SCOTTS BLUFF COUNTY
ZONING REQUEST APPLICATION

ON THE 11th **DAY OF** August **, 20** 25

Silver Spur Feeders LLC - Cottonwood
(Name of Applicant)

HAS CAUSED TO BE MADE AN APPLICATION TO SCOTTS BLUFF COUNTY FOR A CONDITIONAL USE PERMIT FOR LAND DESCRIBED AS FOLLOWS (LEGAL DESCRIPTION):

Part of Section 36, Township 22N, Range54W Scotts Bluff County

THIS ACTION WILL ALLOW (SHOW PRESENT AND PROPOSED USAGE AND JUSTIFICATION FOR REQUEST):

2500 head concentrated animal feeding operation with a current NPDES permit from the Nebraska Department of Water, Environment and Energy. The facility has controls in place to contain any run off water from the 29.3 acres.

FEE $150

OWNER NAME **Silver Spur Feeders LLC**

MAILING ADDRESS **PO Box 426**

CITY/STATE **Minatare, NE 69356**

CONTACT EMAIL: bmarsh@spurranches.com

PHONE: **308-783-1000**

OWNER SIGNATURE: [signature]

SCOTTS BLUFF COUNTY
BUILDING & ZONING DEPARTMENT

______________________ Date: ______ Rcpt #: __________
DEPT REPRESENTATIVE

Stage Storage Data
Basin 2

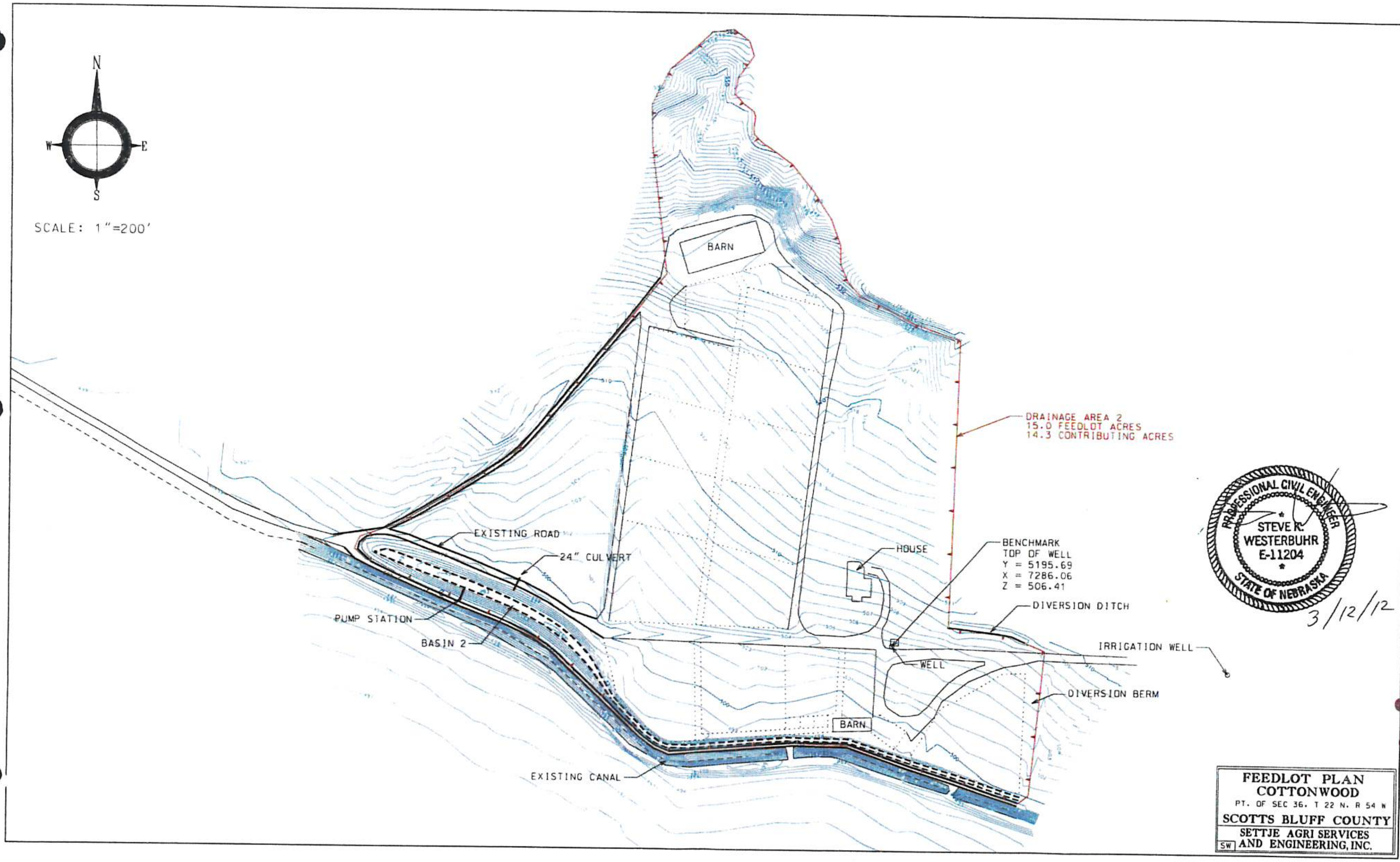
Feedlot Area (Acres)	15
Feedlot Curve Number	90
Contributing Drainage Area (Acres)	14.3
Contributing Area Curve Number	49
Total Runoff Area (Acres)	29.3

Head count in drainage area	2,500
Total Depth (feet)	5.5
25-Year 24-Hour Storm (in)	3.5
25 Year Storm Runoff Volume (ft^3)	142,121
Design Pond Capacity (ft^3)	177,498

	Elev.	Depth From Bottom	Volume			
			Cubic ft.	Acre ft.	Acre in.	Gallons
Top of Berm	498.6	5.5	177,498	4.1	48.9	1,327,685
	498.1	5.0	121,878	2.8	33.6	911,647
	497.6	4.5	86,940	2.0	24.0	650,311
	497.1	4.0	69,930	1.6	19.3	523,076
	496.6	3.5	55,755	1.3	15.4	417,047
	496.1	3.0	43,389	1.0	12.0	324,550
	495.6	2.5	32,481	0.7	8.9	242,958
Start Pumping	495.1	2.0	22,977	0.5	6.3	171,868
	494.6	1.5	14,850	0.3	4.1	111,078
Pre-Winter/Sludge	494.1	1.0	8,046	0.2	2.2	60,184
	493.6	0.5	2,754	0.1	0.8	20,600
	493.1	0.0	0	0.0	0.0	0

PROFESSIONAL CIVIL ENGINEER
STEVE K. WESTERBUHR
E-11204
STATE OF NEBRASKA

3/12/12


N
W
E
S
SCALE: 1"=200'
BARN
DRAINAGE AREA 2
15.0 FEEDLOT ACRES
14.3 CONTRIBUTING ACRES
PROFESSIONAL CIVIL ENGINEER
STEVE R. WESTERBUHR
E-11204
STATE OF NEBRASKA
3/12/12
EXISTING ROAD
24" CULVERT
HOUSE
BENCHMARK
TOP OF WELL
Y = 5195.69
X = 7286.06
Z = 506.41
DIVERSION DITCH
PUMP STATION
BASIN 2
IRRIGATION WELL
WELL
DIVERSION BERM
BARN
EXISTING CANAL
FEEDLOT PLAN
COTTONWOOD
PT. OF SEC 36. T 22 N. R 54 W
SCOTTS BLUFF COUNTY
SETTJE AGRI SERVICES
AND ENGINEERING, INC.
SW

Cottonwood

Irrigation Distribution

No Construction Proposed at this time.

Cottonwood

Nutrient Management Plan

Closure Plan

Sludge Removal Plan

Operation and Maintenance Plan

Best Management Practices of Odor Control

Emergency Response Plan

Mortality Management Plan

Chemical Management Plan

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1. Nutrient Management Plan

This Nutrient Management Plan has been prepared for Cottonwood, which encompasses an existing feedlot with a capacity of 2,500 head of beef cattle. The manure and effluent will be properly utilized by applying it to cropland as fertilizer or irrigation water. The plan will provide management with a system to comply with state and federal regulations and provide the Nebraska Department of Environmental Quality with a means of monitoring, measuring and determining compliance.

The plan follows the narrative approach in that it describes the methods and procedures that will be used for determining nutrient application rates. It considers the production, loss and utilization of nutrients by crops in order to preserve the local natural resources.

1.1 Application Sites

The facility management owns or has contracted an ample amount of land for the application of solid and or liquid manure. **All of the solid manure produced is transferred to Silver Spur Feeders LLC.** The parcels included in this plan are identified on the attached field maps and cross-referenced on the Land Application Site Summary. These agricultural lands are used for production of agricultural commodities or grazing as determined annually by the land owner or operator. Management of the facility will coordinate the appropriate application of manure with the land owner or operator prior to each spreading event. A projection is included with this plan to determine sustainability or need for further acquisition of land for nutrient distribution.

Maps of the applications sites have been created using GIS software and are included as an appendix to this document.

Management will implement and adhere to the following operational guidelines when applying manure or effluent water. Management shall be responsible to account for all sources of nutrients prior to applying manure to land application sites covered in this plan.

1.2 Maximum Application Rates

Projections determining the application rates will be conducted on all sites destined to receive manure for the current or next growing season prior to spreading. Projections will be made for all crops or alternative crops covered in this plan.

In general the method of determining manure application rates will be to establish the usage of nutrients by crops or crop rotation and subtracting nutrients in the soil and all credits.

nutrient requirement / manure nutrient content = application rate

1.2.1 Nitrogen Basis

The primary planning of application rates will be based upon Nitrogen as the desired target nutrient provided other nutrients remain in check. Manure will be applied at agronomic rates based upon Nitrogen demand of a crop for a single growing season. In some cases fields may produce two crops in a single growing season if preferred by the management of the land.

1.2.2 Multi-Year Phosphorus Basis

Manure or nutrients may be applied in a single growing season to provide for multiple growing seasons of phosphorus uptake of the crop or crop rotation. The level of phosphorus will be evaluated prior to the application events by a consultant or qualified individual.

1.2.3 Phosphorus Basis

A phosphorus index will be conducted at a minimum every 5 years. Phosphorus may be used as a secondary means of determining application rates if the deemed necessary by the phosphorus index. The index and all other relevant conditions will be used in an evaluation by the consultant or qualified individual to assess the transport phosphorus from the application fields. Management shall notify NDEQ of any site-specific conservation practices to be implemented, including as appropriate buffers or equivalent practices to control runoff of pollutants.

1.2.4 Factors Determining Rate

The factors that will be used to determine the rate of application of manure and effluent are detailed as follows:

1. Soil analysis results
2. Manure analysis results
3. Crop nutrient requirement
4. Yield goal of the crop to be grown
5. Loss of nutrients in manure through volatilization and or mineralization
6. Projected Credits for all nitrogen that will be plant available
7. Method of application and timing

University of Nebraska recommendations, NRCS 590 standards, or equivalent will be used to determine the application rates. Application rates and management methods will be adjusted based on actual field logs, including but not limited to, plant tissue testing and the use of a Chlorophyll Meter to detect any nitrogen deficiencies.

1.3 Manure and Effluent Analysis

Analyze manure, litter, and process wastewater annually for nitrogen and phosphorus content. The number of samples taken will be determined by site specific criteria.

All samples will be extracted and analyzed according to normally accepted practices or the procedures suggested by the University of Nebraska ***NebGuide G1450*** or the NRCS 590-Standard, however the testing laboratory may determine the appropriate method of analysis based upon the material being analyzed. The results of soil and manure analysis shall be used to determine appropriate land application rates.

1.4 Soil Analysis Procedures

The land identified in this plan that is to receive solid or liquid waste in the next growing season shall be sampled and analyzed for nutrient content prior to nutrient application. It shall be at the discretion of the facility management to conduct samplings on land that is not intended to receive manure within the next growing season. UNL guidelines or NRCS 590 standards for sampling and analysis will be used.

1.4.1 Timing of Soil Sampling

The timing of soil sampling may be either after harvest or prior to planting, prior to application of nutrients.

