

Smith Valley Dairy

**Application for a Nevada
CAFO groundwater discharge permit**

June 4, 2014

Prepared by



**3050 67th Avenue, Suite 200
Greeley, CO 80634
970-535-9318**

Table of Contents

Groundwater Discharge Permit Supplemental Application

- Topographic Map

Engineering Documents

- Site Layout & Grading Plan
- 313 Runoff and Pond Volume Calculations
- Engineer's Narrative (overview of operation, groundwater setbacks and liner information)
- Geotechnical Investigation/Well logs
- Impoundment Construction: Specifications, Liner and Leak Detection Installation

Nutrient Management and Operations/Maintenance Plan (NMP)

- Pond Management
- Mortality Management Plan
- Chemical Management Plan
- Sampling Protocols
- Land Application Site Conservation Practices
- Record Keeping Requirements

NMP Appendix A

- Land Application Map
- Soil Map

NMP Appendix B

- Field Identification
- Soil Information
- Potential Crops

NMP Appendix C

- Yield Information

NMP Appendix D

- Nutrient Budget
- Methodology for N, P, and K Credits
- In Season Adjustments to Budget

NMP Appendix E

- Phosphorus Index Risk Assessment
- RUSLE2 & WEPS

NMP Appendix F

- Manure Nutrient Production
- Land Base Requirement
- Field Rate Determination Sheets with intended rotations, soil test results, Phosphorus Index Risk Assessment Results

NMP Appendix G

- Emergency Action Plan

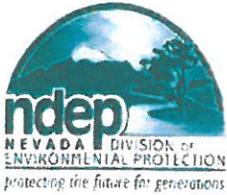
NMP Appendix H

- Suggested Record Keeping Forms

NMP Appendix I

- Reference Material

Groundwater Discharge Permit Supplemental Application



State of Nevada
Department of Conservation
and Natural Resources
Division of Environmental Protection

FOR BWPC USE ONLY:	
Check	No.:
Receipt	No.:
Amount:	\$ _____

CONCENTRATED ANIMAL FEEDING OPERATION (CAFO)
PERMIT APPLICATION SUPPLEMENTAL

APPLICATION - NEW APPLICATION - RENEWAL APPLICATION - MODIFICATION

PERMIT NUMBER: _____ (LEAVE BLANK IF NEW PERMIT)

1. OWNER/RESPONSIBLE PARTY INFORMATION:

Business/Agency Name: Smith Valley Dairy
 Contact Person: Dirk Vlot Phone Number: 559-731-3475
 Mailing Address: P.O. Box 497 Fax Number: NA
 City: Wellington County: Lyons State: NV Zip Code: 89444
 Email Address: valvlot7@aol.com
 Federal Tax ID No.: none at this time
 Note: The Federal Tax ID number is necessary in the event of any error in monetary transaction, i.e. refund or reimbursement, from the State of Nevada

2. BILLING ADDRESS:

Business/Agency Name: Smith Valley Dairy
 Contact Person: Dirk Vlot Phone Number: 559-731-3475
 Mailing Address: P.O. Box 497 Fax Number: NA
 City: Wellington County: Lyons State: NV Zip Code: 89444

3. FACILITY/SITE INFORMATION:

Note: A separate permit application form must be completed for each discharging facility operated by the applicant.

Facility Name: Smith Valley Dairy
 Contact Person: Dirk Vlot Phone Number(s): 1. 559-731-3475
 Email Address: valvlot7@aol.com Fax Number: NA
 Street Address/Location: 40 Hunewill Ln
 City: Wellington County: Lyon State: NV Zip Code: 89444
 Township: 12 N Range: 23E Section(s): 26
 Latitude: 38.87 Longitude: -119.38
 Discharge Location(s): Storage pond spillway
 Discharge Latitude: approx. 38.88 Discharge Longitude: -119.37
 Name of Operator*: _____ Certification Grade*: _____
 *If applicable

CAFO PERMIT APPLICATION SUPPLEMENTAL (CONTINUED)

4. SITE CHARACTERISTICS (if applicable – WPC discharge):

Maps:

Include a topographic map and a site map showing the location of the proposed discharge(s) and the location of proposed or existing groundwater monitoring wells, drinking water wells, irrigation or other wells within a one (1) mile radius.

Wells:

List all wells on the property and include copies of well logs or well specifications. Continue descriptions on additional sheets if necessary. Complete the following information as accurately as possible.

Well Designation	Well Log Number	Notice of Intent Number	Latitude/Longitude	and/or	Section, Township, Range
N/A	Well to be drilled				

Hydrology:

Depth to groundwater: 14 feet
 Groundwater elevation: 4643.9
 Groundwater flow direction: North

5. FLOW:

	30-Day Average		Daily Maximum	
Design Capacity:	<u>0.08</u> MGD	gpm	<u>0.08</u> MGD	gpm
Requested Flow Limit:	MGD	gpm	MGD	gpm
Current Operational Flow*:	MGD	gpm	MGD	gpm

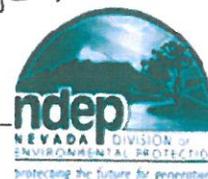
* If applicable
 MGD: million gallons per day
 gpm: gallons per minute

6. DISCHARGE ACTIVITY:

Describe the activity producing the discharge. (Example – wastewater treatment, dewatering, cooling, manufacturing, etc.). Include pertinent elements of water processing or treatment that could affect the quality of the water discharged. Include a Process Flow Diagram.

