its tributaries including Loseke, Sand, Shell, Silver, and Wahoo Creeks. There are a number of reservoirs that serve various purposes within the District. The largest reservoir, Lake Wanahoo, is located north of Wahoo and provides recreational opportunities, environmental benefits, and flood protection for area residents (Figure 8). The District receives approximately 29 inches of precipitation per year over the District as a whole; this amount varies locally, generally increasing from west to east.

### Surface Water Permits

The Department has authority over the permitting, inspection, and adjudication of Nebraska's surface water appropriations, with uses ranging from domestic, to agriculture, and even power generation. Within the District, there are a variety of active surface water permits that include agricultural, industrial, storage, and other uses. Table 2 summarizes the active surface water appropriations by type and water amount, as of February 2018. Each surface water permit has an approved location where the water may be stored or withdrawn; this location is termed the "point of diversion". A map of the District's surface water points of diversion is shown in Figure 9.



Figure 8. Lake Wanahoo, just north of Wahoo, is the District's largest reservoir.



Surface Water Permits In The Lower Platte North NRD (February, 2018)				
Purpose of Permit	Number of Permits	Permitted Acres for Irrigation	Natural Flow Grant (cfs)	Storage Grant (AF)
Diversion from naturally flowing source for irrigation	157	11,618	147	NA
Diversion from a reservoir for irrigation of land that is also approved to receive water from naturally flowing source	1	(209)	NA	(17)
Diversion only from a reservoir for irrigation	6	432	NA	(240)
<b>Total Irrigation Permits</b>	<b>164</b>	<b>12,050</b>	<b>147</b>	<b>(257)</b>
Domestic use	1	0.5	0.01	NA
Dust control	1	NA	0.89	NA
Instream flow	2	NA	Variable <sup>1</sup>	NA
Induced groundwater recharge	6	NA	Variable <sup>1</sup>	NA
<b>Total Miscellaneous Permits</b>	<b>10</b>	<b>1</b>	<b>1</b>	<b>NA</b>
Storage of water in reservoir (permits held by District)	39	NA	NA	14,017
Storage of water in reservoir (all non-District permits)	19	NA	NA	896
Supplemental Storage <sup>2</sup>	7	NA	NA	256
<b>Total Storage Permits</b>	<b>65</b>	<b>NA</b>	<b>NA</b>	<b>15,169</b>
<b>Totals</b>	<b>239</b>	<b>12,051</b>	<b>148</b>	<b>15,169</b>

<sup>1</sup> See permit for amounts allowed

<sup>2</sup> Supplemental Storage is an additional permit for storage in an existing reservoir

**Table 2. Types and amounts of water associated of active surface water permits in the District. Numbers in parenthesis are supplemental uses and are not counted towards totals.**

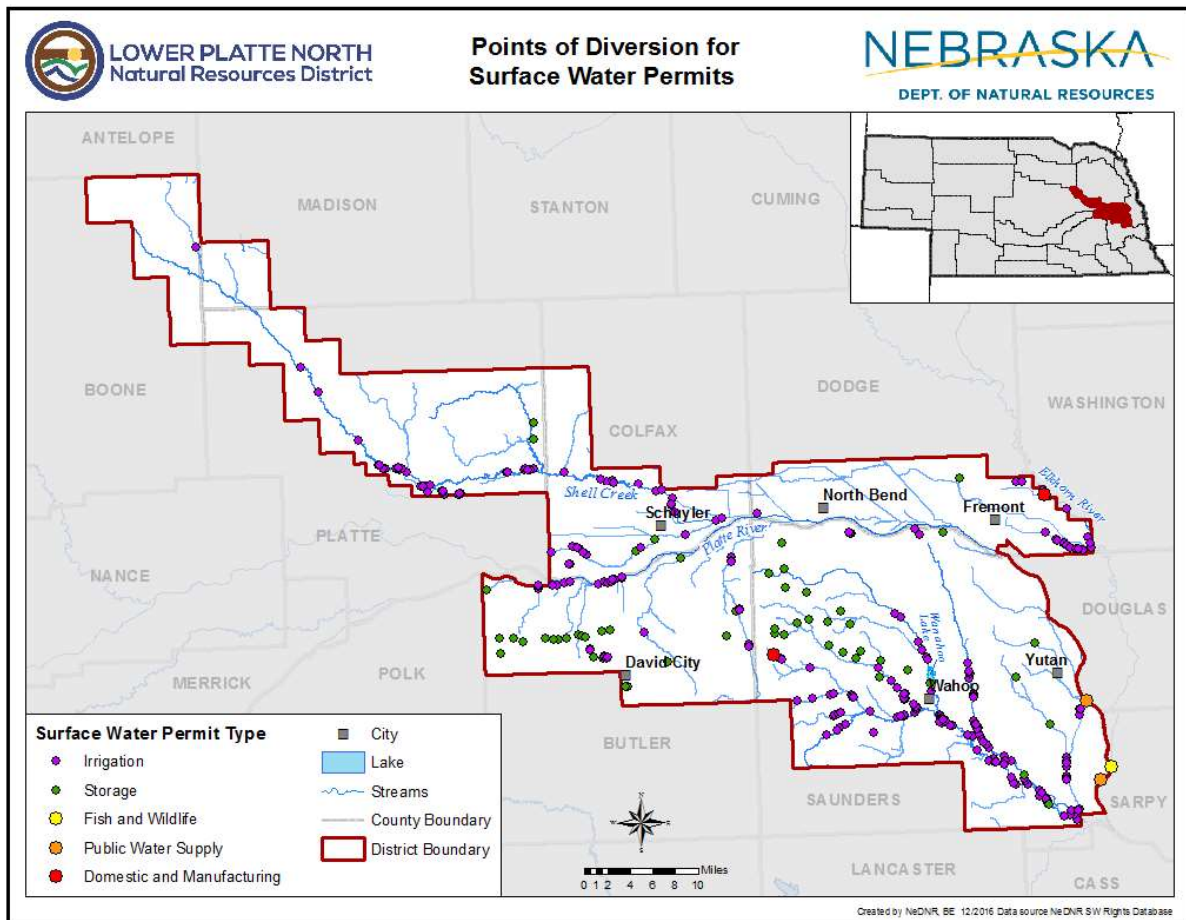


Figure 9. Points of diversion associated with surface water permits.