1.4.2 Depth of Soil Sampling

Management will conduct a surface (0 to 8 inch) and a subsurface (8 to 24 inch) soil test on all application sites that are about to receive manure in any given year. Typically the bottom depth of the shallow sample is 8 inches from the surface but may differ depending upon local conditions. A deep sample analysis shall be performed starting at the bottom depth of the shallow sample extraction and continuing to a minimum of 24 inches below the surface. Deep nitrate soil tests are required whenever manure will be applied with the following exceptions and guidelines from the NRCS 590 Standard:

- *Non-legume crops following annual or biennial legumes (i.e. corn following soybeans/edible beans/sweet clover)* – Deep nitrate tests are required whenever nitrates may be elevated due to previous year manure application, drought, previous crop was hailed out, or any reason that nitrate levels could be elevated.
- *Non-legume crops following alfalfa or other perennial legume (i.e. corn following alfalfa):* Deep nitrate tests are not necessary unless there is a reason to believe they are elevated.
- *Pastures/CRP* – Deep nitrate tests are not necessary unless there is a reason to believe they are elevated. Refer to current NebGuide G78-406-A "Fertilizing Grass Pastures and Haylands".
- Deep nitrate tests are not required when 20 lbs. of nitrogen or less is applied via starter fertilizer and where starter fertilizer is the only source of commercial fertilizer.
- When deep nitrate tests are not taken, an assumed value of at least 3-ppm or 15 lbs/acre for residual nitrate values will be used in the nutrient budget in addition to appropriate nitrogen credits when following legumes.

1.4.3 Soil Sampling Density

Soil samples may be combined to form a composite sample representing an area of 40 acres of land but may be expanded or decreased depending upon specific site conditions as determined by the consulting agronomist or land owner or land operator.

1.4.4 Soil Analysis Requirements

Analyze soil at each application site for nitrogen content prior to the first application of any manure, litter, or process wastewater and then at least annually thereafter when used for application. Analyze soil at each application site for phosphorus content prior to the first application of any manure, litter, or process wastewater and then at least once every 5 years thereafter if used anytime in the 5 years for land application.

1.4.5 Phosphorus Forms

Due to site specific conditions the form of phosphorus analysis to be carried out will be at the discretion of the consulting agronomist or land owner and operator.

1.5 Irrigation Water Analysis Requirements

At a minimum irrigation water will be sampled prior to initial use and at least once every five years thereafter for nitrogen. UNL guidelines for collecting and analysis will be used.

1.6 Crop Rotations

The primary crop rotation will be grazed pasture/alfalfa. Due to annual variations in weather and market conditions the exact rotation of crops will be determined on an annual basis by the land manager and consulting agronomist.

1.7 Alternative Crops

Alternative crops not detailed on this plan may be cultivated for the utilization of manure nutrients. When alternative crops are planned the manure planning will be altered to account for the crop differences. Projections will be made prior to applications to account for differences in crops. Alternative crops, yields, and N & P recommendations are listed on the Crop Management attachment and Ward Guide.

1.8 Historic Yield Data

Crop yield data for this facility was obtained from the National Agricultural Statistics Service web site http://www.nass.usda.gov/Statistics_by_State/index.asp . The yield goal used for projections is derived by calculating the five year county average plus an additional 10%. Yield goals may also be derived from Farm Service Agency crop certifications or other certified yields. The ten percent increase was used to account for developments in agricultural technology and proper nutrient management over that time frame.

1.9 Solid Manure Application

1.9.1 Solid Manure Application Timing

The majority of the manure will be applied between harvest and planting. As weather permits, manure application will take place anytime.

1.9.2 Transportation of Solid Waste

The solid manure generated from the facility will be transported to the application sites using trucks. The facility owns or will obtain the equipment for such hauling and distribution. In addition the management of the facility may at any time retain a custom manure hauling company for the purpose transportation or application of the manure.

Care will be taken by the applicator to prevent spills and ensure proper maintenance of the facility. The Emergency Response Plan (ERP) contained at the end of this section will be implemented should any accidents arise.

1.10 Effluent Application

Effluent will be land applied according to this plan following agronomic rates. If application of effluent from the holding ponds is subject to runoff, the operation shall discontinue irrigation applications until conditions improve.

1.10.1 Change in Method or Location of Distribution

Management shall notify NDEQ in writing prior to changing the method or location of effluent distribution.

1.10.2 Effluent Application System

The facility will utilize a system for handling effluent runoff as follows. The proposed basin will is built to contain a 24 hour/25 year storm event. Following any significant precipitation event, the basin will be pumped down to the start pump level within 100 hours.

The facility has 64.9 acres of land available for effluent application.

According to NebGuide G1465 Crop Water Use in Western Nebraska (attached to this application) during the growing season an actively grazed pasture or alfalfa crop requires 32 inches per acre. The average rainfall for the area during the growing season is 11.63 inches, leaving a net requirement of 20.37 inches for the actively grazed pasture/alfalfa. Therefore the actively grazed pasture/alfalfa will require 1,322 acre-inches of irrigation water.

Using 15.5 inches for the total annual precipitation, the estimated annual runoff for the facility is 1,105,210 gallons or 40.7 acre-inches. This leaves a total annual deficit of 1,281.3 acre-inches of water that will need to be applied as clean irrigation water to meet the crop water use needs.

1.10.3 Method of Effluent Application

Basin 2 is pumped to a gravity irrigation distribution system as illustrated on the Irrigation Distribution Site map and labeled as Site#301 covering 64.9 acres. The facility will utilize a portable diesel powered pump with a rating of at least 325-gpm to dewater the basin. The gated pipe is connected by an 8" high-pressure underground pipe. A forecast of the amount of effluent and nutrient balance has been included on the Planned Manure Application Worksheet. The land area for application of wastewater is identified on the attached Land Application Site Summary Sheet.

1.10.4 Effluent Application Timing

The majority of the effluent will be applied during the growing season as a side-dress application. Effluent can also be applied either late fall after harvest, winter, or early spring prior to planting, as weather permits.

1.10.5 Check Valve Assembly

The irrigation distribution system will have a check valve or total disconnect system to prevent effluent from entering the well. The check valve will be approved and inspected by the local NRD or a qualified individual. The facility also has the option of disconnecting from any irrigation water source during livestock waste application and therefore no check valve is required.

1.10.6 Surface Water Considerations

Management will not apply or stockpile manure and effluent within 100 feet of any surface waters, open tile line intake structures, well head, or other conduits to surface or ground water. Stockpiles of livestock waste shall be located to prevent a discharge to waters of the state.

1.10.7 Compliance Alternatives

The following two compliance alternatives may be substituted for the application setback requirement:

A 35-foot-wide vegetated buffer where the application of manure is prohibited. For the purposes of this document vegetated buffer means a permanent strip of dense perennial vegetation established parallel to the contours of and perpendicular to the dominant slope of the field for the purposes of slowing water runoff, enhancing water infiltration, and minimizing the risk of any potential nutrients leaving the field and reaching waters of the state; or

A satisfactory demonstration that a setback or buffer is not necessary because implementation of alternative conservation practices will provide pollutant reductions equal to or better than reductions that would be achieved by the 100-foot setback.

1.11 Addition/Removal of Application Sites

Management will provide NDEQ with written notification of any additions or deletions of land available for manure application. Such changes will be incorporated into this plan and resubmitted to the NDEQ.

1.12 Manure Gifted, Traded or Sold

Management will keep a record of any manure or effluent that is sold, gifted or traded and will not be responsible for keeping record of or determining distribution rates of such manure. Records of manure transactions will detail the date, amount of manure transferred on a daily basis, party sold or given to, and any other details of the transfer. Management will provide the receiving party a representative manure analysis report.

1.13 Training

Management will attend or participate in the NDEQ approved training for land application as specified in Title 130 every five years or as required.

1.14 Nutrient Management Plan Record Keeping

The plan will contain the following information and be maintained by the facility management, and will be made available to NDEQ upon request. These records shall be retained for a period of five years or as specified by Title 130. Please refer to the enclosed forms.

1. Maintain all records associated with this Plan.
2. Chemical analysis of the effluent produced, time of sampling and special conditions.
3. Chemical analysis of the solid waste produced, time of sampling, and special conditions.
4. Soil tests on application ground per this Plan.
5. Record of field locations and application rates per this Plan.
6. Results of all phosphorus risk assessments
7. Record of crop yield projections, actual crop yields, and adjustments and corrections to the Plan.
8. Record of all manure sold, gifted and traded to another party per this Plan.
9. Record of any correspondence with the NDEQ as to the needed adjustments to this Plan.

2. Closure Plan

Should the need arise to close all or a portion of the LWCF a simple and effective procedure will be implemented, limiting environmental concerns and hazards.

2.1 Closure Notification

The management of the facility will notify the NDEQ within 30 days should the facility become permanently closed.

2.2 Liquid and Solid Distribution

All liquids and solids will be distributed according to the guidelines listed in the Comprehensive Manure and Nutrient Management Plan and the Sludge and Sediment Management Plan.

2.3 Basin Cleaning

All basins and drainage ways will be cleaned and solids distributed according to this plan.

2.4 Liquid Removal

Agitate and de-water any structure detaining effluent. Ample liquid will be left in the pond so that the remaining sludge (if any) can be pumped without plugging the pumping equipment

2.5 Sludge Removal

Once the sludge and liquid have been removed from the structure, excavation equipment will be used to remove remaining sludge to the original constructed grade of the structure floor.

2.6 Equipment Removal

All motors, switches and piping will be removed from the pump stations and/or lift stations and the pump sump will be filled with on-site soils.

2.7 Final Site Topography

After all wastes and equipment have been removed, the pond site will then be leveled or left as is.

3. Sludge and Sediment Removal Plan

The pond will not be allowed to accumulate sludge above the Maximum Sludge Depth (as defined in the Operation and Maintenance Plan). When the need to restore capacity to the structure is determined from the listed indicator, the sludge will be removed when the sludge level reaches the Maximum Sludge Depth.

Agitation and pumping unit or excavation equipment will be used to physically remove a portion or all of the accumulated sludge/sediment. The removal equipment will not be allowed to physically come into contact with the liner; therefore, this system should allow proper protection of the liner.

Sludge or solids shall not be allowed to accumulate such that it cannot be disposed of agronomically. Samples shall be obtained in order to determine proper land application rates. The method and location of sludge and sediment application will be in accordance with the NMP for this facility.

STEVE K. WESTERBUHR E-11204 PROFESSIONAL CIVIL ENGINEER STATE OF NEBRASKA 9/9/16

4. Operation and Maintenance Plan

4.1 Inspection Requirements

Management will keep detailed written documentation for the operation, maintenance and inspection of the LWCF and related components on a weekly basis. In addition to the weekly recordings, the change in basin depth shall be recorded following a precipitation event or land application from the LWCF. Record the LWCF condition, and evaluating the maintenance procedures as outlined herein. Corrective measures that are taken will be documented.

Parcels receiving manure will be monitored and inspected daily by the operator of manure application equipment to ensure that manure and/or runoff from the application site is not leaving the site. If a discharge is occurring, management will take necessary corrective action immediately. Documentation of each corrective action shall be made and be available for inspection by the NDEQ if requested.

All records shall be kept by management for a period of at least five years at the facility. Any discharge shall be reported within 24 hours of the event, to the Department of Environmental Quality at (402) 471-2186. Such written report shall be submitted (see enclosed sample report form from NDEQ) to the NDEQ within 5 days of the event.

4.2 Pumping Station Systems and Debris Basin Maintenance

The basin shall be pumped down to the start pump level within 100 hours following a precipitation event, unless conditions exist where runoff from the application site is likely. If application of effluent from the basins is subject to runoff, the operation shall discontinue irrigation applications until conditions improve.

4.2.1 Equipment Security

All pumping equipment will have controlled access and be monitored to prevent any tampering or unauthorized use.

4.2.2 Equipment Inspections

All pumping equipment shall be inspected by management weekly. Such inspection shall assure the proper operation of all valving, backflow prevention devices and pumping equipment.

4.2.3 Basin Inspections

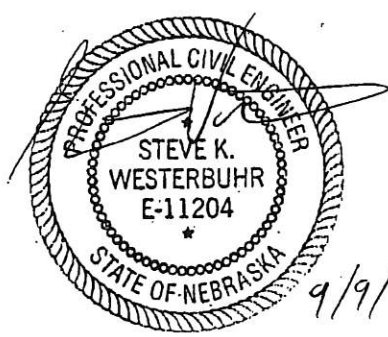
All basins shall be inspected by management weekly. Such inspection shall assure the proper operation of all valving, backflow prevention devices and pumping equipment. Necessary repairs shall be implemented as soon as possible.

4.2.4 Sludge Removal

Management will remove sludge from basins as needed to ensure proper drainage and maintain function with regard to controlling the runoff from the design storm.