Description of facility process (if applicable):

Process water is generated in the parlor on a daily basis. It flows over a solid separator, and outflow water is stored in holding ponds. Stormwater runoff from corrals, feed storage & manure stockpiles drain to the holding ponds.



CAFO PERMIT APPLICATION SUPPLEMENTAL (CONTINUED)

7. DISPOSAL/REUSE (if applicable – WPC discharge):

Describe the method of disposal and/or reuse application method (irrigation, percolation, evaporation, spray, disk, etc.):

Wastewater generated at the facility is stored in lined ponds for evaporation and application to crops at agronomic rates.

8. TREATMENT:

Describe the treatment or process that will be used to meet the discharge limits:

None

A. Has NDEP approved the design of this treatment system?

YES
 NO

Date Approved: _____

B. Does this facility have an approved Operations and Maintenance Manual or Effluent Management Plan?

YES
 NO

Date Approved: _____

submitted with application

9. DISCHARGE CONSTITUENTS (if applicable – WPC discharge):

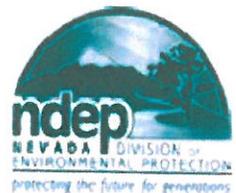
Describe the average annual results of the parameters listed below that may be present in the discharge and in the monitoring wells reports. Source: Average values taken from a similar operation in the area.

Analyte	Concentration (mg/L)	Analyte	Concentration (mg/L)
BOD ₅ :	751.5	Total Nitrogen as N:	758.4
Total Suspended Solids:	2200	Kjeldahl Nitrogen as N:	525
Total Dissolved Solids:	4258	Nitrate as N:	0.99
Fecal Coliform:	235,753	Total Phosphorus:	43.8
pH (Standard Units)	7.58	Other:	
Chloride	275		

10. NOTIFICATION REQUIREMENTS:

In the event of an unauthorized diversion, bypass, spill, overflow, or discharge while operating under an NPDES permit, the Permittee must notify all agencies, organizations, tribes, utilities, and local governments responsible for, having a legal interest in, or impacted by downstream water quality affecting public health and welfare, biological integrity, or designated uses. On the attached form, provide the list of any agencies, organizations, tribes, utilities, and local governments that would be required to be contacted in the event of an unauthorized discharge:

See Attached Form



CAFO PERMIT APPLICATION SUPPLEMENTAL (CONTINUED)

RENEWAL APPLICANTS ONLY: PERMITTEES RENEWING EXISTING PERMITS MUST ALSO COMPLETE ITEMS 11-13.

11. MODIFICATIONS:

List and briefly describe any changes to the production, treatment, or disposal processes of the facility since issuance of the current permit:

12. DISCHARGE DISCREPANCIES:

List Discharge Monitoring Report (DMR) dates and parameters where the facility exceeded the permitted discharge limits (attach additional sheets if necessary):

13. DISCHARGE HISTORY:

Submit graphs of the monitored parameters in the discharge and in any groundwater wells over the time period of the existing permit (e.g., plot BOD₅ vs. month). The time scale should not be less frequent than the permitted sampling frequency. Attach a tabulated compilation of all compliance data for all monitoring parameters analyzed or measured during the preceding five (5) years or the lifetime of the permit, whichever is shorter. Provide the tabulated data in hard copy, and if available, an electronic file compatible with Microsoft Office software (version 97 or later).

I hereby certify that I am familiar with the information contained in the application and that to the best of my knowledge and ability such information is true, complete, and accurate.

Print Name of Applicant:

Dirk Vlot

Title:

Owner

Signature of Applicant:



Date:

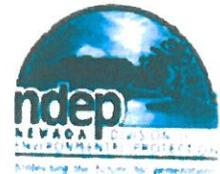
9/3/13

Any person who knowingly makes any false statement, representation, or certification in any application, record, report, plan, or other document filed or required to be maintained by the provisions of NAC445A.070 to 445A.348, inclusive, or by any permit, rule, regulation, or order issued pursuant thereto, or who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under the provisions of NAC 445A.070 to 445A.348, inclusive, or by any permit, rule, regulation, or order issued pursuant thereto, is guilty of a gross misdemeanor and shall be punished by a fine of not more than \$10,000 or by imprisonment in the county jail for not more than 1 year, or by both fine and imprisonment.