## 5.4 Groundwater

### Major Aquifers

The District consists of various aquifer types, though most fall into two predominant categories: bedrock and alluvial aquifers. For the purposes of this IMP, the primary and secondary aquifers of the District are described as follows:

- **Bedrock Aquifers:** defined as water bearing, consolidated to semi-consolidated, rock formations including:
  - **Ogallala Aquifer:** The Ogallala Aquifer is located mostly in the northwestern part of the District, covering a small portion of Boone, Platte, and Madison counties. It consists of sand, sandstone, silt, and gravel. This aquifer group is part of a larger aquifer known as the High Plains Aquifer.
  - **Dakota Aquifer:** The Dakota aquifer underlies alluvial aquifers. Wells drilled in this aquifer are located mostly in the central to southeastern part of the District, including portions of Butler, Colfax, Dodge, and Saunders counties. The Dakota Aquifer is

considered a secondary aquifer, with water quality issues due to elevated levels of sodium, chloride, and total dissolved solids.

- **Alluvial Aquifers:** Broadly defined as buried paleovalley aquifers in ancient stream valleys, aquifers created by modern streams, and aquifers of other origins. Most registered wells in the district are completed in undifferentiated sand and gravel aquifers of multiple origins. These aquifers, distributed across the District, are discontinuous and have inconsistent thickness. Productivity of these wells varies significantly depending on the local thickness and continuity of the sand and gravel deposits.

### Registered Wells

There are over 7,000 registered wells in the District, over half of which are high capacity wells for irrigation use. As such, irrigation is the driving force behind groundwater usage in the District. With such a large number of high capacity wells, it is incumbent that the District take steps to ensure that existing groundwater users are protected from shortages. While protecting existing groundwater users is paramount, the District recognizes the need for a smart growth strategy, allowing for new groundwater uses, using the latest data, techniques, and studies from a variety of sources. The spatial extent of registered wells in the District is shown in Figure 10.

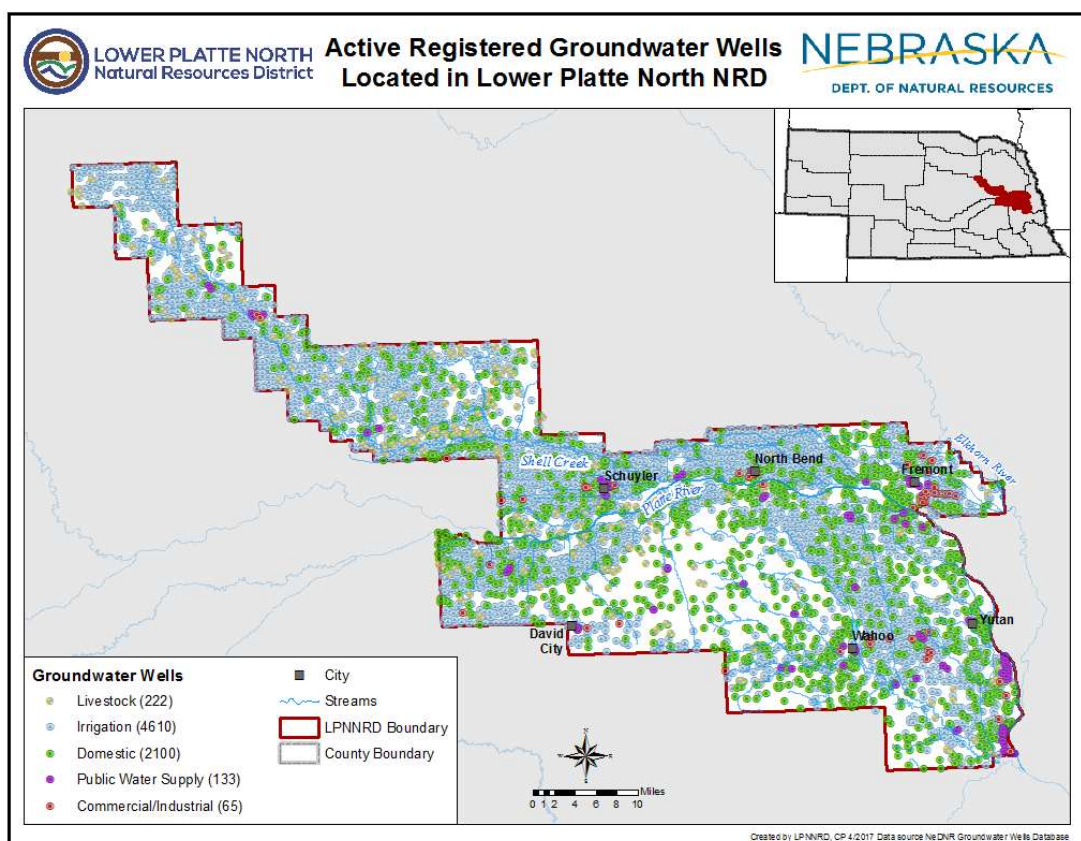


Figure 10. Registered wells distribution within the District.

## District Groundwater Management

Groundwater in the District varies greatly, in terms of both quantity and quality. These variations can occur over relatively small geographic areas. To efficiently address this variation, the District has created several groundwater management areas as shown in Figure 11. Some of these management areas overlap the Groundwater Control Area of the IMP (Figure 5). The additional restrictions on these areas, as set forth by the District under the Board of Director’s authority, shall be the prevailing management doctrine in those areas of overlap.