4.3 Basin Maintenance Procedures

1. Erosion - Repair and re-vegetate any areas of significant erosion.
2. Damaged Grade Work - Repair any damaged earthwork to original grade.
3. LWCF Modifications - Any modifications to the LWCF shall be accomplished in accordance with the specifications and the guidelines of Title 130.
4. Liners & Pipes - Repair any damaged liner or pipes as discovered.
5. Livestock Entry - Livestock shall be prohibited from entering the earthen containment structure at any time.
6. Trash - Remove and dispose of significant trash and debris that will affect the functioning of the pumping unit system.
7. Weed Control - The pond will be maintained with seeding of the berms, diversion drainage channels and all disturbed soil. Proper herbicide applications and spraying will also take place to prevent the growth of weeds and trees on the berms to help maintain the integrity of the dikes.
8. Extraneous Water – If extraneous storm water runoff is diverted around the LWCF to eliminate unnecessary volume, then the diversions will be maintained on a regular basis to prevent the backup and spillage of fresh water into the waste retention pond (s).



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5. Best Management Practices

The following Best Management Practices (BMP) may be implemented by management of the operation, based upon the existing physical and economic conditions, opportunities and constraints:

5.1 Odor Control BMP's

The following management practices will assist in minimizing odor effect.

5.1.1 Facility Maintenance and Odor Control Practices.

1. Keep pens as clean and dry as possible to avoid anaerobic decomposition of organic material.
2. Avoid manure buildup, thereby decreasing odor sources.
3. Basins will be cleaned as needed. Care will be taken to account for wind direction and timing of such activities to stay away from weekends and Holidays.

5.1.2 Pond Odor Control Practices

1. The pond (s) will be managed properly with respect to dewatering as often as specified above.
2. The pond is large enough to consistently hold all runoff, store excess runoff and apply in a timely manner to cropland.
3. The pond (s) will be inspected and monitored as specified in the Operation and Maintenance Plan to prevent excess sludge accumulation and odor production associated with normal pond activities.

5.1.3 Land Application

1. The application of liquid and solid manure onto cropland may be a significant source of odors and nuisance complaints from surrounding neighbors. The following procedures may help alleviate those concerns.
2. When liquids are applied to cropland, care will be taken to ensure wind direction is not conducive to neighbor residences and runoff is prevented.
3. Try to apply manure during times when the air is warming and rising from the ground.
4. Try to avoid application on hot humid days (where odors will stay close to the ground) and on weekends or holidays.

5.2 Other Best Management Practices

5.2.1 Surface Water

Manure and effluent will not be applied in a manner to allow contamination to surface waters.

5.2.2 Conservation Practices

Manure and effluent will utilize application areas that are under proper conservation treatment to prevent runoff into surface waters.

5.2.3 Agronomic Rates

Manure and effluent will not be applied in excess of agronomic rates for Nitrogen and shall provide for sampling and management as specified in the Nutrient Management Plan (NMP) in this application.

5.2.4 Manure Management Plan

Management will implement the NMP according to the requirements listed in Title 130, Chapter 11.

6. Emergency Response Plan

6.1 Emergency Response Strategies

Overbuilding the structure will minimize the risk of the holding pond overtopping or breaching due to power failures, storms, and chronic wet periods. Accidental spills of solids could result from such activities as hauling and transporting solid manure. All employees of the facility are responsible for taking immediate action to contain any spill or leak that they may observe, provided their immediate safety is not in jeopardy. Containment procedures include taking action to prevent further loss of the material and preventing the material from spreading. In the case of an emergency, all employees of the operation can be made available.

In the event of an immediate safety hazard the area will be evacuated to a safe distance. All other employees will be warned as best possible. The local Fire Department, rescue squad or county sheriff's office at (911) shall be notified immediately.

6.2 Spill & Leak Prevention

The maintenance of all equipment associated with waste containment, transport, and distribution in optimum working conditions will prevent spills and leaks. Each employee responsible for handling manure will be educated within one week of their first employment date on the proper maintenance of the equipment. In addition, when equipment is in long-term continual use (such as in irrigation distribution) it will be monitored twice daily to detect leaks and any equipment failure in a timely manner.

6.3 Large Spill Response Practices

6.3.1 Stop the Cause

Shut off any mechanical device (such as a pump) or empty any containment structure that may be causing the spill or leak to continue.

6.3.2 Containment

Contain the spill with local area soils by building temporary dikes or dams. The equipment to build such structures is readily available as the owner has a loader, a box scrapper and a manure spreader.

6.3.3 Absorb Effluent

Absorb any effluent substance with local soil. The material will then be disposed of by land application at agronomical rates.

6.3.4 Verbal Notification

Management must immediately report any releases of wastewater off of the property to NDEQ (402) 471-2186 within 24 hours of the event.

6.3.5 Written Notification

A written report of a discharge will be submitted to NDEQ within 5 days of the event. Such a report shall be recorded on the Notification of Discharge of Livestock Waste form.

6.4 Small Spill Response Practices

Repair any equipment failure such as valves or joints in piping that may be causing a small-scale leak.

6.4.1 Verbal Notification

Management must immediately report any releases of wastewater off of the property to NDEQ (402) 471-2186 within 24 hours of the event.

6.4.2 Written Notification

Any discharge of waste shall be reported a written report of a discharge will be submitted to NDEQ within 5 days of the event. Such report shall be recorded on the enclosed form titled Livestock waste Discharge Notification.

7. Mortality & Chemical Management Plan

Animal mortalities will not be disposed of in any livestock waste control facility.

7.1 Catastrophic Mortality Event

In the case of a catastrophic mortality event, management shall contact the agencies listed below management within 18 hours of discovery.

Nebraska Department of Agriculture	(402) 471-2351
Nebraska Department of Environmental Quality	(402) 471-2186

Final disposal of mortalities from a catastrophic event shall be approved on a case-by-case basis by the superior agency in charge. Depending on the nature of such an event different state or federal agencies may have jurisdiction.

7.2 Temporary Mortality Storage Area

Prior to final disposal, mortalities shall be stored in a location and manner consistent with this plan and the rules and regulations in effect at the time of such storage. This area is located on-site and is designated on the Mortality Management Site Map.

7.2.1 Runoff Control

Storm water runoff from this area shall either be contained and disposed of by land application or directed into the LWCF. Mortalities shall temporarily be stored un-covered.

7.3 Mortality Disposal Methods

Disposal of mortalities shall conform to Nebraska Department of Agriculture's, §54-744.

7.3.1 Primary method

Within 36 hours of discovery, mortalities shall be disposed of via commercial renderer.

7.3.2 Secondary method

If the Primary Disposal Method is unattainable, mortalities shall be buried within 36 hours. Burial shall be conducted at the location designated on the Mortality Management Site Map.

7.4 Chemical Management Plan

Chemicals such as herbicides, insecticides and rodenticides may be used at this AFO to control unwanted vegetative growth, insect pests and rodents.

7.5 Chemical Storage

Chemicals will be stored in their original containers in a designated area with restricted entrance, away from feedstuffs.

7.6 Container Disposal

Empty containers will be flushed and disposed of according to label instructions. Chemicals or chemical containers will not be disposed of in any liquid manure, dry manure or process wastewater system associated with this LWCF.

7.7 Farmstead Safety & Security

Management will implement a Biosecurity plan for visitors, livestock, veterinary waste, sanitation, & employee safety as they see fit. Guidance for Safety and Security was derived from NebGuide G1444 and G1411.

8. Nutrient Management Plan Attachments

1. Waste Production Volumes
2. Chemical & Mortality Management Map
3. Listing of land available for manure application (Land Application Site Summary)
4. P-Index and Nitrogen Leaching Summary
5. Manure Management Worksheet
6. Maps of Application Sites
7. Planned Manure Applications
8. Alternative Crops and Nutrient Requirements
9. Operation and Maintenance record keeping forms
10. Land Application Agreements (if applicable)
11. Ward Guide Attachment
12. Record keeping forms

Cottonwood

Chemical & Mortality Management Plan

0 135 270 540 810 1,080
Feet

Facility
Section_Lines

N

· ***Waste Production Volume***

Solids Production

A	B	C	D	E	F	G	H
Type of Animals:	Number of Animals:	Average Weight (lbs):	Animal Units (au)	Volume of Waste Produced Per A.U. (cf/d/au)	Weight of Waste Produced Per A.U. (lb/d/au)	Annual Volume of Waste produced (d*e*365) (cu ft)	Annual Weight of Waste produced (e*f*365) (lbs)
Beef Feeders	2,500	850	2,125	1.10	65.0	853,188	50,415,625

Solid manure (8% of weight produced)	4,033,250
Solid manure (total lbs./2000)	2,017
Percentage of soil removed from pens	10%
Annual Total Weight of Solids (solid manure tonage + soil removed)	2,218
Annual Total Volume of Solids (annual weight * 2000/85)	52,195
Volume of Liquid remaining in solids (annual solids * .5 * .5)	555
Weight of Liquid remaining in solids (liquid volume *85/2000)	24
Volume to be haulded annually (cu. ft.)	65,244
Weight to be hauled annually (tons)	2,773
No. of Manure Spreaders	1
Volume of Manure Spreaders (tons)	16
Loads of Solids Per Year	173

*Animals are assumed to be in place 365 days per year

* 100% of manure from the facility will be collected.

Open Lot Runoff

I	J	K	L	M	N	O
Area:	Curve Number:	Find S (1000/I)-10	Solve for Runoff Q=((P-(.2*S))2)/(P+(.8*S))	Ratio of Contributing Acres to Feedlot Acres	Runoff (in.)	Runoff Volume (acre ft)
15	90	1.11	2.45	0.07	3.50	4.4
14.3	49	10.41	0.17		0.24	0.3

Total Drainage Area Runoff (acre ft)	4.7
Solids Accumulation (acre ft)	0.5
Additional Added Liquid From Overflow Water (acre ft)	0.00
Total Runoff Volume (acre ft)	5.2
Total Runoff Volume (gallons)	1,682,849
Total Gal. Per Minute Pump Capacity	325
Avg Annual Pumping Time (hours)	86

* Runoff values were derived from the WP-41 Worksheet

Manure Management Worksheet
Open Feedlot Manure

A	B	C	D
Permitted Head Count	Turns Per Year	Total Head Count Finished Per Year	Avg. Wt. (lbs.)
2500	2.3	5,750	850

Production and Storage Loss

E	F	G	H	I	J	K	L	M
	Nitrogen				Phosphorus			
	Produced	Storage Loss			Produced	Storage Loss		
Manure Type	N / Animal / Year (lbs)	Total N / Year (c*f) (lbs.)	% Retained (book value)	After Losses (g*h) (lbs)	P_2O_5 / Animal / Year (book value) (lbs)	Total P_2O_5 / Year (c*j) (lbs)	% Retained (book value)	After Losses (k*l) (lbs)
Solids	48.6	279,384	50%	139,692	7.07	40,629	95%	**38,597**
Effluent	48.6	279,384	5%	13,969	7.07	40,629	5%	**2,031**

Nitrogen Application Loss

N	O	P	Q	R	S	T	U
Manure Type	% of Organic N in Manure (book value)	First Year Available Organic-N (book value) (%)	Total Organic N (i*o*p) (lbs.)	Ammonium in Manure (book value) (%)	Available Ammonium (book value) (%)	Total NH4-H (i*r*s) (lbs.)	Total (q+t) (lbs N/year)
Solids	80%	50%	55,877	20%	5%	1397	**57,274**
Effluent	10%	70%	978	90%	50%	6286.14	**7,264**

Solids Distribution Minimums

V	W	X	Y	Z	AA	AB	AC
Crop	Yield	N Uptake Per Yield Unit (book value) (lbs)	N Uptake (w*x) (lbs/acre)	Minimum Required Area For Complete Nitrogen Distribtuion (u / x) (acres)	P Uptake Per Yield Unit (book value) (lbs)	Total P Uptake (w * aa) (lbs/acre)	Minimum Required Area For Complete Phosphorus Distribtuion (m / ab) (acres)
Corn	161.2	0.97	157	365.0	0.3	49	783.9
Corn Silage	17.8	10.50	187	306.4	3.2	57	681.5
Sorghum Silage	8	9.00	72	795.5	3.0	24	1,608.2
Oats	44.75	0.78	35	1,636.5	0.2	10	3,706.1
Sunflower	2150	0.04	81	704.2	0.0	28	1,385.8
Alfalfa	4.378	55.00	241	237.9	9.2	40	955.4

Effluent Distribution Minimums

AD	AE	AF	AG	AH	AI	AJ	AK
Crop	Yield	N Uptake Per Yield Unit (book value) (lbs)	N Uptake (ae*af) (lbs/acre)	Minimum Required Area For Complete Nitrogen Distribtuion (u/ag) (acres)	P Uptake Per Yield Unit (book value) (lbs)	Total P Uptake (ae*ai) (lbs/acre)	Minimum Required Area For Complete Phosphorus Distribtuion (i/aj) (acres)
Brome Grass	2.5	39.20	98	74.1	10.8	27	75.1
Corn	161.2	0.97	157	46.3	0.3	49	41.3
Alfalfa	4.378	55.00	241	30.2	9.2	40	50.3

All information and calculations were derived from the UNL Land Estimator spreadsheet. However certain assumptions were made as defaults to save time and reduce errors. The assumptions are as follows:

1. The spreadsheet is only to be used for open lot cattle facilities with all defaults.
2. Manure is broadcast applied, not incorporated, and is applied to cool soils.