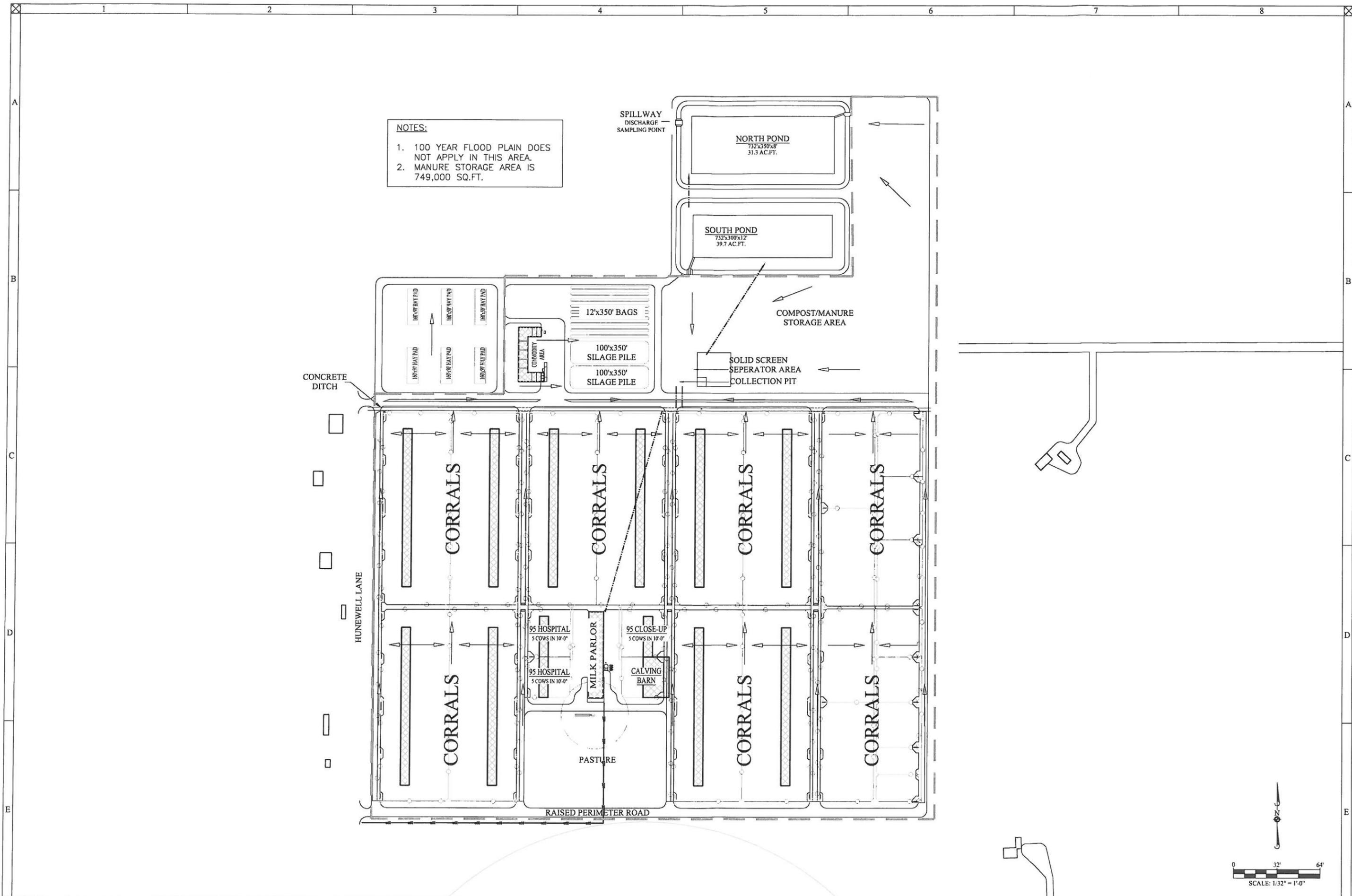
REMIT APPLICATION AND FEE (PER NAC445A.232) TO:
NEVADA DIVISION OF ENVIRONMENTAL PROTECTION
BUREAU OF WATER POLLUTION CONTROL
901 S. Stewart Street, Ste. 4001
CARSON CITY, NEVADA 89701

PHONE: (775) 687 - 9418

NDEP - Bureau of Water Pollution Control
<http://ndep.nv.gov>



Engineering Documents



NOTES:

1. 100 YEAR FLOOD PLAIN DOES NOT APPLY IN THIS AREA.
2. MANURE STORAGE AREA IS 749,000 SQ.FT.

SPILLWAY
DISCHARGE
SAMPLING POINT

NORTH POND
732'x350'x8'
31.3 AC.FT.

SOUTH POND
732'x300'x12'
39.7 AC.FT.

COMPOST/MANURE
STORAGE AREA

SOLID SCREEN
SEPARATOR AREA
COLLECTION PIT

12x350' BAGS

100'x350'
SILAGE PILE

100'x350'
SILAGE PILE

COMMODITY
AREA

160'x90' HAY PAD

CONCRETE
DITCH

HUNEWELL LANE

CORRALS

CORRALS

CORRALS

CORRALS

CORRALS

CORRALS

CORRALS

95 HOSPITAL
5 COWS IN 10'-0"

95 HOSPITAL
5 COWS IN 10'-0"

MILK PARLOR

95 CLOSE-UP
5 COWS IN 10'-0"

CALVING
BARN

PASTURE

RAISED PERIMETER ROAD

DATE	September 19, 2013
SCALE	---
FILE	attach b
SIZE	ANSI D (24X36)
UNITS	ENGLISH
DRAWN BY	---
REVISIONS	---
NUMBER	DATE
---	---
---	---
---	---

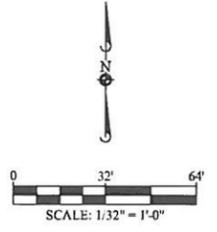


AGPRO professionals
DEVELOPERS OF AGRICULTURE
4350 Highway 66, Longmont, CO 80504
(970) 535-9318 • fax: (970) 535-9854