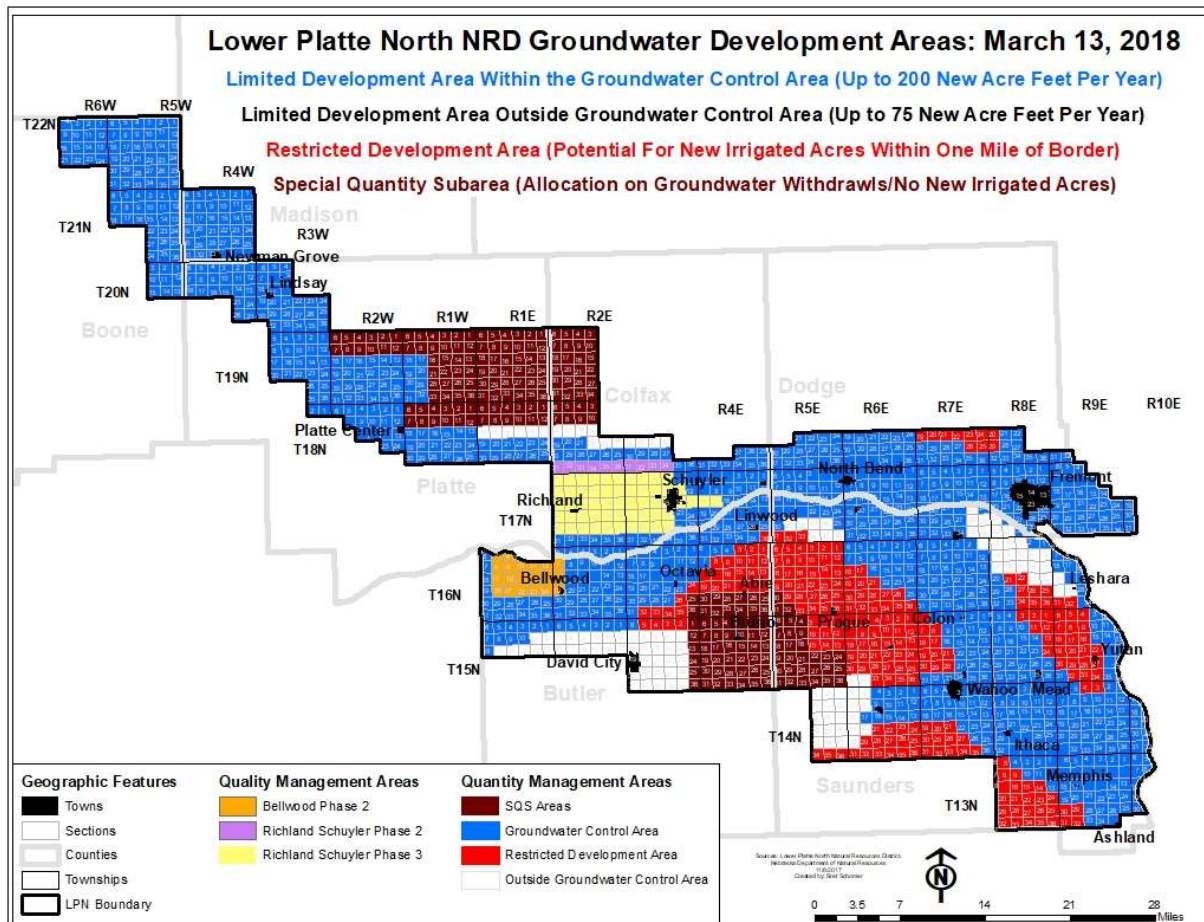


Figure 11. Groundwater Management Areas within the District, including two Water Quantity Areas and two Water Quality Areas.

## 6.0 GOALS AND OBJECTIVES

Goals begin as abstract thoughts that are refined through discussion and debate. Reaching a goal requires completing a series of objectives along the way, which, in turn, require their own set of actions. The final goals, objectives, and action items of an IMP are a carefully constructed mosaic of stakeholder, District, and Department inputs. Those items create a path forward for effective, long-term, management of groundwater and surface water. Under advisement from the Stakeholder Advisory Committee, the District and Department agreed, where feasible, to implement goals and objectives in ways that maximize benefits, reduce costs, and have the least impact upon end users. The goals, objectives, and action items developed for this voluntary IMP are shown in Table 3 through Table 7.



### Goal One: Water Supply Inventory

In order to successfully manage any resource, it is vital to have an understanding of the availability of that resource. Recognizing that a thorough accounting of groundwater and surface water supplies needs developed, the District and the Department have partned on Goal 1, which is the backbone of a successful IMP. The following table summarizes the steps needed to attain this goal.

Goal 1: Develop and maintain a District-wide water supply inventory		
Objective	Action Item	Assigned To
<b>Objective 1.1:</b> Conduct data collection and analyses of current and potential water supplies using best available information, data, science, and considering future technological advances.	1.1.1 Maintain a database of current ground and surface water supplies.	District and Department
	1.1.2 Use best available science to identify District-wide aquifer distribution, including the distribution of bedrock, perched, and pocket aquifers.	District and Department
	1.1.3 Maintain a database of current water quality problem areas.	District
	1.1.4 Use best available data and methods to refine delineations of hydrologically connected surface water and groundwater.	District and Department
	1.1.5 Evaluate the potential to augment existing supplies by accessing additional waters within and outside of the District, including recharge projects, improving existing and adding new water storage/conveyance infrastructure, or through brackish water supplies.	District and Department
	1.1.6 Evaluate short and long term climate variability and potential effects on water supply.	District and Department
	1.1.7 Evaluate new technologies and methods of water accounting that support water management goals.	District and Department
	1.1.8. Coordinate District and Department databases to better utilize staff time, improve water management efficiencies, and assist with public outreach.	District and Department
<b>Objective 1.2:</b> Determine the District's inflows and outflows of surface water and groundwater and changes in storage	1.2.1 Continue surface water and groundwater monitoring across the District.	District and Department
	1.2.2 Use surface water and groundwater measurements and models to estimate District inflows and outflows.	District and Department
	1.2.3 Identify data gaps in monitoring networks (precipitation, stream flow, groundwater level networks, etc.).	District and Department

Table 3. Goal 1 of the voluntary IMP.

## Goal Two: Water Demand Inventory

Once an inventory of current water supplies is completed, it is necessary to understand the current demand for those supplies. Without a firm grasp of supply and demand, there is a very real risk of applying poor management techniques to the resource and ending up with a water deficit. It is much more difficult to manage from behind regarding water usage. Table 4, shown below, defines how the District and the Department will build a comprehensive database of current water usage in order to build a foundation for improved water management.