Alternative Crops and Nutrient Requirements

Crop	Yield Unit	Yield	Nitrogen Requirement (lbs/yield unit)	Total Nitrogen Requirement (lbs./acre)	Phos. Removal (lbs/yield unit)	Total Phos. Required (lbs./acre)
Afalfa Irrigated	tons	4.4	55.00	240.8	12.00	52.5
Bromegrass	tons	2.5	39.20	98.0	10.90	27.3
Corn Irrigated	bu	161.2	1.20	193.4	0.31	49.2
Corn Silage Irrigated	tons	17.8	10.50	186.9	3.20	57.0
Oats	bu	44.8	1.30	58.2	0.23	10.3

**Values derived from Ward Laboratories, Inc. (Ward Guide)*

**Alternate Crops listed in Ward Guide Attachment*

**Legume crops use Nutrient Content per Crop (Ward Guide)*

Mineralization and Volatilization Chart

Ammonium-N Available This Year:				Organic Available					
Application Method	Incorporation	Liquid	Solid	Speicies	Manure Type	Organic-N Available This Year	Next Year	2 Years From Now	3 Years From Now
Sidedress	Incorporated	1		Beef/Dairy	Solid	0.25	0.15	0.07	0.04
	Sprinkler	0.5		Beef/Dairy	Stored Liquid	0.35			
	Flood	0.9		Beef/Dairy	Compost	0.15			
Preplant Incorporated	Immediately	0.95		Swine	Fresh	0.50			
	One Day	0.5	0.7	Swine	Stored Liquid	0.35			
	Two Days	0.25	0.5	Poultry	Deep Pit	0.45			
	Three Days	0.15	0.35	Poultry	Solid with litter	0.30			
	Seven Days or More	0	0	Poultry	Solid w/out litter	0.35			
Crop Available Nitrogen =	*Available This Year +*			*Organic Available This Year +*			*Organic N From Previous Apps.*		

** Based on UNL NebGuide G-1335*

Previous legume credit (I)

Legume	Lbs N/A
Soybean	40
Alfalfa (50-100%	100
Alfalfa (50% sta	50-75
Alfalfa (less thai	0-25
Other Beans	25
Clovers	75

**If yield is <30 bu/ac due to season-long stress then use half (22 lb. N/ac.)*

**Based on UNL Limitations and Ward Guide*

N Requirement (F) - Residual Soil N (Soil Test Results) - Legume Credit (I) - Commercial Fertilizer Credit - Clean Water Irrigation Credit / Crop Available Manure Content (H) = Application Rate

Planned Manure Application - Effluent - Field 301 - Alfalfa/Grazed Pasture (Gravity)

Manure Analysis Information

A	B	C	D	E	F	G	H	I	J	K
			Total Nitrogen Available (tons)							
Nutrient	Analysis Value (lbs/1000 gal)	Application Method/Timing (select from list)	First Year Availability Factor	First Year Value (b*d) (lbs)	Second Year Availability Factor (book value)	Second Year Value (b*f) (lbs)	Third Year Availability Factor (book value)	Third Year Value (b*h) (lbs)	Fourth Year Availability Factor (book value)	Fourth Year Value (b*j) (lbs)
Amm.-Nitrogen	2.6	Not Incorporated	0.90	2.35	0.00	0.00	0.00	0.00	0.00	0.00
Org.-Nitrogen	0.3	Not Incorporated	0.35	0.10	0.15	0.04	0.07	0.02	0.04	0.01
				2.45	0.15	0.04	0.07	0.02	0.04	0.01
Phosphorus	1.7	Not Incorporated	0.7	1.211						

Nitrogen and Phosphorus Demand

L	M	N	O	P	Q	R	S	T
	Crop Rotation					Nitrogen Demand	Phosphorus Demand	
Scenario ID:	Current Crop	5-Year Average Yield For Current Crop (bu/ac or T/ac)	Crop Harvest Units	Realistic Yield Goal (n * 110%)	Nitrogen Uptake Per Harvest Unit (book value) (lbs)	Total Nitrogen Uptake (p*q) (lbs/acre)	Phos. Uptake Per Harvest Unit (book value) (lbs)	Total Phos. Uptake (p*s) (lbs/acre)
2017	Brome Grass	2.5	tons/ac	2.8	39.2	108	10.8	29.8
2018	Brome Grass	2.5	tons/ac	2.8	39.2	108	10.8	29.8
2019	Brome Grass	2.5	tons/ac	2.8	39.2	108	10.8	29.8
2020	Brome Grass	2.5	tons/ac	2.8	39.2	108	10.8	29.8
2021	Brome Grass	2.5	tons/ac	2.8	39.2	108	10.8	29.8

*Demands are calculated by multiplying the yield goal by the uptake per harvest unit

Nitrogen Credits

U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
Scenario ID:	Soil Test Residual Nitrate (lbs/acre)	Previous Year Legume Credit (lbs/acre)	Manure Application Rate (1000's gal/acre)	3 Year Previous Manure Application Rate (1000's gal/acre)	3 Year Previous Manure Application Credit (y*k) (lbs/acre)	2 Year Manure Application Rate (1000's gal/acre)	2 Year Previous Manure Application Credit (aa*i) (lbs/acre)	1 Year Previous Manure Application Rate (1000's gal/acre)	1 Year Previous Manure Application Credit (ac*g) (lbs/acre)	Irrigation Water and Other Credits (lb/ac)	Total Nitrogen Credits (v+w+z+ab+ad+ae) (lbs/acre)	Remaining Deficient N Recommendation (r-af) (lb/ac)
2014			31									
2015			31									
2016			31									
2017	10.0	0	31	31.0	0.4	31.0	0.6	31.0	1.3	0.0	12.3	95.5
2018	10.0	0	31	31.0	0.4	31.0	0.6	31.0	1.3	0.0	12.3	95.5
2019	10.0	0	31	31.0	0.4	31.0	0.6	31.0	1.3	0.0	12.3	95.5
2020	10.0	0	31	31.0	0.4	31.0	0.6	31.0	1.3	0.0	12.3	95.5
2021	10.0	0	31	31.0	0.4	31.0	0.6	31.0	1.3	0.0	12.3	95.5

Initial Application Rate

AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ
Scenario ID:	First Year Availability (e) (lbs/1000 gal)	Allowable Effluent App. Rate For Balance of Nitrogen (ag/al) (1000's gal/acre)	Desired Application Rate For Nitrogen (1000's gal/acre)	Total 1st Year Available N @ Desired Rate (lbs/acre) (al*ak)	Commercial Nitrogen Fertilizer Applied (lbs. of N / acre)	Phosphorus Applied at Allowable N Rate (lbs/acre)	Phos Balance After Allowable N Rate (lbs/acre)	Phosphorus Applied at Desired N Rate (lbs/acre)	Phos Balance After Desired N Rate (lbs/acre)
2017	2.45	39.0	31.0	76.0	19.5	67.4	37.6	37.5	7.8
2018	2.45	39.0	31.0	76.0	19.5	67.4	75.3	37.5	15.6
2019	2.45	39.0	31.0	76.0	19.5	67.4	112.9	37.5	23.4
2020	2.45	39.0	31.0	76.0	19.5	67.4	150.6	37.5	31.2
2021	2.45	39.0	31.0	76.0	19.5	67.4	188.2	37.5	39.0

- Nitrogen availability based UNL NebGuide G1335 - "Determining Crop Available Nutrients from Manure"
- Application rates are based on UNL Nitrogen fertilizer recommendations for corn grain, found in EC117 - "Fertilizer Suggestions for Corn"
3Soil Nitrate N Credit = ppm Nitrate N x 0.3 x Depth of sample in inches
4 Previous Legume Crop N Credit = UNL Guidelines or Ward Guide
5 Past Manure Credit within the last 3 years = Assumed Organic N availability x application rate
6 Irrigation Water N Credit = (inches pumped x ppm Nitrate N x 2.7) / 12

Application Land Site Summary Information

NDEQ Field ID	Field Name	Legal Description	Owner Name	Address	City, State, Zip	Crop Rotation	Total Acres	Dominant Soil Type	Fall Application	Spring Application	Sidedress	App Agreement	Livestock waste from another facility applied to this site
301	Pasture	PT. SE1/4, Sec.36, Tow. 22N, Ran.54W, of Scotts Bluff County	Silver Spur Feeders, LLC	PO Box 426	Minatare, NE 69356	alfalfa/grazed pasture	64.9	Minatare-Janise complex, rarely flooded	Medium-Low	Medium-Low	Low	☐	☑
							64.9						

NDEQ ID	Field Name	Index Date	Erosion Sheet Rill Estimate	Sediment Trap	Distance To Water	Filter Strip Width (ft.)	Tillage #1	Tillage #2	Crop System	Critical Soil Type	Fert. Phos App. Rate (P2O5 #/acre)	Irrigation Type	Manure Application Rate (tons)	Manure Application Frequency (years)	Runoff P Value	Erosion P Value	Phos Index Value	PIndex Test	Erosion Practices Planned	Waterway Planned	Filter Strips Planned	Setback Required
301	Pasture	9/8/2016	0.00	None	300	0-10 ft	Perennial Forage and Grass	Perennial Forage, Grass, or Hayland	Meadow / Grass hayland (Non Grazed)	5665	38	Furrow + total recapture	0	0	0.35	0.00	0.35	Low	☐	☐	☐	☑

Cottonwood

Application Land

Cottonwood
Dewatering Soil Holding Analysis

Basin 2

(a.) 25yr-24hr Storm Runoff (derived from WP-41 Basin Calculation)	39.2 Acre-Inches
(b.) Alfalfa/Actively Grazed Pasture Available for Effluent Application	64.9 Acres
(c.) Effleunt Applied Per Acre Following 25yr-24hr Storm Event (a / b)	0.60 Inches
(d.) 25yr-24hr Storm Event	3.50 Inches
(e.) Total Effluent Applied During and Following 25yr-24hr Storm Event (c + d)	**4.1** Inches