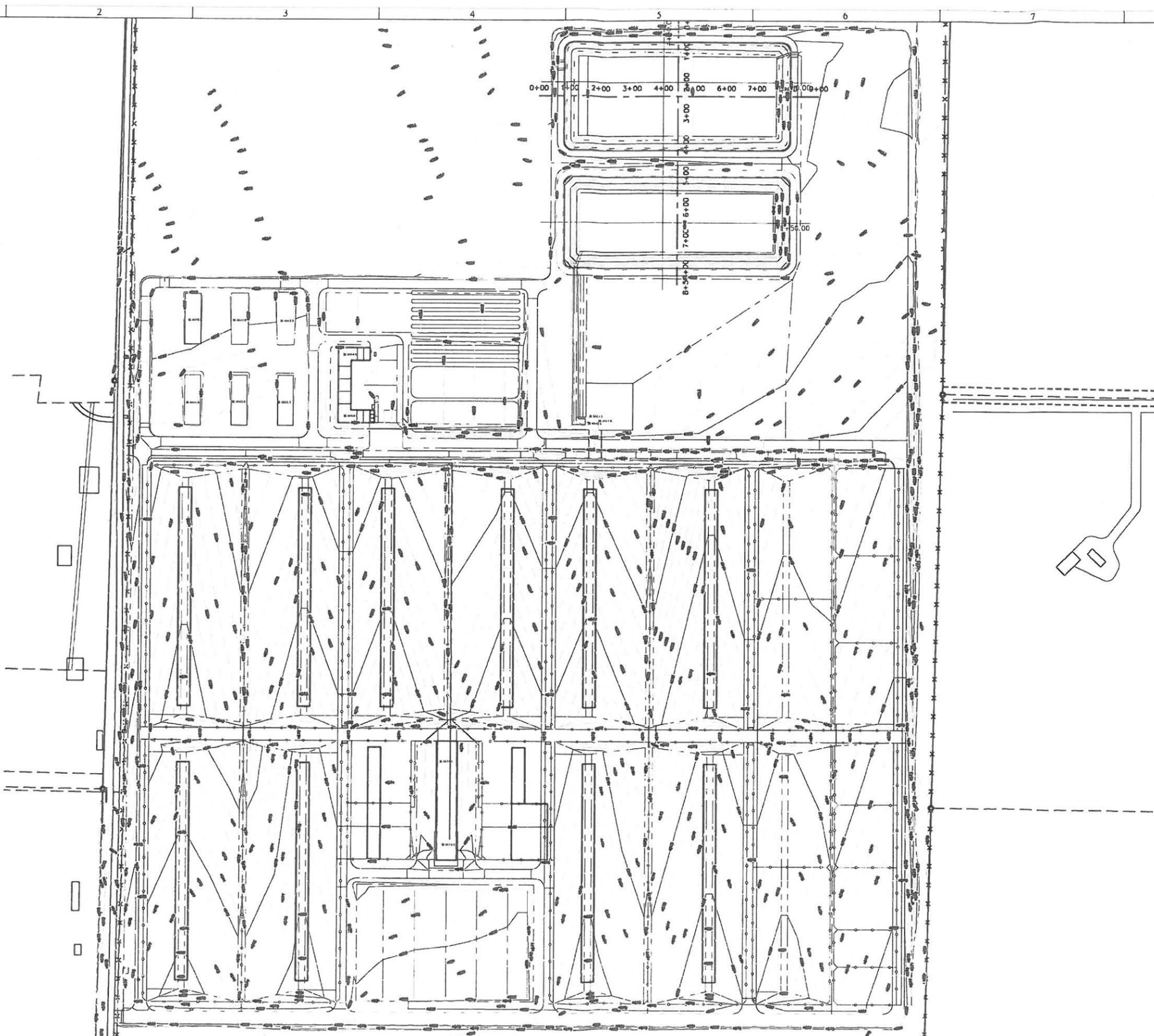
SMITH VALLEY DAIRY
SITE PLAN
LYON COUNTY NEVADA

SHEET:
S-1

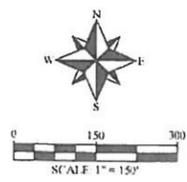
SMITH VALLEY DAIRY
LYON COUNTY NEVADA



\\200-542721 - Smith Valley Dairy\01 - Due Diligence\01 - D5 - Waste System Design & Engineering\Grading\ 2731-02-02_P-Contours.dwg 09/19/2013 Elliot DN



PROPOSED GRADING CONTOURS



DATE	09/25/13
SCALE	AS SHOWN
FILE	
SHEET	AGPRO 02/01/13
UNIT	ENGLISH
DRAWN BY	
CHECKED BY	
REVISIONS	
NUMBER	DATE

AGPRO professionals
 DEVELOPERS OF AGRICULTURE
 4350 Highway 66, Longmont, CO 80504
 (970) 535-9318 • fax: (970) 535-9854



SMITH VALLEY DAIRY
PROPOSED CONTOURS
 LYON COUNTY, NEVADA

SHEET:
GR-2

SMITH VALLEY DAIRY
 PROPOSED CONTOURS

RECTANGULAR WASTE STORAGE POND DESIGN COMPUTATIONS

Project Name: Smith Valley Dairy
 Location: Wellington, Nevada

Computed By: AGPRO
 Date: 9/19/2013

Checked By:
 Date:

Climate Station: Select a climate station from the list: select

BASIC DATA		POND DESIGN VOLUME		RECTANGULAR STORAGE POND DESIGN DIMENSIONS	
Solids & Slurry Inflow:	0 cu. ft./day	Max Working Storage:	55.42 Acre-ft	Freeboard:	0.0 ft.
Other Liquid Waste Inflow:	80000 gal./day	Design Storm Runoff:	15.35 Acre-ft	Inside Slope:	4 H:1V
Contributing Roof Area:	0 sq. ft.	Design Requirement:	70.77 Acre-ft	Evaporation Area:	357,500 sq.ft.
Contributing Paved Lot Area:	0 sq. ft., CN = 49	Available Storage:	100% of design	Seepage Rate:	0.000 Inches/day
Contributing Earth Lot Area:	140 Acres, CN = 90	Storage Safety Factor:	1.3	Seepage Area:	0 sq.ft.
25yr-24hr Precipitation Depth:	2.07 inches	(w/ freeboard)			
10yr-10day Precipitation Depth:	0.00 inches				
Annual FWS Evaporation:	48 inches				

Design Surface Area: 475,800 sq. ft.
 Available Storage Volume: 71.0 Acre-ft
 Freeboard Volume: 22.1 Acre-ft
 Total Volume: 93.1 Acre-ft

Month	MONTHLY POND INFLOW										MONTHLY POND OUTFLOW					WORKING STORAGE	
	Monthly Contribution to Working Storage from Precipitation					Waste Inflow					Total Inflow (Acre-ft)	Planned Drawdown (Acre-ft)	Total Outflow (Acre-ft)	Monthly In - Out (Acre-ft)	Monthly Accumulated Storage (Acre-ft)		
	Precip. (inches)	Earth Lot Runoff (inches)	Earth Lot Runoff (Acre-ft)	Paved Lot Runoff (inches)	Paved Lot Runoff (Acre-ft)	Roof Runoff (inches)	Roof Runoff (Acre-ft)	On Pond (Acre-ft)	Solids (Acre-ft)	Liquids (Acre-ft)							
Jan.	0.79	0.01	0.14	0.35	0.0000	0.59	0.0000	0.7191	0.0000	7.6012	8.46	0.00	0.0000	0.00	0.00	8.46	38.50
Feb.	0.83	0.02	0.20	0.34	0.0000	0.63	0.0000	0.7555	0.0000	7.3550	8.31	0.00	0.0000	0.00	0.00	8.31	46.81
Mar.	0.85	0.02	0.23	0.33	0.0000	0.65	0.0000	0.7737	0.0000	7.6012	8.61	0.00	0.0000	0.00	0.00	8.61	55.42
Apr.	0.30	0.03	0.38	0.56	0.0000	0.15	0.0000	0.2731	0.0000	7.3560	8.01	5.01	3.4230	0.0000	15.00	18.42	45.01
May	0.64	0.00	0.01	0.41	0.0000	0.45	0.0000	0.5826	0.0000	7.6012	8.19	6.38	4.3614	0.0000	10.00	14.36	38.84
June	0.54	0.00	0.01	0.45	0.0000	0.35	0.0000	0.4915	0.0000	7.3560	7.86	7.56	5.2375	0.0000	10.00	15.24	31.46
July	0.33	0.03	0.26	0.54	0.0000	0.19	0.0000	0.3186	0.0000	7.6012	8.18	8.88	6.0705	0.0000	10.00	16.07	23.56
Aug.	0.36	0.02	0.24	0.53	0.0000	0.19	0.0000	0.3004	0.0000	7.6012	8.20	8.09	5.5343	0.0000	10.00	15.53	16.24
Sep.	0.35	0.02	0.26	0.54	0.0000	0.19	0.0000	0.3277	0.0000	7.3560	7.92	6.16	4.2130	0.0000	10.00	14.21	9.94
Oct.	0.51	0.00	0.03	0.47	0.0000	0.33	0.0000	0.3186	0.0000	7.6012	8.18	4.17	2.8485	0.0000	0.00	2.85	15.27
Nov.	0.50	0.00	0.04	0.47	0.0000	0.32	0.0000	0.4642	0.0000	7.3560	7.85	1.95	1.3357	0.0000	0.00	1.34	21.78
Dec.	0.50	0.00	0.04	0.47	0.0000	0.32	0.0000	0.4551	0.0000	7.6012	8.09	0.00	0.0000	0.00	0.00	0.00	29.88
Totals:	6.35	0.18	2.09	5.55	0.00	4.19	0.00	5.78	0.00	89.99	97.86	48.29	33.02	0.00	65.00	98.02	

RAINFALL AND RUNOFF ESTIMATION FOR WASTE STORAGE POND DESIGN			
1 day Curve Numbers:	Earth Areas		Pond Surface
	Paved Areas	Roofed Areas	
25yr-24hr Rainfall:	90	49	100 %
25yr-24hr Runoff:	2.07 inches	2.07 inches	2.07 inches
Runoff Volume:	13.46 Acre-ft	0.00 Acre-ft	1.88 Acre-ft
Total 24hr-25yr Event Runoff Volume: 15.35 Acre-ft			
Chronic Storm (10 day event)			
10yr-10day Rainfall:	81	41	100 %
10yr-10day Runoff:	0.0 inches	0.0 inches	0.00 inches
Runoff Volume:	1.39 Acre-ft	0.00 Acre-ft	0.00 Acre-ft
Total 10yr-10day Event Runoff Volume: 1.39 Acre-ft			
Average Monthly Runoff Contribution to Working Storage			
30 day Curve Numbers:	77	41	98
Monthly Runoff:	(see computations in monthly mass balance table above)		
Average Annual Rainfall:	0.0 inches	0.0 inches	0.0 inches
Average Annual Runoff:	0.18 inches	5.55 inches	4.19 inches
Runoff as % of Rainfall:	#DIV/0!	#DIV/0!	#DIV/0!