Goal 2: Develop and maintain a District-wide water demand inventory		
Objective	Action Item	Assigned To
<b>Objective 2.1:</b> Evaluate current and future water demands that may be influenced by municipal, agricultural, industrial, hydropower, and instream flow requirements	2.1.1 Develop standard protocols to ensure municipal water supply reports and forecasts are integrated into the District-wide and Department databases.	District and Department
	2.1.2 Evaluate how population growth and potential water reuse could influence per capita water consumption to estimate future water demands.	District and Department
	2.1.3 Continue certification of irrigated acres, well metering, and reporting requirements to track current water demands.	District
	2.1.4 Evaluate how historical and future land use/cover changes, urban growth, or adoption of conservation practices affects water demand.	District and Department
	2.1.5 Coordinate with the Department to identify surface water rights for potential prioritization in Department adjudication investigations.	District and Department
	2.1.6 Evaluate current and project future water demands of all water users to assess instream flow within the district and comply with downstream requirements.	District and Department
	2.1.7 Evaluate potential water demands for hydropower.	District and Department
<b>Objective 2.2:</b> Evaluate current water demands and estimate future impacts concerning surface or groundwater quality	2.2.1 Estimate effects on demands due to environmental mitigation activities that utilize large quantities of water.	District
	2.2.2 Estimate effects on demands in scenarios where municipal wells are moved to hydrologically connected areas to improve quality.	District and Department
	2.2.3 Continue mapping and tracking surface water irrigated acres and voluntary water use reporting to monitor surface water demands.	Department

Table 4. Goal 2 of voluntary IMP.

### Goal Three: Sustainability of the Resource

The information gathered in Goal 1 and Goal 2 will allow the District and Department to implement proactive management techniques in an attempt to ensure there is a sustainable balance between supply and demand. The path toward sustainability is shown in Table 5 below.

Goal 3: Develop and implement water use policies and practices with the purpose of achieving and sustaining a balance between water uses and supplies		
Objective	Action Item	Assigned To
<b>Objective 3.1:</b> Update policies, practices, and programs to maintain and improve water supply and water quality as it affects supply	3.1.1. Where feasible, promote practices focused on reuse of rain, storm, waste, industrial, or irrigation water.	District
	3.1.2. Develop a District-wide water banking program to minimize water conflicts between different water users and sources.	District and Department
	3.1.3 Cooperate with other entities to identify, evaluate, and prioritize locations and types of conjunctive water management and water use projects	District and Department
	3.1.4. Periodically review rules and regulations, ensuring they are up-to-date with current data, technologies, and the IMP.	District and Department
<b>Objective 3.2:</b> Develop programs and guidelines to conserve water within municipalities, the agricultural sector, and industrial applications	3.2.1 Where feasible, implement cost-share programs for irrigation conservation by partnering with producers in technologies that improve irrigation efficiency and track water usage over time.	District and Department
	3.2.2 Use new, and existing, studies and data to establish specific guidelines for sustainable development of major, minor, and pocket aquifers.	District
	3.2.3 Collaborate with municipalities and industrial users on development or refinement of water conservation plans.	District

**Table 5. Goal 3 of the voluntary IMP.**

### Goal Four: Public Outreach

With competing interests, legal complexity, and finite resources, it is imperative that the District and the Department remain as transparent as possible about the management techniques that are utilized to preserve water as a resource for all Nebraskans. Table 6 lists how the District and Department plan to integrate a comprehensive public outreach program within the IMP.

Goal 4: Communicate to the public that Nebraska has a great supply of water, and we need to continue to manage it well		
Objective	Action Item	Assigned To
<b>Objective 4.1:</b> Maintain existing public outreach activities and programs	4.1.1 Maintain District certification classes to update producers on current water conditions, best management practices, potential state legislation, and changes in District and state water management issues.	District
	4.1.2 Maintain public education programs including county fairs, newsletters, newspaper articles, radio spots, public notices, fliers, social media, and District and Department websites.	District and Department
	4.1.3 Continue to cooperate with UNL Extension to utilize and explore the use of mobile applications to assist producers with different water conservation practices.	District and Department
<b>Objective 4.2:</b> Incorporate new data, technologies, and programs to enhance public outreach	4.2.1 Develop new materials and activities to educate the public on the benefits and limitations of riparian vegetation management.	District and Department
	4.2.2 Educate homeowners on ways to conserve water in the home, garden, and lawn, through planting of more drought-resistant plants or different landscaping practices.	District
	4.2.3 Explore information-sharing systems between District personnel and water users in the District. These systems could be used to track precipitation patterns, crop evapotranspiration (ET) requirements, soil moisture levels, rotation of pumping between water users to reduce peak aquifer demands, real-time groundwater energy level sites in important aquifers or subareas, and current stream flow conditions.	District
	4.2.4 Quantify water use efficiencies and disseminate through public education programs to enhance productivity.	District
	4.2.5 Explore public education through television and social media to inform the public about current programs and elicit feedback for projected District programs.	District

Table 6. Goal 4 of the voluntary IMP.

### Goal Five: Basin-wide Coordination

The District is part of the larger Lower Platte River Basin. Attempting to manage groundwater and surface water resources within a subset of the basin is short-sighted. In order to effectively manage the Lower Platte River Basin as a whole, the District and the Department will cooperate with the Coalition, the Eastern Nebraska Water Resources Assessment (ENWRA), and others to set forth a series of cooperative steps to mitigate problems throughout the Basin. Table 7 lists the cooperative actions to be undertaken to help manage the Basin water supplies and uses as a whole.