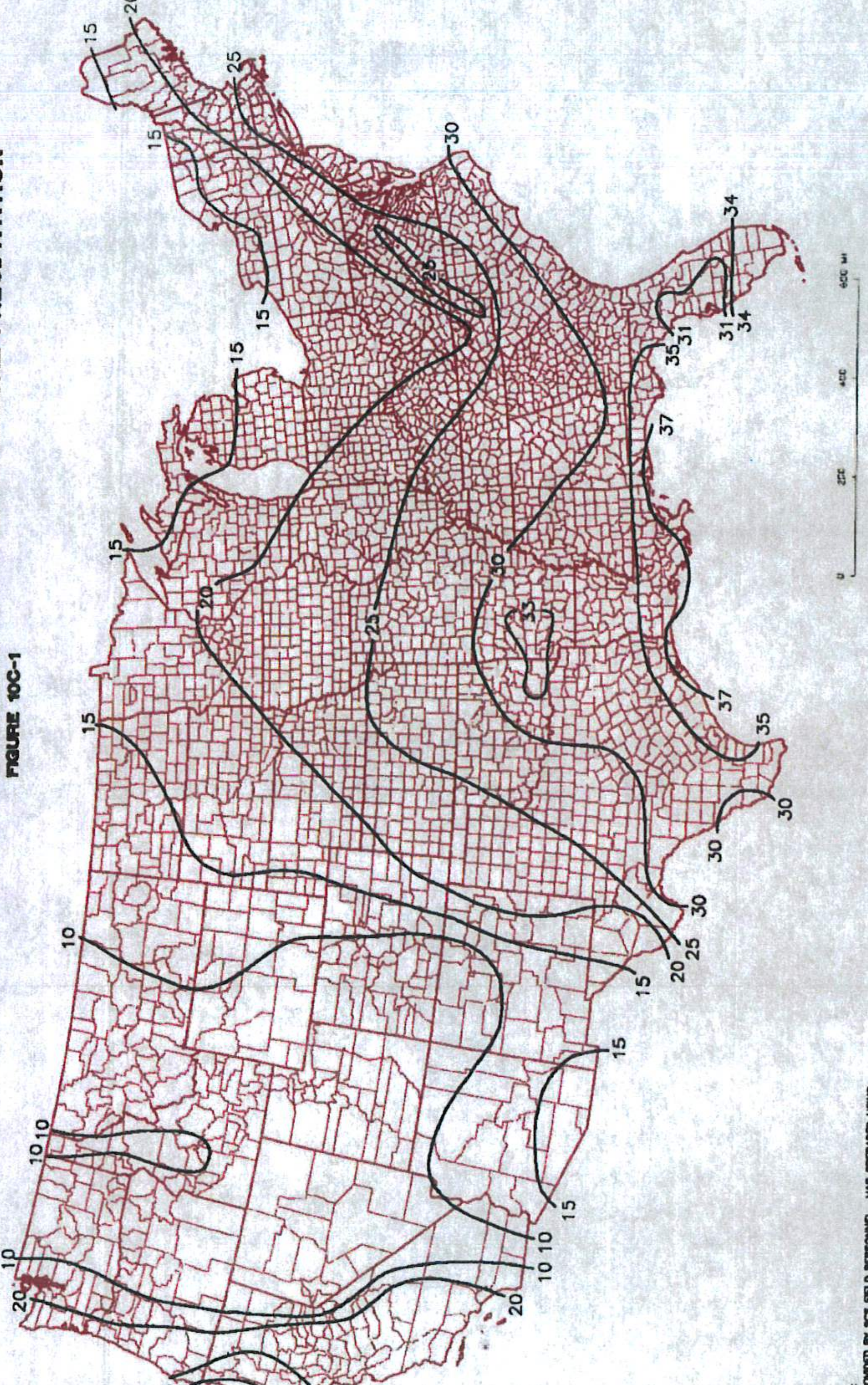
(f.) Available Water Holding Capacity For The Field Soil	1.15 Inches / Foot
(g.) Effective Root Zone of Alfalfa/Actively Grazed Pasture	8 Foot
(h.) Available Water Capacity in the Effective Root Zone (f * g)	**9.2** Inches

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

ANNUAL RUNOFF
FROM UNSURFACED FEEDLOTS (CN-90) AS PERCENT OF MEAN ANNUAL PRECIPITATION

FIGURE 10C-1



SOURCE:
DATA PROVIDED BY SCS FIELD PERSONNEL. MAP PREPARED USING AUTOMATED MAP CONSTRUCTION. NATIONAL CARTOGRAPHIC CENTER, FORT WORTH, TEXAS 1991.

REVISED MARCH 1991 1004857

hausted the soil moisture around its roots as to have irrecoverable tissue damage, thus yield and biomass are severely and permanently affected. The water content in the soil is then said to be the permanent wilting percentage for the plant concerned.

Experimental evidence shows that this water content point does not correspond to a unique tension of 15 atmospheres for all plants and soils. The quantity of water a plant can extract at tensions greater than this figure appears to vary considerably with plant species, root distribution, and soil characteristics. Some plants show temporary plant moisture stress during hot daytime periods and yet have adequate soil moisture. In the laboratory, permanent wilting point is determined at 15 atmospheres tension. Unless plant specific data are known, any water remaining in a soil at greater than 15 atmosphere tension is considered unavailable for plant use.

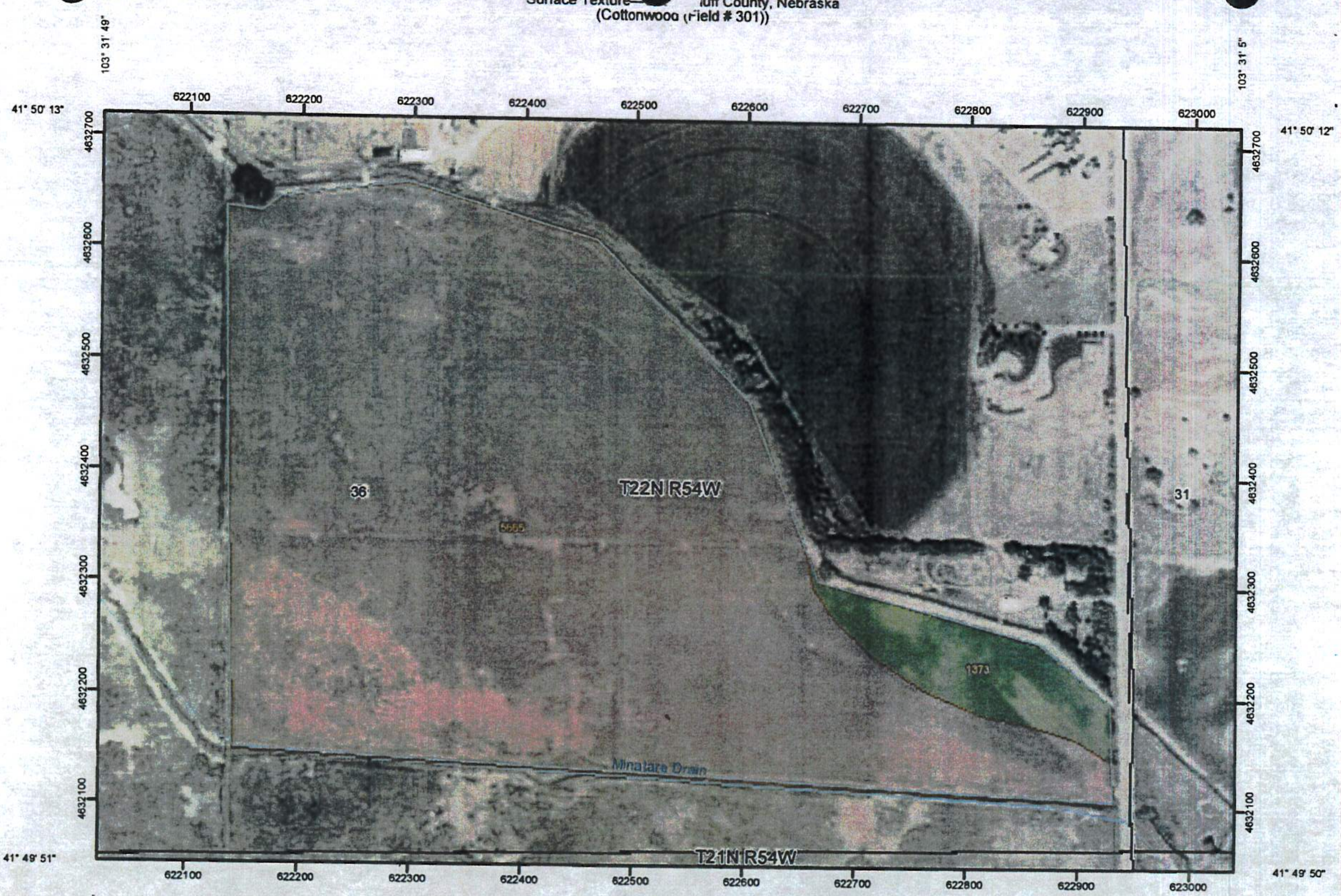
Major soil characteristics affecting the available water capacity are texture, structure, bulk density, salinity, sodicity, mineralogy, soil chemistry, and organic matter content. Of these, texture is the predominant factor in mineral soils. Because of the particle configuration in certain volcanic ash soils, these soils can contain very high water content at field capacity levels. This provides a high available water capacity value. Table 2–1 displays average available water capacity based on soil texture. Table 2–2 provides adjustments to the available water capacity based on percent rock fragments. Generally, rock fragments reduce available water capacity.

The available water capacity value shown on the Soil Interpretation Record (SOI-5) accounts for the estimated volume of coarse fragments for the specific soil series. However, any additional coarse fragments found upon field checking must be accounted for. Coarse fragments of volcanic material, such as pumice and cinders, can contain water within the fragments themselves, but this water may not be available for plant use because of the restricted root penetration and limited capillary water movement. A process to adjust the available water capacity based on additional field information is displayed in table 2–3.

Table 2–1 Available water capacity (AWC) by texture

Texture symbol	Texture	AWC range (in/in)	AWC range (in/ft)	Est. typical AWC (in/ft)
COS	Coarse sand	.01 – .03	.1 – .4	.25
S	Sand	.01 – .03	.1 – .4	.25
FS	Fine Sand	.05 – .07	.6 – .8	.75
VFS	Very fine sand	.05 – .07	.6 – .8	.75
LCOS	Loamy coarse sand	.06 – .08	.7 – 1.0	.85
LS	Loamy sand	.06 – .08	.7 – 1.0	.85
LFS	Loamy fine sand	.09 – .11	1.1 – 1.3	1.25
LVFS	Loamy very fine sand	.10 – .12	1.0 – 1.4	1.25
COSL	Coarse sandy loam	.10 – .12	1.2 – 1.4	1.3
SL	Sandy loam	.11 – .13	1.3 – 1.6	1.45
FSL	Fine Sandy Loam	.13 – .15	1.6 – 1.8	1.7
VFSL	Very fine sandy loam	.15 – .17	1.8 – 2.0	1.9
L	Loam	.16 – .18	1.9 – 2.2	2.0
SIL	Silt loam	.19 – .21	2.3 – 2.5	2.4
SI	Silt	.16 – .18	1.9 – 2.2	2.0
SCL	Sandy clay loam	.14 – .16	1.7 – 1.9	1.8
CL	Clay loam	.19 – .21	2.3 – 2.5	2.4
SICL	Silty clay loam	.19 – .21	2.3 – 2.5	2.4
SC	Sandy clay	.15 – .17	1.8 – 2.0	1.9
SIC	Silty clay	.15 – .17	1.8 – 2.0	1.9
C	Clay	.14 – .16	1.7 – 1.9	1.8

Surface Texture—[redacted]luff County, Nebraska
(Cottonwood (Field # 301))



Map Scale: 1:4,830 if printed on A size (8.5" x 11") sheet.

Meters: 0, 50, 100, 200, 300

Feet: 0, 250, 500, 1,000, 1,500

N

USDA Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

12/14/2011
Page 1 of 3

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- loam
- sandy loam
- Not rated or not available

Political Features

- Cities
- PLSS Township and Range
- PLSS Section

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:4,830 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Scotts Bluff County, Nebraska
Survey Area Data: Version 9, Oct 30, 2009

Date(s) aerial images were photographed: 7/28/2006

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Surface Texture

Surface Texture— Summary by Map Unit — Scotts Bluff County, Nebraska (NE157)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
1373	Chappell-Dix complex, 1 to 3 percent slopes	sandy loam	4.0	5.9%
5665	Minatare-Janise complex, rarely flooded	loam	64.4	94.1%
Totals for Area of Interest			**68.4**	**100.0%**

Description

This displays the representative texture class and modifier of the surface horizon.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Lower

Layer Options: Surface Layer

NebGuide
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G1465

Crop Water Use in Western Nebraska

C. Dean Yonts, Extension Irrigation Engineer

This NebGuide provides information on average weekly crop water use values for the major crops grown in western Nebraska. The information is best used for planning decisions before the season begins or for long term irrigation system planning.

Whether your water originates from the ground or the river, water for irrigation is becoming limited due to diminishing supplies and increasing environmental needs. In many areas of the Nebraska Panhandle, groundwater levels are dropping due to over development of the aquifers. In river valleys, water shortages occur during periods of drought. Management is made even more difficult when a portion of the water supply is used for the needs of endangered species. In tight economic times, some deficit irrigation is probably the optimal management strategy.

Although water supplies are obtained from different places, surface water or groundwater, the connection between the two can be seen in a variety of ways. For example, outside of the river valleys where groundwater has been developed for irrigation, groundwater levels have declined and can be seen through the drying of ponds or lakes. In river valleys, water that seeps from canals and fields provides groundwater that can be pumped for various purposes or the water may return to rivers through streams or creeks.

We must recognize the connection between surface and groundwater and understand that our water supply is limited. Through irrigation management we can have a significant impact on sustaining or reducing the decline of water supplies. Improved irrigation methods offer some potential for sustaining water supplies by improving the efficiency of water application. However, the largest consumption of water within agriculture is the water that is consumed by the crop.