North Pond			
Bottom Width:	0.0	Inside Top Width:	0
Bottom Length:	0.0	Inside Top Length:	0
Design Depth:	0.0	Total Depth:	2
Freeboard:	2.0 ft.	Design Surface Area:	256,200 sq. ft.
Inside Slope:	0 H:1V	Available Storage Volume:	31.30 Acre-ft
Evaporation Area:	195,000 sq.ft.	Freeboard Volume:	12.20 Acre-ft
Seepage Rate:	0.000 inches/day	Total Volume:	43.50 Acre-ft
Seepage Area:	0 sq.ft.		

South Pond			
Bottom Width:	0.0	Inside Top Width:	0
Bottom Length:	0.0	Inside Top Length:	0
Design Depth:	0.0	Total Depth:	2
Freeboard:	2.0 ft.	Design Surface Area:	219,600 sq. ft.
Inside Slope:	0 H:1V	Available Storage Volume:	39.70 Acre-ft
Evaporation Area:	162,500 sq.ft.	Freeboard Volume:	9.90 Acre-ft
Seepage Rate:	0.000 inches/day	Total Volume:	49.60 Acre-ft
Seepage Area:	0 sq.ft.		

Pond ???			
Bottom Width:	0.0	Inside Top Width:	0
Bottom Length:	0.0	Inside Top Length:	0
Design Depth:	0.0	Total Depth:	2
Freeboard:	2.0 ft.	Design Surface Area:	0 sq. ft.
Inside Slope:	0 H:1V	Available Storage Volume:	0.00 Acre-ft
Evaporation Area:	0 sq.ft.	Freeboard Volume:	0.00 Acre-ft
Seepage Rate:	0.000 inches/day	Total Volume:	0.00 Acre-ft
Seepage Area:	0 sq.ft.		

Pond ???			
Bottom Width:	0.0	Inside Top Width:	0
Bottom Length:	0.0	Inside Top Length:	0
Design Depth:	0.0	Total Depth:	2
Freeboard:	2.0 ft.	Design Surface Area:	0 sq. ft.
Inside Slope:	0 H:1V	Available Storage Volume:	0.00 Acre-ft
Evaporation Area:	0 sq.ft.	Freeboard Volume:	0.00 Acre-ft
Seepage Rate:	0.000 inches/day	Total Volume:	0.00 Acre-ft
Seepage Area:	0 sq.ft.		

Pond ???			
Bottom Width:	0.0	Inside Top Width:	0
Bottom Length:	0.0	Inside Top Length:	0
Design Depth:	0.0	Total Depth:	2
Freeboard:	2.0 ft.	Design Surface Area:	0 sq. ft.
Inside Slope:	0 H:1V	Available Storage Volume:	0.00 Acre-ft
Evaporation Area:	0 sq.ft.	Freeboard Volume:	0.00 Acre-ft
Seepage Rate:	0.000 inches/day	Total Volume:	0.00 Acre-ft
Seepage Area:	0 sq.ft.		

ALL PONDS FOR AREA ?



Smith Valley Dairy

North Pond

<u>Elev (ft)</u>	<u>Gauge Reading (ft)</u>	<u>Contour Area (ft^2)</u>	<u>Slice Volume (ft^3)</u>	<u>Cumulative Volume (ft^3)</u>	<u>Cumulative Volume (ac-ft)</u>
4649	0.0	47,965	0	0	0.0
4650	1.0	68,695	58,330	58,330	1.3
4651	2.0	83,390	76,043	134,373	3.1
4652	3.0	145,067	114,228	248,601	5.7
4653	4.0	187,246	166,157	414,758	9.5
4654	5.0	201,475	194,361	609,118	14.0
4654.4	5.4	206,207	81,536	690,655	15.9
4655	6.0	213,305	207,390	816,508	18.7
4656	7.0	225,447	426,922	1,036,040	23.8
4657	8.0	237,899	231,673	1,048,182	24.1
4658	9.0	250,664	244,281	1,292,463	29.7
4658.28	9.3	267,388	72,527	1,364,990	31.3
4659	10.0	263,729	257,197	1,549,660	35.6
4660.28	11.3	251,867	329,982	1,879,641	43.2