Goal 5: Coordinate with Lower Platte River Basin NRDs, and appropriate groups and agencies, to develop a water management plan for the Lower Platte River Basin that maintains a balance between current and future water supplies and demands		
Objective	Action Item	Assigned To
<b>Objective 5.1:</b> Continue active participation in Lower Platte River Basin Coalition (Coalition) water management planning activities	5.1.1 Cooperate on water management studies and planning with the Coalition.	District and Department
	5.1.2 Evaluate federal, statewide, and local funding options for basin-wide water management activities.	District and Department
	5.1.3 Coordinate to develop and implement transfer and water banking systems that are compatible between the District and the Coalition	District and Department
	5.1.4 Evaluate proposed transfers utilizing methodology consistent with other Lower Platte NRDs, as specified in the basin-wide plan.	District
<b>Objective 5.2:</b> Coordinate to expand conjunctive management opportunities to mitigate new uses	5.2.1 Review and analyze existing studies of water storage opportunities in the Lower Platte River Basin and conduct additional multi-agency studies, as appropriate.	District and Department
	5.2.2 Evaluate benefits and limitations of potential conjunctive management projects	District and Department
<b>Objective 5.3:</b> Coordinate with ENWRA to increase knowledge about existing groundwater supplies and connection to surface water	5.3.1 Continue active participation in ENWRA meetings, studies, and activities.	District and Department
	5.3.2 Evaluate whether ENWRA data can improve modeling of hydrologically connected areas on a large scale.	District and Department
<b>Objective 5.4:</b> Strengthen coordination with other agencies about efforts to sustain or increase Lower Platte River flows	5.4.2 Coordinate to review and assess benefits and limitations of protecting Lower Platte River flows through existing instream flow water rights.	District and Department
	5.4.3 Continue to coordinate with other agencies on riparian vegetation management activities.	District and Department

Table 7. Goal 5 of the voluntary IMP.



## 7.0 LONG TERM STUDY

The District and the Department held several coordination meetings to determine the feasibility of proposed goals, objectives, and action items following the stakeholder process. A better understanding of tile drainage systems, an ongoing request at stakeholder meetings, was originally placed as an objective in water inventory goals. Due to costs, availability of funding, staff commitment, and questions regarding the reliability of results using current techniques, the District Board of Directors found including tile drainage systems to be infeasible during the near term implementation of the voluntary IMP.

In consultation with the stakeholder group, the District and the Department classified the tile drainage objective as a long-term study to be addressed if funding, data, or improved methodologies become available (Table 8).

LONG-TERM STUDY			
Goal / Study	Action Item	Assigned To	Reporting/ Exchange
<b>Long-term Study 1.1</b> Increase understanding of tile drainage systems in the District and their impact on water supply.	1.1.1 Conduct a tile drainage study based upon review of existing data and funding.	District	Discuss solutions to obstacles pertaining to action items listed at annual meeting.
	1.1.2 Seek voluntary data from landowners pertaining to tile drain locations.	District	
	1.1.3 Evaluate the potential to develop modeling scenarios that predict the impact of tile drainage on streamflow and recharge.	District and Department	

**Table 8. The long-term study of the voluntary IMP.**

## 8.0 REGULATORY ACTIONS (CONTROLS)

Per Neb. Rev. Stat. § 46-715, each IMP must have at least one groundwater control and at least one surface water control. The controls must be consistent to meet the goals and objectives of the Basin Plan. The allowable groundwater and surface water controls are specified in Neb. Rev. Stat. §§ 46-739 and 46-716, for groundwater and surface water, respectively. For this IMP, the District and Department each agreed on two controls that will be jointly implemented to manage hydrologically connected groundwater and surface water. These controls are “limits on new uses” and “municipal water use tracking requirements”, and are further described below.

### **Limits on New Uses**

The Coalition agreed to specific limits on the development of new water uses within the hydrologically connected area of each NRD, and as specified in the Basin Plan, initially discussed in Section 3.0 (Background). The limits on development of new water uses are in terms of allowable “stream depletions.” This corresponds to the impact that new surface water and groundwater uses are expected to have on the the Platte River and its tributaries during the peak water period of June to August over a period of 50 years.

The allowable stream depletions were based on analyses that evaluated historic excess flows in the Lower Platte Basin; these excess flows were further subdivided into subbasins. Limits for individual NRDs were agreed upon through discussions between the NRDs in each respective Lower Platte River subbasin. The Department and each respective NRD then determined the division of groundwater and surface water depletions that would be carried out through the individual IMP controls.

The allowable stream depletions correspond to a five-year increment that began July 1, 2016 and ends December 31, 2021 (i.e. First Increment). All surface water and groundwater development initiated after July 1, 2016 will be included in the accounting of new uses. An agreed upon methodology will be used by the NRDs and the Department to convert new irrigated acres into estimated stream depletion. The controls for limits on new uses are as follows:

#### **District Groundwater Limits**

The District will limit new groundwater uses to 50% of the annually available stream depletions over the Basin Plan’s first five-year increment which concludes on December 31, 2021<sup>1</sup>.

#### **Department Surface Water Limits**

The Department will limit new surface water uses to 50% of the annually available stream depletions over the Basin Plan’s first five-year increment which concludes on December 31, 2021<sup>1</sup>.

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<sup>1</sup>Depletions that are not utilized by the District or the Department will be redistributed annually and shared equally between the District and the Department (see Appendix C for an example).

## **Municipal Tracking**

The District and Department shall require tracking of municipal water use. At present, municipal water use is only tracked by the District or the Department if there is a transfer permit. This regulatory action increases the ability of the Department and District to accurately account for the usage of this large-scale water consumer. The controls for tracking of municipal water use are:

### **District Groundwater Municipal Tracking**

The District will require annual use reports for municipal groundwater users.

### **Department Surface Water Municipal Tracking**

The Department will require annual use reports for municipal surface water permit holders and municipal groundwater transfer permit holders.

## **9.0 MONITORING PLAN**

The District and Department have agreed to the following course of action in accordance with Neb. Rev. Stat. § 46-715 (2)[e]. This includes:

- Gathering and evaluating data, information, and methodologies to complete the voluntary IMP,
- Increase understanding of the surface water and hydrologically connected groundwater system, and
- Test the validity of the conclusions and information upon which the voluntary IMP is based.

In order to evaluate progress of voluntary IMP implementation, the District and Department have agreed to collect, track, evaluate, and report on specific activities.