Slowing the rate of decline of water supplies will, in some cases, mean reducing the amount of water that is being used. This might mean limited irrigation where plants are allowed to go into crop water stress. In other cases it may mean changing to a crop that consumes less water or even reducing the amount of land irrigated. Either way, the results may mean smaller yields or growing a different crop.

We often consider making changes to our irrigation practices to improve efficiency and save water. Let's assume we convert from furrow irrigation to a center pivot. How much water can we save? If the same crop were grown, the same amount of water will be transpired or consumed by the crop. For the furrow system, water that ran off the field or percolated from the root zone is not lost as it will return to the river or groundwater where it can be used again. The result is that improving application efficiency by converting to a center pivot had minimal impact on water savings within the drainage basin.

However, improving application efficiency is still important. Converting from furrow to pivot reduces the amount of water that moves through the soil profile. This minimizes the degradation of the quality of groundwater. If surface water supplies are being used, improved application efficiency means that less water needs to be diverted to meet crop demands. Less water diverted means more water is retained in storage reservoirs for release at a later date. We also need to keep in mind that improved application efficiency upstream will result in less runoff and may negatively impact downstream water users that rely on runoff water for irrigation.

As irrigators make efforts to reduce consumption by converting to more efficient irrigation systems or changing crop rotations, deciding which system to use or which crop to grow will not be easy. This transition will take time and additional information. Producers must understand the crops they grow and the amount of water used.

As stated earlier, consumption of water by irrigated crops is the biggest user of water in Nebraska. This is not to say that all crops use the same amount of water or that crops use water at the same time of the year. *Table I* gives average weekly crop water use for the major crops grown in western Nebraska. These values should only be used as a guideline and not as actual values for scheduling irrigations. Water use fluctuates due to cloud cover, air temperature, humidity and wind. See

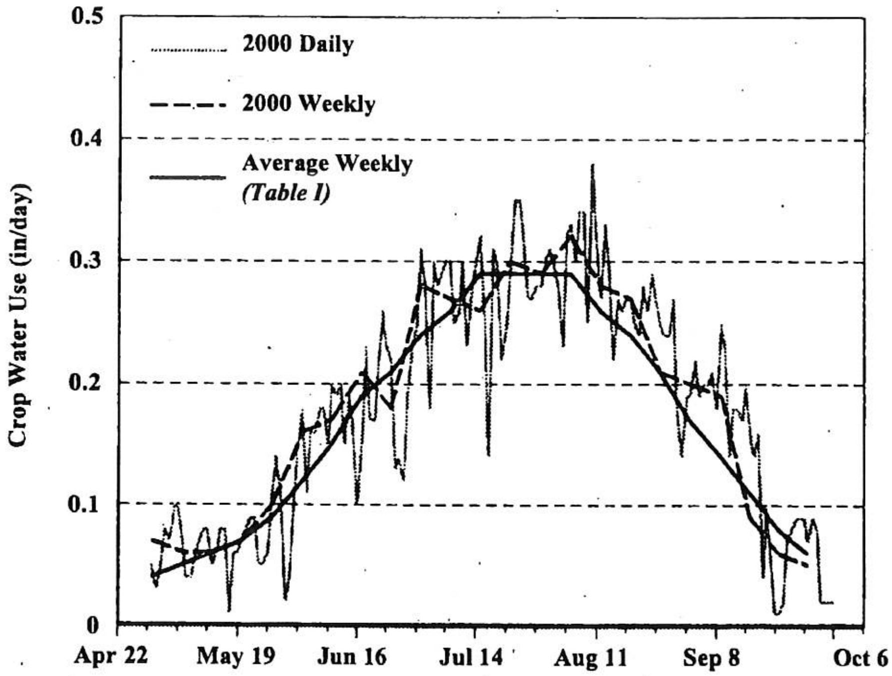

Figure 1. Example of daily variation in crop water use for corn.

NebGuide G85-753, *Irrigation Scheduling Using Crop Water Use Data,* for irrigation scheduling concepts and methods. Such variation is also expected from year to year.

Crop water use varies daily depending on climatic conditions. As an example, the variation in daily water use for corn in 2000 is shown in *Figure 1*. Note, in mid-July water use varied from over 0.3 inches per day to 0.13 inches per day in less than a week. When these daily values are expressed in terms of inches per week, also shown in *Figure 1*, we see that weekly water use values vary much less than daily values and a seasonal water use curve begins to develop.

The final curve shown in *Figure 1* is the average weekly water use values for corn from *Table I*. The difference between the 2000 weekly water use and the average weekly water use is small. This would indicate that the average water use values given in *Table I* can be used effectively for planning purposes but do not predict daily water use accurately enough for scheduling irrigations.

When using *Table I*, remember a killing frost in the fall effectively stops crop water use for the season. The exception is for winter wheat, and perhaps cool season pasture and alfalfa. Although water use values through the winter are not given, evaporation of water from the soil surface continues. During this dormant period evaporation may total as much as 4 inches. The water that evaporates must be replaced through precipitation or irrigation in the spring or early summer to avoid plant water stress.

Weekly values for alfalfa in *Table I* assume the crop is always growing at full cover. Because alfalfa is cut 3 - 4 times during the season, total water use given in *Table I* reflects the reduction in water use that occurs when the crop is removed. After cutting, alfalfa water use is reduced to nearly half of current water use rates. Water use then gradually increases over about a two-week period until the crop attains full cover and returns to the rates given in the table. For pasture, the crop is not expected to reach full cover due to grazing. As a result, water use values given in the table have been reduced by 15% of the full cover crop amount.

Also given in *Table I* are normal precipitation amounts for three areas in the Panhandle. Comparing precipitation with a specific crops water use can provide an indication of when and how much irrigation will be needed through a normal growing season. This information can assist in the planning process before the season begins as well in designing system capacity, selecting a crop rotation or determining the number of acres a given water supply will support. To find more information on irrigation systems, system efficiency and irrigation water management, visit this Web site: *www.ianr.unl.edu/pubs/irrigation/*.

Table I. **Average weekly crop water use in western Nebraska and 30-year normal precipitation for select locations.**

Date	Weekly crop water use (inches/week)								Precipitation (inches/week)		
	Alfalfa	*Corn*	*Dry Edible Bean*	*Small Spring Grain*	*Sugar beet*	*Small Winter Grain*	*Actively Grazed Pasture*	*Potato*	*Scottsbluff*	*Alliance*	*Sidney*
4/15-22	0.50	—	—	0.25	0.20	0.60	0.40	—	0.37	0.38	0.39
4/22-28	0.80	—	—	0.30	0.30	0.85	0.65	—	0.41	0.42	0.43
4/29-5	1.10	0.25	—	0.35	0.35	1.05	0.90	—	0.56	0.57	0.60
5/6-12	**1.45**	**0.35**	—	**0.55**	**0.40**	**1.25**	**1.10**	—	**0.65**	**0.65**	**0.67**
5/13-19	**1.80**	**0.40**	—	**0.80**	**0.50**	**1.50**	**1.30**	**0.30**	**0.66**	**0.66**	**0.69**
5/20-26	**1.85**	**0.50**	—	**1.10**	**0.60**	**1.95**	**1.35**	**0.40**	**0.67**	**0.67**	**0.70**
5/27-2	**1.90**	**0.65**	**0.20**	**1.30**	**0.75**	**2.00**	**1.45**	**0.45**	**0.67**	**0.67**	**0.71**
6/3-9	2.00	0.85	0.20	1.45	0.90	1.95	1.45	0.55	0.64	0.65	0.69
6/10-16	2.00	1.05	0.30	1.70	1.05	1.75	1.50	0.70	0.64	0.64	0.67
6/17-23	2.05	1.30	0.50	2.15	1.20	1.50	1.50	0.85	0.64	0.64	0.67
6/24-30	2.10	1.50	0.80	2.10	1.35	1.15	1.50	1.05	0.61	0.61	0.65
7/1-7	**2.10**	**1.70**	**1.25**	**1.95**	**1.50**	**0.75**	**1.60**	**1.30**	**0.51**	**0.52**	**0.57**
7/8-14	**2.10**	**1.85**	**1.70**	**1.70**	**1.65**	**0.50**	**1.60**	**1.50**	**0.49**	**0.51**	**0.56**
7/15-21	**2.10**	**2.00**	**1.90**	**1.40**	**1.75**	**0.10**	**1.60**	**1.65**	**0.49**	**0.50**	**0.54**
7/22-28	**2.10**	**2.00**	**2.05**	**0.95**	**1.85**	—	**1.60**	**1.80**	**0.47**	**0.48**	**0.53**
7/29-4	**2.05**	**2.05**	**1.90**	**0.55**	**1.90**	—	**1.50**	**1.85**	**0.39**	**0.39**	**0.44**
8/5-11	2.00	2.00	1.65	0.10	1.85	—	1.50	1.80	0.33	0.32	0.37
8/12-18	1.90	1.85	1.35	—	1.75	—	1.40	1.75	0.31	0.31	0.36
8/19-25	1.80	1.65	0.95	—	1.70	—	1.35	1.65	0.29	0.28	0.34
8/26-1	1.70	1.45	0.55	—	1.60	—	1.30	1.55	0.28	0.27	0.32
9/2-8	**1.60**	**1.20**	**0.20**	—	**1.50**	—	**1.20**	**1.45**	**0.31**	**0.30**	**0.33**
9/9-15	**1.45**	**0.95**	**0.10**	—	**1.35**	—	**1.10**	**1.35**	**0.31**	**0.30**	**0.32**
9/16-22	**1.35**	**0.75**	—	—	**1.20**	—	**1.00**	**1.25**	**0.28**	**0.29**	**0.31**
9/23-29	**1.20**	**0.55**	—	—	**1.00**	**0.30**	**0.90**	—	**0.25**	**0.26**	**0.28**
9/30-6	**1.05**	**0.40**	—	—	**0.85**	**0.40**	**0.80**	—	**0.22**	**0.22**	**0.23**
10/7-13	1.00	—	—	—	0.65	0.50	0.70	—	0.20	0.20	0.21
Total	32.00*	27.25	15.60	18.70	29.70	17.90	32.25	23.20	11.63	11.69	12.56

* Total crop water use for Alfalfa has been reduced to account for the approximate reduction in water used due to harvesting.

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Irrigation Management and Crop Characteristics of Alfalfa

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Alfalfa is relatively drought-tolerant, but irrigation makes it possible to grow high-quality alfalfa in Nebraska, on a wide range of soils, producing yields almost proportional to water available.

Alfalfa (*Medicago sativa*) is the most important forage legume in Nebraska. Irrigation makes it possible to grow high quality alfalfa throughout Nebraska on a wide range of soils. While alfalfa is relatively drought-tolerant, it responds favorably to irrigation and will produce yields almost proportional to the amount of water available to the crop.

Special Alfalfa Irrigation Characteristics

A number of important factors cause alfalfa irrigation to differ from other crops normally irrigated in Nebraska. These factors include:

1. Alfalfa is a perennial crop with a potential deep-root system that can use moisture deep within the soil profile.
2. Multiple harvests prevent irrigation for about 7 to 10 days per growth cycle.
3. Frequent heavy equipment traffic across an alfalfa field causes soil compaction and often forms a crust on the soil surface. This crust could result in reduced soil water infiltration rates as stands age.
4. Over-irrigation can quickly injure alfalfa plants and encourage weed invasion, especially right after harvest.
5. Water use efficiency is greatest during cool to moderate temperatures, especially during spring.

Alfalfa Water Use Characteristics

Because it has a longer growing season, alfalfa can use more water annually than other crops. Irrigation management must consider characteristics such as water requirements (including seasonal, total and daily water use), root system development, and critical stages of growth as well as soil characteristics, the irrigation system, and the available water supply.

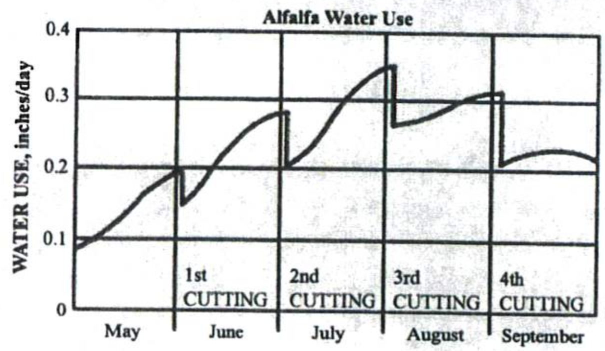

Figure 1. Seasonal water use pattern for alfalfa in Nebraska.