### **Monitoring and Reporting of Water Use and Water Supply**

The District is tasked with the following monitoring and reporting activities:

- Groundwater elevation data
- Flow meter data (if meter data is collected)
- Certified irrigated groundwater acres
- Municipal and industrial groundwater uses
- New groundwater consumptive uses (agricultural, municipal, industrial)
- Retirement of groundwater consumptive uses (agricultural, municipal, industrial)
- Well drilling permits approved, cancelled, or denied
- Variances for new water uses granted, cancelled, or denied
- Water transfer permits granted, cancelled, or denied
- Stream gage measurements on District maintained gages

- District regulations/management activities (designated groundwater management areas, use restriction, etc.)
- New depletions accounting report
- Streamflow accretion activities (new projects, conjunctive management projects, etc.)
- Water banking activities (if bank exists)

The Department is tasked with the following monitoring and reporting activities:

- Surface water irrigation use
- Municipal and industrial surface water uses
- New surface water appropriation granted (natural flow, storage, groundwater recharge, etc.)
- New groundwater permits issued
- Stream gage measurements from Department maintained gages
- Transfers/cancellations of surface water appropriations
- Surface water administrative actions taken
- New depletions accounting
- New data acquisitions, model and/or study results (conservation measured, riparian evapotranspiration, etc.)
- Voluntary water use
- Surface water pump investigations

### **Monitoring of Water Balance and Increase Understanding of Hydrologically Connected Areas**

In conjunction with several Platte River Basin NRDs, the Department developed a methodology, the Integrated Network of Scientific Information and GeoHydrologic Tools (INSIGHT), to quantitatively assess water supplies and balances. The results and data behind these analyses are distributed to the Lower Platte River Basin NRDs. The INSIGHT methodology is updated with the best available data and analysis, as provided by the District and the Department. Any updates to the methodology will be used to expand the understanding of the hydrologically connected area, and, if necessary, refine the boundaries of management areas.

### **Joint Analyses of Data and Information, and Impacts on Existing Uses**

The District and the Department will jointly review monitoring and studies, data, and information and evaluate for accuracy and consistency. Any discrepancies will be documented, reviewed, and revised, using the best available data and methods. Additionally, the District and the Department will utilize INSIGHT to compare annual water use data to historically reported water use data to perform analyses determining the impacts of new water uses on existing water users within the District.

## 10.0 INCENTIVE PROGRAMS

The District and the Department shall evaluate cost-share incentive programs that promote water conservation practices. Incentive programs may include any program authorized by state law or federal programs. Water users or landowners, who utilize such programs, may be required to enter into and perform such agreements or covenants concerning the use of land or water as are necessary to produce the benefits for which the incentive program is established. The District shall explore grant opportunities to supplement the annual budgeting process for funding incentive programs for voluntary IMP activities.

## 11.0 FUNDING OPTIONS

Additional funding sources may be needed to implement some of the action items listed in this voluntary IMP. This section provides information on a variety of funding options that the District and the Department may utilize. The general criteria and applicability of each of the funding sources are presented. The funding sources presented here are not necessarily inclusive of all funding options available; information presented here is subject to change as funding sources may change their terms and criteria.

### 11.1 Federal Funding Options

#### **U.S. Department of Agriculture, Farm Service Agency**

- *Conservation Reserve Enhancement Program (CREP)*. The CREP is part of the Conservation Reserve Program (CRP). The Nebraska CREP is intended to reduce irrigation water use, improve water quality, and enhance wildlife habitat through the establishment of vegetative cover. The program helps replenish streams, rivers, and reservoirs.

#### **U.S. Department of Agriculture, Natural Resource Conservation Service**

- *Agricultural Conservation Easement Program (ACEP)*. The ACEP provides financial and technical assistance to protect critical wetlands, agricultural lands, and grasslands through easements.
- *Conservation Security Program (CSP)*. The CSP is available in select watersheds across the nation. This program is designed to reward farmers and ranchers who implement conservation on working lands and to encourage them to do more.
- *Environmental Quality Incentives Program (EQIP)*. The EQIP offers technical assistance, cost-share, and incentive payments available to agricultural producers to implement conservation practices that improve water quality, increase water conservation, and enhance grazing lands.
- *Wildlife Habitat Incentives Program (WHIP)*. The WHIP provides technical and financial assistance to landowners and others to develop and improve wildlife habitat on private lands.

#### **U.S. Department of the Interior, Bureau of Reclamation**

- *WaterSMART Program*. Grants are provided to irrigation districts, water districts, and other organizations that deliver water or power to cost-share on projects that use water more efficiently. The projects should support water sustainability in the west.



## 11.2 State Funding Options

**The Nebraska Environmental Trust.** The Nebraska Environmental Trust was established in 1992 to conserve, enhance, and restore the natural environments of Nebraska. The Trust especially seeks projects that involve public and private sector collaboration to implement high-quality, cost-effective projects.

### Nebraska Department of Environmental Quality

- *Nonpoint Source Water Quality Grants (Section 319).* Under Section 319 of the federal Clean Water Act, the federal government awards funds to the Nebraska Department of Environmental Quality to provide financial assistance for prevention and abatement of nonpoint source water pollution. This funding is granted to units of government, educational institutions, and non-profit organizations for projects that facilitate implementation of the state Nonpoint Source Management Plan.

### Nebraska Game and Parks Commission

- *Nebraska Wildlife Conservation Fund.* This fund exists for conservation of nongame species, with particular focus on species determined to be threatened or endangered, ensuring their continued existence for scientific purposes and human enjoyment.

### Nebraska Department of Natural Resources

- *Water Well Decommissioning Fund.* The objective of the Water Well Decommissioning Fund is to provide cost share assistance to encourage proper decommissioning of water wells in the state.
- *Nebraska Soil and Water Conservation Fund.* This fund provides state financial assistance to landowners for installation of approved soil and water conservation measures meant to improve water quality, conserve water, and control erosion and sedimentation.
- *Small Watersheds Flood Control Fund.* The purpose of this fund is to assist local sponsors with the acquisition of land rights for flood control projects. Local sponsors use the fund to acquire easements or fee title to tracts that are needed to implement a project.
- *Natural Resources Water Quality Fund.* This fund was created to provide state funds to NRDs for their water quality programs.
- *Water Sustainability Fund.* During the 2014 legislative session, the Nebraska Legislature passed LB-1098, creating the Water Sustainability Fund. This fund acts to improve water quality and usage, achieve water management goals, evaluate flood control, and comply with existing interstate agreements and compacts.

### 11.3 Local Funding Options

It is the intent of the District to utilize qualified projects described in Neb. Rev. Stat. § 2-3226.04 to provide river-flow enhancement to achieve the goals and objectives of the District and Department under the Groundwater Management and Protection Act. The District may fund projects through the following mechanism:

**Occupation Tax (Neb. Rev. Stat. § 2-3226.05).** This authority allows the District to levy an occupation tax, not to exceed ten dollars per irrigated acre, upon the activity of irrigation of agricultural lands on an annual basis. Statute requires a public meeting for the provision of public comments to be held if the District board moves to implement an occupation tax for a qualifying project.

### 12.0 REVIEW PROCESS AND MODIFICATIONS

IMP implementation utilizes an adaptive management approach for attaining or maintaining the desired balance of the hydrologic system. An adaptive management approach allows an IMP to be modified as changes to a District area, sub-area, new techniques, or the availability of additional data or information occur.

The District and Department will hold an annual review to evaluate progress made towards implementation of the voluntary IMP. As part of this annual review, the District and Department will exchange annual reports summarizing the monitoring activities described in Section 9.0. The monitoring and study reports and data will be prepared, compiled, and exchanged in a standardized format, as agreed upon by the District and Department. This annual meeting may occur in conjunction with the Lower Platte River Basin Coalition annual meeting. Stakeholders and the public will be encouraged to attend the annual review.

The District and Department will regularly evaluate whether IMP goals and objectives are being met, and will jointly determine if amendments to the IMP are required. Amendments will require an agreement by both the Department and the District, and may require reconvening the Stakeholder Advisory Committee. If amendments to the IMP are proposed, the District and Department will hold a joint hearing to issue the pertinent orders to formally adopt the revised IMP.

## 13.0 INFORMATION CONSIDERED IN DEVELOPMENT OF THIS PLAN

The following sources of information were used in the preparation of the voluntary IMP:

- The Lower Platte River Basin Coalition’s “Basin Water Management Plan” (2018)
- Data on recharge rates within the District and adjoining NRDs
- Community Involvement Plan for the District, 2012
- The District’s Water Balance Study, 2014
- The District’s Sub-area Delineation Study, 2009
- The Department’s rules for surface water
- The Department’s groundwater models
- The Department’s stream gage records
- The Department’s INSIGHT tool and web portal
- The Department’s surface water administrative records
- The Department’s surface water digitized fields geospatial layer
- The Department’s Fully Appropriated Basins report and data
- The U.S. Geologic Survey’s stream gage records
- Past and present surface water use within and bordering the District
- Climate data and information (accessed from High Plains Regional Climate Center)
- Data on groundwater supplies and groundwater uses within and bordering the District
- Land cover data (Cropland data layer, CALMIT 2005, the District’s certified acres)
- Report entitled “Development of Groundwater Flow Model for the Lower Platte North Natural Resources District Area, Nebraska”, Dr. Xun-Hong Chen and Gengxin Ou, 2013
- Additional data acquired by the District or the Department and additional data on file with the District and Department.

## 14.0 GLOSSARY OF TERMS

**Acre-foot (AF)**—Volume of water required to cover 1 acre of land (43,560 square feet) to a depth of 1 foot, equivalent to 325,851 gallons.

**Alluvial aquifers**—Buried paleovalley aquifers in ancient stream valleys, aquifers created by modern streams, and aquifers of other origins.

**Aquifer**—A geological formation or structure of permeable rock or unconsolidated materials that stores and/or transmits water, such as to wells and springs.

**Appropriation**—A permit granted by the Department to use surface water for a beneficial use in a specific amount, purpose, and location. It is based on first-in-time, first-in-right.

**Bedrock aquifers**—Water bearing, consolidated to semi-consolidated rock formations.

**Conjunctive management**—The coordinated and combined process that utilizes the connection between surface water and groundwater to maximize water use, while minimizing impacts to streamflow and groundwater levels in an effort to increase the overall water supply of a region and improve the reliability of that supply.

**Cubic foot per second (cfs)**—The rate of discharge representing a volume of 1 cubic foot passing a given point during 1 second.

**Groundwater**—Water which occurs in, or moves, seeps, filters, or percolates, through the ground under the surface of the land, and shall include groundwater which becomes commingled with waters from surface sources.

**Groundwater management plan**—The Lower Platte North NRD's plan that identifies the water quantity and quality characteristics, supplies, uses, data collection methods, management objectives, and management areas of groundwater supplies within the NRD.

**Groundwater recharge**—The addition of water to the zone of saturation. Infiltration of precipitation and its movement to the water table is one form of natural recharge.

**Hydrologically connected**—Describes a geographic area designated by the Department where the existing amount of groundwater and surface water each has significant influence on the other, and where appropriate regulations exist.

**INSIGHT**—Developed and maintained by the Department, INSIGHT stands for an Integrated Network of Scientific Information and GeoHydrologic Tools. The purpose of INSIGHT is to provide an annual snapshot of water conditions across the state. Hydrologic data are consolidated from several different sources, including the Department, U.S. Geological Survey, U.S. Bureau of Reclamation, and local NRDs, and are presented in charts for the following categories: water supplies, water demands, nature and extent of use, and water balance. These data are presented in a

consistent format and become more local as the user drills down from the statewide level to the basin-wide and subbasin levels using the database interface.

**Instream Flow Demand**—Demand for streamflow taking place within the stream and is not withdrawn from a surface water source. These demands are based on current appropriations held by the Nebraska Game and Parks Commission or any NRD.

**River basin**—The land area that is drained by a river and its tributaries.

**Stakeholders**—Representatives from various groups and professional fields who have an interest or concern in a particular topic, and can affect or be affected by an organization's actions.

**Subbasin**—A portion of a river basin that is drained by a portion of tributaries in that river basin.

**Stream depletion**—Reduction to streamflow that results from a new use of either groundwater or surface water.

**Surface water**—Water which occurs or moves on the surface of the Earth such as in a stream, river, lake, wetland, or ocean.