A water-use pattern for alfalfa in Nebraska is shown in *Figure 1*. This pattern shows typical daily crop evapotranspiration (ET) throughout the growing season. Evapotranspiration is the combination of water transpired by the crop and water evaporating directly from the soil and plant surfaces. The amount of water used by alfalfa varies from season to season and location to location, but will follow this same general pattern. The primary climatic factors affecting the magnitude of water use are air temperature (greater with higher temperatures and less with cooler temperatures), solar radiation and wind speed. Availability of soil water also will directly affect crop water use.

Alfalfa begins using water when plant growth starts in the spring. For Nebraska conditions, growth typically begins in early to mid-April. Initial crop water use is small because growth is slow and temperatures are cool. As temperatures rise and the rate of growth increases, daily water use increases. The water use rate rises sharply and reaches a peak at canopy closure near the pre-bud stage at 10-12 inches in height.

Water use may drop slightly as harvest approaches, but it drops sharply when alfalfa is cut because transpiration is minimal when most of the leaf area has been removed. After harvest, alfalfa re-growth begins and the water use cycle begins again. This cycle is repeated for each cutting (i.e., every 30 to 40 days).

The active roots of the alfalfa plant can penetrate 8 to 12 feet in deep, well-drained soils. However, alfalfa will obtain 75 to 90 percent of its moisture from the upper four feet of soil. Water in the lower portion of the root zone is especially important if the crop's water demand cannot be totally supplied by the irrigation system during peak water use periods.

During the growing season, irrigation normally will not supply water any deeper than four feet in the soil profile. Irrigation and precipitation in the fall or early spring can supply water to the deeper portions of the soil profile for use during the growing season. A clay pan or other restrictive soil layers can limit the effective root zone depth. Shallow root zones require smaller and more frequent irrigations.

Alfalfa does not have a stage of growth that is extremely critical or less sensitive to water stress. If water is not available, the plant will slow or stop growing and go dormant. When water becomes available, growth will resume. However, lack of moisture will reduce crop ET and yield. Drought-stressed alfalfa matures earlier, thus forage quality will peak earlier and degrade more rapidly than under normal conditions. In Nebraska, precipitation and stored soil moisture normally will be adequate for the first cutting. Thus, when the irrigation water supply is limited, irrigation will probably be most beneficial just before the second cutting and during the third and fourth cutting growth periods.

Although alfalfa responds well to irrigation, too much water can damage it. Alfalfa is susceptible to damage from over-irrigation, ponding of water, and high water tables, especially on fine-textured soils with low permeability. Subirrigation from high water tables can effectively meet the water requirements of alfalfa.

In general, serious damage may occur when the water table is at a depth of three to four feet or less. Crop damage results from poor aeration and diseases such as crown and root rots. Damage will be more extensive during periods of high temperatures. In general, the alfalfa plant should not be submerged in water for more than 24 to 48 hours to prevent reduced growth and stand loss.

The peak daily water use of alfalfa in Nebraska normally will range from 0.3 to 0.35 inch per day in July and August, but may be as high as 0.5 inch during hot, windy, and dry days. During the peak water use period in July and August, the alfalfa crop will use about 5 to 6 inches of water for each ton of field-dry hay produced.

If yields of 1.5 tons per acre per cutting are expected, 7.5 to 9.0 inches of water will be required for each of the third and fourth cuttings. If all of this water must be supplied to the crop by irrigation, 8.8 to 10.6 inches of water will need to be applied (assuming an irrigation application efficiency of 85 percent) to meet the net irrigation water requirement of 8.8 to 10.6 inches.

In most cases, some of the water requirement will be supplied by precipitation and moisture stored in the soil from the spring, so the net irrigation requirement for the third or fourth cutting will typically be 6 to 7 inches. The corresponding gross irrigation requirement will be 7.1 to 8.2 inches (85 percent efficiency). If sufficient water is available for irrigation after the first harvest, use it early in the season since water use efficiency is higher during cooler weather.

Water Application

Alfalfa responds well to water application regardless of the type of irrigation system used. With surface irrigation systems, have good land preparation before seeding. The topography and degree of water control desired will determine the extent of land preparation required. After the stand is established, no further preparation can be done. The most common surface irrigation systems used for irrigating alfalfa are border strips, furrows or corrugations, although basin irrigation may also be used.

Furrow irrigation can be effective for alfalfa if adequate slope, proper stream sizes, and proper lengths of run are used. Furrow spacing normally will vary from 30 to 60 inches. Spacings greater than 60 inches will not provide adequate lateral movement in most soils. Match furrow spacing to the wheel spacing of harvest equipment. Make the furrow size adequate to carry the recommended water flow in the furrow, but not so large that considerable growth is left in the furrow at harvest time. Small furrows or corrugations spaced 15 to 30 inches apart to direct the water across the field also may be used. With small furrows, the length of run must be shorter and furrow flow size will be smaller. The Natural Resources Conservation Service can provide design guidelines for surface irrigation systems. Surface irrigation normally adds several inches per irrigation (about 3 inches on average), depending on the furrow flow, row spacing, and set time.

When properly designed, sprinkler systems can be adapted to most soil and topographic conditions to irrigate alfalfa. Sprinkler systems capable of frequent light irrigations can be used to establish an alfalfa stand. Center pivots and linear (lateral) move systems apply about 0.5 to 1 inch of water, depending on the water infiltration rate of the soil, water-holding capacity, depth, and speed of the system. Light and frequent irrigations of less than 1 inch tend to encourage shallow rooting, reducing one of alfalfa's advantages — a potentially deep root system and its resultant expanded soil profile. Irrigation should encourage deep rooting; applying greater amounts at each irrigation, if infiltration rates permit, are more desirable.

Irrigation Management

Irrigation management includes deciding when and how much water to apply. The decision must be based on the available irrigation water supply, the available water-holding capacity and intake rate of the soil, the water needs of alfalfa for a given period and the irrigation system capacity. The management objective normally will be to meet the crop water needs to provide for optimum plant growth. The success in meeting crop needs will depend upon the size of the available water supply. The timing of harvest and other time factors also must be considered. Criteria to help determine when to irrigate include soil water monitoring and water use prediction based on climatic data.

Crop Appearance and Proportion of Growth

The appearance of alfalfa can indicate soil water status. When adequate water is available, alfalfa usually will be light green. As moisture stress develops, the color darkens. Apply water when the plant has turned dark green, before wilting occurs, otherwise yield and quality will be reduced. Wilting generally will occur when about 25 to 30 percent of the available water capacity remains in the root zone. Drought-stressed alfalfa matures earlier, thus forage quality will peak earlier and degrade more rapidly than under normal conditions.

In Nebraska, precipitation and stored soil water will normally be adequate for the first cutting. If not, irrigate during the first cutting because this is when water is used most efficiently to produce increased yield. It is suggested that adequate soil moisture (i.e., 80-90% of the field capacity) be maintained in the soil profile to a 4-ft depth at the time of first cutting.

Estimate the irrigation water requirement based on crop water requirements, soil characteristics, and proportion of crop growth that has occurred. Also, consider weather conditions and precipitation. For example, if a yield of one ton per acre is expected, about six inches of water will be required for the cutting. To estimate how much water is needed to refill the profile at any given time, estimate the proportion of growth that has been made. If 50% of the growth has occurred, 3.0 inches of water will have been consumed (0.50 × 6.0). The net application amount will be 3.0 inches which will require a gross application of 3.5 inches if the system efficiency is 85 percent (3.0 in. ÷ 0.85).

Calendar Method

To determine a calendar schedule, use an estimated water-use rate and soil water-holding capacity. For example, if the average water use rate is 0.35 inch per day and the available water capacity is 1.75 inches per foot, the following schedule could be developed:

Effective root zone = 3.0 ft.
Available water capacity = 3.0 ft. × 1.75 in./ft. = 5.25 in.
Minimum allowable balance = 35%
Available water at minimum allowable balance = 0.35 × 5.25 = 1.84 in.
Usable water = 5.25 in. - 1.84 in. = 3.41 in.
System application efficiency = 85%
Gross irrigation application = 3.41 in. ÷ 0.85 = 4.0 in.
Irrigation frequency = 4.0 in. ÷ 0.35 in./day = 11.4 days

Do not overlook weather conditions, irrigation system capacity, and other factors when using either the proportion of growth or calendar schedule. Without consideration of all the factors involved, it will be easy to over- or under-irrigate.

Crop Water Use and Monitoring Soil Water Status

Daily weather data can be used to estimate crop water use. Estimated crop water use can be calculated using data from a series of automated weather stations across Nebraska. Get weather data and estimated crop water use from the High Plains Regional Climate Center (*http://www.hprcc.unl.ed*) for many locations in Nebraska.

Crop water use estimates can help calculate the current soil water status of a given field. One of the oldest procedures is called "checkbook irrigation management." The soil acts as a "bank" or reservoir to store water for crop uptake. Rain and irrigation are deposits to the bank and the crop water use is a withdrawal. Like a checking account, a weekly (or any other interval) balance of these deposits and withdrawals will give the amount of water remaining in the root zone.

Alfalfa will maintain optimum growth when the soil water is maintained between 70 to 50 percent of the water-holding capacity. As long as water remains in this range, there will be little difference in yield and water use. However, for highest yield, the soil water balance in the root zone should not drop below 40 percent of the available water capacity.

Start irrigation before soil water in any part of the field drops below 40 percent of the available water holding capacity (40 percent depletion). From a practical standpoint, and especially for coarse-textured (sandy) soils, start irrigation when 50 percent of the available water capacity has been used. Plant stress can occur when available soil water drops below 50 percent.

Monitoring soil water is critical for an effective irrigation management, so you know when to irrigate and how much water to apply. Several methods can be used. The calculated soil water balance can be checked periodically by using some type of soil water monitoring. Measuring the irrigation water applied to a field will improve the accuracy of the soil water balance calculation.

Watermark sensors can be used to monitor soil matric potential for irrigation management. Detailed information on how to use these sensors for irrigation management can be found in *Watermark Granular Matrix Sensor to Measure Soil Matric Potential for Irrigation Management*, UNL Extension Circular EC783.

Watermark sensors measure soil matric potential, which is an indication of the energy plants must exert to extract water from soil. The soil matric potential reading at which irrigation is necessary depends on soil texture (see *Table I*). Sandy soils retain far less water than soils with a high clay, silt, or organic matter content, so irrigation on sandy soils should occur more frequently and at a lower soil matric potential value (negative sign of the matric potential is omitted).

The matric potential reading will increase as the soil becomes drier. After the field is irrigated, the matric potential readings typically return to lower values (i.e., 0 to 10 kPa). These wetting and drying cycles continue throughout the season as the crop is irrigated and the soil dries with crop water use and surface soil evaporation. The key to proper irrigation management using soil water sensors is to monitor the sensors regularly, track the soil water level, and irrigate when the kilopascal (1 kPa = 1 cbar) readings are in the desired range for your soil type (See *Table I*; Orloff et al., 2001). Irrigating when the soil water readings exceed the desired range may result in crop stress and yield loss. Irrigation before the readings reach the desired range may result in excessive irrigation, water wastage or runoff.

Table I. Suggested values of soil matric potential at which irrigations should be applied for alfalfa for different soil types.

Soil type	*Average soil matric potential reading of top three sensors (kPa)*
Sand or loamy sand	40-50
Sandy loam	50-70
Loam	60-90
Silt loam	80-100
Clay loam or clay	100-120

Other Considerations

A major consideration when timing irrigation is interference with harvest. Irrigate as close to harvest as possible to meet the peak needs of the crop and have adequate moisture available to start re-growth. Give the soil surface enough time to dry to prevent excess soil compaction during harvest and to prevent hay on the soil surface from absorbing excess water and delaying the drying process. If the surface is too wet at harvest, the soil will be compacted by the harvesting equipment, seriously reducing the soil intake rate for future applications of water.

Although surface irrigation may be easiest just after cutting, the alfalfa plant is most vulnerable to excess water at this time. Irrigating immediately after harvest also may stimulate weed growth. As a general rule, complete irrigation several days before cutting and do not start again until alfalfa re-growth has begun. This full interval may not be possible on soils with low available water-holding capacity or when the irrigation system capacity is limited. During these situations, stop irrigation 2-3 days before the cutting and begin again as soon as hay is removed.