**Water use**—The legally accepted use of a groundwater well or surface water appropriation.

**Water bank**—A mechanism used to facilitate the transfer of water between parties, often using market-driven transactions. Water banks can be institutional, physical, or mixtures of both.

**Watershed**—The area of land where all of the water that drains under or off of it goes to the same outlet.

## APPENDIX A

### STAKEHOLDER ADVISORY COMMITTEE

# Lower Platte North Natural Resources District's Voluntary IMP Stakeholder Advisory Committee

Note: This list only includes those who attended one or more meeting

First Name	Last Name	Affiliation
Frank	Albrecht	Nebraska Game and Parks Commission
Larry	Andreasen	City of Fremont Department of Utilities
Ron	Brown	Hormel Foods
Joel	Christensen	Metropolitan Utilities District
Dana	Divine	University of Nebraska-Lincoln
Francis	Emanuel	Francis Emanuel Farms
Jocelyn	Golden	City of Lincoln
John	Hayes	City of Lindsay
Lumir	Jedlicka	Agricultural Producer
Matt	Jedlicka	Agricultural Producer
Tracy	McConnell	Grosch Irrigation, Drilling and Exploration
Jim	McGowen	City of Schuyler
Ron	Papa	Papa Farms
Steve	Peterson	U.S. Geological Survey
Jeff	Runge	U.S. Fish and Wildlife Service
Loran	Schmit	Association of Nebraska Ethanol Producers
Meghan	Sittler	Lower Platte River Corridor Alliance
Ron	Sladky	Sladky Farms
Kristine	Stein	U.S. Army Corps of Engineers
Todd	Thompson	Mid-Continent Irrigation
Kevin	Tobin	Metropolitan Utilities District
Carol	White	Lyman-Richey Corporation
Doug	Whitfield	Metropolitan Utilities District
Rick	Wilson	U.S. Geological Survey



## APPENDIX B

### DEPLETION CALCULATION EXAMPLE FOR LIMITS ON NEW DEVELOPMENT

#### Depletion calculation example for limits on new development 50/50 groundwater/surface water split, reset annually

Modified Handout from District Water Committee: January 31, 2018

- Limits on New Development (from the Lower Platte Basin Water Management Plan):

**TABLE 4.2. FIRST 5-YEAR INCREMENT ALLOWABLE NEW DEVELOPMENT (DEPLETIONS) BY NRD**

NRD	Sub-Basin	First 5-year Increment Allowable New Development (Depletions) - Peak Season <sup>1</sup>	
		% Sub-Basin	AF
Upper Loup NRD	Loup River	32%	2,768
Lower Loup NRD	Loup River	68%	5,883
Upper Elkhorn NRD	Elkhorn River	25%	1,504
Lower Elkhorn NRD	Elkhorn River	75%	4,514
Papio-Missouri River NRD	Lower Platte River	21%	869
Lower Platte South NRD	Lower Platte River	24%	993
Lower Platte North NRD	Lower Platte River	55%	2,276

<sup>1</sup>The allowable new depletion is for all new uses. Apportionment between new surface water and groundwater uses will be made according to each NRD Integrated Management Plan.

- Example of a groundwater depletions calculation (from the LP Basin Water Management Plan).
  - 160 acres of corn
  - Net Irrigation Requirement of 12 inches (1 ft)
  - Stream Depletion Factor (SDF) at this location is 0.50
  - 30% of depletions occur during the peak season

New Depletions (AF) = (# of acres) × (Net Irrigation Requirement in feet) × (SDF) × (% depletions during peak season)

**(160 acres) × (1 ft) × (0.50) × (0.30) = 24 AF groundwater depletion.**

3. Example of a surface water depletions calculation
  - 160 acres of corn
  - Net Irrigation Requirement of 12 inches (1 ft)
  - Stream Depletion Factor (SDF) is 1.0
  - 100% of depletions occur during the peak season

**$(160 \text{ acres}) \times (1 \text{ ft}) \times (1.0) \times (1.0) = 160 \text{ AF surface water depletion.}$**

4. Specific parameters for District (based on Department’s preliminary model results)
  - District’s Net Corn Crop irrigation Requirement ranges from 8.8 inches to 6.5 inches (west to east); with a mean value of **7.28** inches.
  - SDF: 0.3 to 1.0, **mean SDF is 0.76** (higher closer to streams)
5. GW and SW Development in 2016 and 2017 in the District.

Year	GW Acres	GW Depletions	SW Acres <sup>1</sup>	SW Depletions <sup>1</sup>
2016	~2500	~350 AF	0	0
2017	~2500	~350 AF	0	0

<sup>1</sup>The Department did not approve any new SW permits for irrigation from natural flow. There was one “Irrigation from Storage Only” permit, approved in 2017, for 129 acres.

6. Example of how a 50/50 division of GW and SW could look if implemented in voluntary IMP. The 50/50 division is re-calculated every year based on available acres. We start with 2,276 AF, or 1,138 AF each.

Year	Total available Depletion (AF)	Available GW Depletion (AF)	Available SW Depletion (AF)	Used GW depletion (AF)	Used SW Depletion (AF)	Total Used Depletion (AF)	Remaining Depletion for next year (AF)
2016	2, 276	1,138	1,138	(350)	(0)	(350)	1,926
2017	1,926	963	963	(350)	(0)	(350)	1,576
2018	1,576	788	788	--	--	--	--

7. How many GW acres result in 788 AF in the District? A generalized example follows.

GW--Assume 0.7 SDF, NIR= 7.28 in (0.6 ft), 0.3 (30%) in peak season:

**$788 \text{ AF} / (0.7 \text{ SDF} \times 0.6\text{ft} \times 0.3) = 6,253 \text{ acres}$**

8. How many SW acres result in 438 AF in the District? A generalized example follows.

SW--Assume 1.0 SDF, NIR=7.28 in (0.6 ft), 1.0 (100%) in peak season:

**$788 \text{ AF} / (1.0 \text{ SDF} \times 0.6\text{ft} \times 1.0) = 1,313 \text{ acres}$**