Fall irrigation can be an important management tool on deep, medium-textured soils in the drier areas of the state. Fall irrigation provides good growing conditions prior to winter dormancy and helps the plant build its reserves in the root system, and gives vigorous spring re-growth. The deeper portion of the soil profile can be refilled in this off-season period because peak water use is not placing a demand on the system capacity. Water placed in the deeper portion of the profile will be available during the peak water use period. When water is applied in the fall, avoid excessive applications which can cause water to percolate below the root zone or ponding which, in turn, will cause crop loss.

Because of its deep, well-developed root system, alfalfa can allow the irrigator to use rainfall efficiently. To maintain the best growing conditions and receive the greatest benefit from rainfall, irrigation applications should not exceed three inches (when surface irrigation is used) except for a fall or spring irrigation on deep, medium-textured soils. In eastern Nebraska it is possible to utilize rainfall more effectively if the soil profile is not completely refilled by irrigation. This leaves water-holding capacity in the soil to store rain occurring immediately after irrigation.

For surface irrigation systems using applications of about four inches and two irrigations per cutting will normally be required. Start the first application about five days after cutting and finish the second about five days before cutting. This type of schedule must be adjusted to reflect soil moisture status, crop needs and system capacity. For sprinkler systems, the size of application often will be smaller. Because of the lower application amounts, the irrigation frequency likely will range from three to seven days. However, after crop re-growth has begun to use higher amounts, use up to 3 inches per application if soil infiltration rates will allow, to prevent development of shallow root systems.

Summary

- Alfalfa can be grown on a variety of soils, but deep, uniform, well-drained, medium-textured soils are easiest to manage. Most irrigation systems can be used on alfalfa if designed properly for the site.
- Seasonal water use in Nebraska ranges from 30 to 38 inches, including precipitation, depending on location and weather conditions. The peak daily water use rate of alfalfa will normally range from 0.30 to 0.35 inches during the peak ET month(s) (July and August). The water requirement averages approximately six inches for each ton of hay produced but varies during the growing season.
- For optimum growth, maintain soil water content in the effective root zone between 50 to 70% of the available water holding capacity. Manage irrigations so that the soil is not excessively wet at harvest. For effective irrigation management, monitor soil water status and couple this information with crop water needs and system capacity.
- Excess water causes diseases, reduced growth rate, and loss of stand.
- Effective irrigation management through measurement of soil water status in the soil profile coupled with monitoring crop water use will help to increase crop yield quantity and quality and will help to save water and energy.

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Index: Irrigation Engineering
Irrigation Operations & Management
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NITROGEN FERTILIZER RECOMMENDATIONS

Plants absorb nitrate from the soil solution and synthesize it into amino acids for use in plant growth. Nitrate is the decomposition product in the aerobic nitrogen cycle before it is taken up by the plants. Nitrate is soluble and easily extracted from the soil. The total amount measured by the soil test is usually available to the crop. Nitrogen recommendations are made by assuming 100 percent of the nitrate is available in the surface soil and subsoil.

Nitrogen fertilizer recommendations are made by calculating a nitrogen requirement for the crop and yield goal and subtracting the soil nitrate values from the requirement. The amount of nitrogen available from a past legume crop and/or from livestock manure must also be subtracted from the nitrogen requirement.

The suggested amounts of nitrogen available from a past legume crop are as follows:

(1) Alfalfa...............100 lbs N/A
(2) Alfalfa ½ stand.....50 - 75 lbs N/A
(3) Alfalfa poor stand...0 - 25 lbs N/A
(4) Soybeans............40 lbs N/A
(5) Other Beans.........25 lbs N/A
(6) Clovers...............75 lbs N/A

The historic suggested amounts of nitrogen available from a manure application are as follows:

(1) Beef Feedlot.........5 lbs N/ton
(2) Dairy Barn............5 lbs N/ton
(3) Poultry...............15 lbs N/ton
(4) Swine...............8 lbs N/ton
(5) Slurry...............17 lbs N/1,000 gal

However it is suggested that your manure/slurry be analyzed for a more accurate evaluation. The nitrogen requirement for each crop is shown on the next page along with the subsoil factor for converting the subsoil nitrate test to lbs of N per acre. The total nitrogen requirement is determined by multiplying the crop yield goal by the nitrogen requirement. Surface soil nitrate ppm reading is multiplied by .3 and by the sample depth (inches) to arrive at pounds of N per acre. The pounds of N in the subsoil are calculated by multiplying the subsoil nitrate ppm reading by subsoil sample depth (inches) and the subsoil factor. The sum of nitrogen from the surface soil and subsoil is subtracted from the calculated total nitrogen requirement. If a subsoil nitrate test is not available assume it to be 5 ppm NO_3-N for fine textured soils and 2 ppm NO_3-N for sandy soils.

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Crop	Nitrogen Requirement	Subsoil Factor
Corn	1.2 lbs / bu	0.3
Milo	1.15 lbs / bu	0.3
Popcorn	0.031 lbs / lb	0.3
Seed Corn	2.0 lbs / bu	0.3
Corn Silage	10.5 lbs / ton	0.3
Sorghum Silage	9.5 lbs / ton	0.3
Feed-Hay	27.0 lbs / ton	0.3
Sudan Hay	27.0 lbs / ton	0.3
Soybeans	See Footnote	
Pinto Beans	3.0 lbs / cwt	0.3
Gr. No. Beans	3.0 lbs / cwt	0.3
Peanuts	See Footnote	
W. Wheat	2.4 lbs / bu	0.3
Sp. Wheat	2.5 lbs / bu	0.3
Oats	1.3 lbs / bu	0.3
Rye	1.9 lbs / bu	0.3
Feed Barley	1.5 lbs / bu	0.3
Malting Barley	1.3 lbs / bu	0.3
Sm. Gr. Silage	13.0 lbs / ton	0.3
Sm. Gr. Hay	35.0 lbs / ton	0.3
Alfalfa	0	0
New Alfalfa	See Footnote	
Grass-Alfalfa	20.0 lbs / ton	0.3
Clover	0	0
Bromegrass	40.0 lbs / ton	0.3
Bermudagrass	40.0 lbs / ton	0.3
Fescue	40.0 lbs / ton	0.3
Native Grass	27.0 lbs / ton	0.3
Lovegrass	32.0 lbs / ton	0.3
Cool Grass	40.0 lbs / ton	0.3
Sugar Beets	8.0 lbs / ton	0.3
Sunflowers	0.05 lbs / lb	0.3
Potatoes	0.5 lbs / cwt	0.3
Cotton	0.1 lbs / lb	0.3
Millet	1.7 lbs / bu	0.3
Onions	0.25 lbs / cwt	0.3
Melons	14 lbs / ton	0.3
Garden	135 lbs / unit	0.3

Footnote: The nitrogen rate for these legume crops is calculated on the basis of the P2O5 requirement.
The N requirement is based on a 1:3 ratio (N:P2O5)

Bus: 308-234-2418
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website
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4007 Cherry Ave., P.O. Box 788
Kearney, Nebraska 68848-0788

Raymond C. Ward, Ph.D.
Certified Professional Soil Scientist

Quantities of Plant Nutrients in Crops
(Pounds of Plant Nutrient per Unit Indicated)

Crop	Yield Unit	N (Nitrogen)	P_2O_5 (Phosphate)	K_2O (Potash)	Calcium	Magnesium	Sulfur	Copper	Manganese	Zinc
Corn (Grain)	per bu	0.75	0.33	0.23	0.01	0.05	0.07	0.0004	0.0006	0.001
	200 bu	150	66	60	46	10	14	0.08	0.12	0.2
Soybeans (Grain)	per bu	3.7	0.77	1.4	0.18	0.18	0.32	0.001	0.0013	0.001
	60 bu	222	46.2	84	10.8	10.8	22.2	0.06	0.078	0.06
Wheat (Grain)	per bu	1.2	0.52	0.26	0.015	0.15	0.12	0.0007	0.002	0.003
	60 bu	72	31.2	15.6	1.5	9	7.2	0.042	0.12	0.18
Cotton (Lint and Seed)	per bale	12.5	4.8	5.8	0.67	1.33	0.96	0.02	0.037	0.107
	2 bale	25	9.6	11.6	1.34	2.66	1.34	0.04	0.074	0.214
Sorghum (Grain)	per bu	0.9	0.27	0.2	0.067	0.083	0.083	0.000167	0.0007	0.00067
	100 bu	90	27	20	6.7	8.3	8.3	0.0167	0.07	0.067
Sunflowers (Grain)	per cwt	3.6	1.2	1.1	1.2	0.20	0.22	.002	.002	.005
	20 cwt	72	24	22	2.4	4.0	4.4	0.04	0.04	0.1
Alfalfa (Total)	per ton	55	12	50	28	5.25	5.0	0.015	0.11	0.105
	6 ton	330	72	300	168	31.5	30	0.09	0.66	0.63
Grass (Total)	per ton	30	12	42	8	3.5	3.75	0.01	0.15	0.04
	4 ton	120	48	168	32	14	15	0.04	0.6	0.16
Sugar Beets (Total)	per ton	8	1.4	6.7	2.2	0.50	0.67	0.002	0.05	.002
	25 ton	200	35	160	55	12.5	16.75	0.05	1.25	.05
Oats (Grain)	per bu	0.70	0.25	0.15	0.025	0.0375	0.074	0.0004	0.0015	0.0006
	80 bu	56	20	12	2	3	5.9	0.032	0.12	0.048
Potatoes (Tuber)	per cwt	0.35	0.13	0.60	0.015	0.03	0.03	0.0002	0.0005	0.00025
	100 cwt	35	13	60	1.5	3	3	0.02	0.05	0.025
Peanuts (Nuts)	per cwt	3.7	0.46	0.68	0.6	0.57	0.53	*	*	*
	35 cwt	129.5	16.1	23.8	21	19.95	18.55	*	*	*

*No data for this nutrient

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Maintenance Inspection Log

Facility Name: *Cottonwood* **Year** ______

Facility Manager ______________________

Maintenance Inspections	(place an 'X' if conducted) Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Berm or sidewall damage (erosion, vegetative loss)												
Rip rap (coverage, or damage)												
Riser pipes (damage or blockage)												
Vegetative overgrowth (weeds, trees, bushes)												
Staff gauge (damage, or leaning)												
Pumps (leakage, or damage)												
Waterlines inspected daily (wastewater, or drinking)												
Dead animal containment area												
Chemical and fuel containment area												
Irrigation system (pump, pipes, or pivots)												
Manure Application Equipment												

Corrections taken:

____

____

____

____

____

____

Completed by: ______________________
(Print Name)

Instructions: Please note all repairs or maintenance activity. List the date, cause and corrective measures.

Pond Level, and Precipitation Log

Facility Name: **Cottonwood**
Facility Manager:

Month / Yr:

Maximum Water			
Start Pumping			
Max. Sludge & Winter			
Day	Precip Amt	Pond Level	Comments
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			

Dewatering Log

Facility Name Cottonwood

Facility Manager

Month / Yr

Pond #

Maximum Water Level

Start Pumping Level

Maximum Sludge & Winter Pumpdown Level

Date	Pond Level	Start Pumping	Stop Pumping		Application Field ID	24 Hours Prior		24 Hours Post		Volume Pumped
		Hr / Min	Hr / Min	Level		Wind Dir. / Speed	Temp High & Low	Wind Dir. / Speed	Temp High & Low	

Manure Application Worksheet

Cottonwood

Date	Field	Load Weights	Number of Loads	Acres Covered	Estimated Tons/Acre	Manure Sample ID	24 Hours Prior		24 Hours Post		Notes
							Wind Dir / Speed	Temp High & Low	Wind Dir / Speed	Temp High & Low	

Manure Sale or Gift Register

Facility Name: *Cottonwood* Facility Manager

Date of Transfer	Quantity	Delivery Point	Recipient	
			Name	
			Address	
			City	
			State	
			Phone	
			Name	
			Address	
			City	
			State	
			Phone	
			Name	
			Address	
			City	
			State	
			Phone	
			Name	
			Address	
			City	
			State	
			Phone	
			Name	
			Address	
			City	
			State	
			Phone	
			Name	
			Address	
			City	
			State	
			Phone	

Mortality Management Worksheet

Facility Name: *Cottonwood*
Facility Manager ____________________

Mortality Date	Animal Type	Head Ct.	Disposal Date	Disposal Method

Chemical Storage Log

Facility Name: *Cottonwood*
Facility Manager

Chemical Name	Storage Location	Application Date	Container Disposal Method

Fuel / Petroleum Disposal

Fuel Name	Storage Location	Disposal Date	Disposal Method