Pumpdown

Freeboard mark

Top of Berm

Based on proposed design contours





Smith Valley Dairy

South Pond

<u>Elev</u> <u>(ft)</u>	<u>Gauge</u> <u>Reading</u> <u>(ft)</u>	<u>Contour</u> <u>Area</u> <u>(ft^2)</u>	<u>Slice Volume</u> <u>(ft^3)</u>	<u>Cumulative</u> <u>Volume</u> <u>(ft^3)</u>	<u>Cumulative</u> <u>Volume</u> <u>(ac-ft)</u>
4646.34	0.0	15,000	-	0	0.0
4647.28	0.9	25,000	18,800	18,800	0.4
4648.28	1.9	75,000	50,000	68,800	1.6
4649.28	2.9	101,178	88,089	156,889	3.6
4650.28	3.9	127,384	114,281	271,170	6.2
4651.28	4.9	134,806	131,095	402,265	9.2
4652.28	5.9	142,257	138,532	540,796	12.4
4653.28	6.9	149,842	146,050	686,846	15.8
4654.28	7.9	157,561	153,702	840,547	19.3
4655.28	8.9	165,414	161,488	1,002,035	23.0
4656.28	9.9	173,401	169,408	1,171,442	26.9
4657.28	10.9	181,553	177,477	1,348,919	31.0
4658.28	11.9	189,778	185,666	1,534,585	35.2
4659.28	12.9	198,169	193,974	1,728,558	39.7
4660.28	13.9	206,693	202,431	1,930,989	44.3
4661.28	14.9	215,351	211,022	2,142,011	49.2

Freeboard mark

Top of Berm

Based on proposed design contours



Assumptions
used in the
Trapezoidal Waste Storage Pond Design Worksheet

1. The storage pond has a trapezoidal cross section with a level bottom.
2. Pond Volume, V, in Acre-Feet is computed using the following formula:

$$V = \frac{(W_b L_b D_d) + z D_d^2 (W_b + L_b) + \frac{4}{3} z^2 D_d^3}{43,560}$$

where: W_b = bottom width in feet,
L_b = bottom length, in feet,
D_d = design depth, or D_t is design dept + freeboard, in feet, and
z = inside slope ratio, expressed as horizontal run (z) per 1 foot rise.

3. Surface area is computed at the maximum depth, D_t (design depth + freeboard), for the purpose of estimating the volume of direct precipitation on the pond as: (W_b + 2zD_t)(L_b + 2zD_t)
4. Required Design Volume is the sum of working storage and storm runoff storage.
5. Working storage is the maximum monthly value of accumulated storage computed from an average annual water budget process, which includes solid and liquid waste inflow, storm runoff from contributing darinage areas, and direct precipitation on the pond surface.
6. Accumulated storage is the sum of monthly storage increment plus the accumulated storage from the previous month.
7. The monthly storage increment is computed as total inflow less total outflow during each month.
8. Total monthly inflow is the sum of waste loading, precipitation on the pond surface and runoff from contributing drainage areas described in the basic data input.
9. Waste loading is computed as the product of a daily value and the days per month.
10. Average monthly precipitation is used to estimate the runoff component of the working volume. Data from WETS tables⁵ have been entered into the Colorado Climate Data worksheet. Appropriate values are inserted in the pond design worksheet when the user selects a climate station from the drop down menu. Note the average annual precipitation depth, which is computed independently of the monthly values, is always less than the sum of the average monthly values. This indicates that use of the average monthly values for an annual water budget process is a conservative assumption.

11. Monthly runoff, in inches is computed using the average monthly precipitation and the NRCS runoff equation⁷ with the one day runoff curve number adjusted to a 30 day curve number, as follows:

$$q = \frac{\left[P - 0.2 \left(\frac{1000}{CN_{30}} - 10 \right) \right]^2}{P + 0.8 \left(\frac{1000}{CN_{30}} - 10 \right)}$$

here: q = runoff depth, in inches
P = average monthly precipitation in inches
CN₃₀ = 30 day curve number⁸, computed as:

$$CN_{30} = CN_1 - 1.48 \left[CN_1 - 15 - \left(\frac{CN_1^{2.365}}{631.79} \right) \right]$$

Assumptions
used in the
Trapezoidal Waste Storage Pond Design Worksheet

12. Total monthly outflow is the sum of evaporation losses, seepage losses and planned draw down volumes.
13. Monthly Evaporation is estimated as the product of the average annual free water surface evaporation⁹ and a monthly distribution factor¹⁰. The monthly loss is the product of the evaporation depth and the evaporation area. The default evaporation area is the pond bottom surface area, $W_b \times L_b$.
14. Monthly seepage losses are computed as the product of the seepage rate and the seepage area. The default seepage area is assumed to be the bottom surface area plus the side slope area at 1/2 of the design depth.
15. In accordance with the current Colorado CAFO General Permit requirements, the storm runoff volume is either the 24hr-25yr rainfall runoff amount or the 10day-10year runoff amount, whichever is larger. The runoff depths are computed using the NRCS runoff equation described above, substituting the appropriate rainfall amounts and using either a one day or 10 day curve number. 10 day curve numbers¹¹ are estimated using the following equation:

$$CN_{10} = 0.000115CN_1^3 - 0.013CN_1^2 + 1.32CN_1 - 16.6$$

REFERENCES CITED

1. NOAA. 1973. Atlas 2 - Precipitation Frequency Maps of the Western United States, Volume III - Colorado. National Weather Service. Washington, D.C.
2. NRCS. 2001. Technical Note 25 - Ten Year Ten Day Rainfall Depths for Selected Climate Stations in Colorado. USDA Natural Resources Conservation Service. Lakewood, Colorado.
3. NOAA. 1982. NOAA Technical Report NWS 33, Evaporation Atlas for the Contiguous 48 United States. National Weather Service. Washington, D.C.
4. Wolfe, D. and R. Stenzel. 1995. Evaporation. In proceedings of Evaporation and Irrigation Efficiency Seminar, Arvada, CO, 10/10-11/1995. American Consulting Engineers Council of Colorado. Denver, CO.
5. NRCS. 2000. Climate Analysis for Wetlands (WETS Tables). USDA Natural Resources Conservation Service, National Water and Climate Center. Portland, OR.
6. NRCS. 1964. National Engineering Handbook Section 4, Hydrology - Chapter 10, Direct Estimation of Rainfall Runoff. USDA Natural Resources Conservation Service. Washington, D.C.
7. Stettler et.al. 2000. Monthly Runoff Volume. (unpublished paper). USDA Natural Resources Conservation Service, National Water and Climate Center. Portland, OR.
8. same as 3.
9. same as 4.
10. NRCS. 1985. Technical Release 60, Earthen Dams and Reservoirs, Table 2-3B. USDA Natural Resources Conservation Service. Washington, D.C.

ENGINEER'S NARRATIVE

Smith Valley Dairy

6.03.2014

Smith Valley Dairy is a new dairy facility located 6 miles NE of Smith Valley, on the east side of Hunewill Lane in Sec 26, T12N, R23E, Lyon County Nevada. The facility is located within a non-discharging drainage basin. Discharges from the facility would ultimately flow through a series of public ditches to the evaporative Artesia Lake, an alkali flat 3 miles north of the facility. Therefore it is appropriate for the facility to apply for a Nevada CAFO Groundwater Discharge Permit.

Dairy construction will be industry-typical open corrals with pipe and cable fence, concrete feed aprons and feed bunks, feed alleys and cow movement alleys, feed storage areas and associated storage structures, maintenance facilities, and waste management/control structures. The facility will operate a lane flush system that utilizes recycled water. In cold temperatures the lanes will be scraped to collection lanes.

The ultimate maximum capacity at the 140 acre facility will be 7,248 head (see NMP for details). Initially young stock will be transferred off site, and replacement stock will be imported from other farms. However, the facility has been designed to keep all stock on site and wishes to be permitted for such.

The facility will have one drainage basin and be graded so that all stormwater runoff from the production area, corrals, and processed feed storage areas, and water generated in the milk parlor will be captured in a pump station which delivers water to a 2 stage detention pond system. Runoff from the unprocessed hay storage area will be directed away from the facility's containment system to reduce the amount of non-production area water the facility needs to manage. A concrete ditch along the north side of the corrals facilitates the movement of stormwater from the corrals to the collection pit.

The NRCS Rectangular Waste Storage Pond Design Computations were used to predict runoff and pond storage needs. The ponds have been designed to hold 4 months or more of process generated water and winter stormwater runoff as well as the runoff generated in a 25-year, 24-hour storm event while maintaining 2 feet of freeboard. An emergency spillway in the north and final pond in the series has been designed to accommodate flows in excess of those expected during a 25-year, 24-hour storm event.

The milk parlor produces process wastewater that flows via pipeline into a concrete ditch, which then flows to a collection pit. From the pit wastewater is pumped over a solid separator screen to allow for solids removal prior to entering the ponds. Water from the screen can also be redirected back into the collection pit for use in flushing the barns.

The soil was bored in 15 locations around the proposed facility, and groundwater levels were determined (see application). The test pit boring logs from the location of the ponds is attached. A minimum 2' setback from the pond bottoms has been maintained in the design standards. Further protection of groundwater will be accomplished through the use of a 60 ml high density polyethylene liner in the storage ponds coupled with a leak detection system. See further information in the document titled "Impoundment Construction: Specifications, Liner and Leak Detection Installation".

The groundwater gradient indicated in the application was determined after a review of "Geology and Water Resources of Smith Valley, Lyon and Douglas Counties Nevada", Geologic Survey Water-Supply Paper 1228, by O.J. Loeltz and T.E. Eakin, 1953. West Walker River flows towards the river. A groundwater divide exists approximately 1 to 2 miles north of the West Walker River and runs parallel to the river. Unconfined groundwater south of the divide flows towards the river. Smith Valley Dairy is located north of the divide, and therefore unconfined groundwater flows north to the alkali flat Artesia Lake, located at the north end of Smith Valley.

Run-on from adjacent land will not be a concern. Surrounding topography is gently sloped and will be farmed. The entire production area of the facility will be surrounded by a 2' raised perimeter farm road that will prevent any irrigation water or run-on from entering the production area.

No mapped 100yr floodplain impacts this facility.

A calibrated staff gauge will be installed in a manner that does not compromise the integrity of the pond liner in the final lagoon. This gauge will be marked in 1ft increments with the pump down (level required to be maintained in order for the pond to hold the runoff generated in a 25-year, 24-hr storm event) and freeboard (2') levels clearly indicated.

Pond capacity information, including the working volume, process water runoff and storage, design storm, and its corresponding runoff are located in the facility's nutrient management plan (NMP), along with plans for operations/maintenance of the ponds.

Manure is handled in both solid and liquid forms and is distributed to crop production areas. Manure generated by the dairy in excess of crop production needs and land availability will be stockpiled or composted within the footprint of the production area in a manner that is compliant with all permit requirements. Excess manure and compost will then be transferred to neighboring farmers. Runoff collected from the dairy which does not evaporate will be used to irrigate the dairy's crops. Compost will only include agricultural waste and will not be sold to the public without a permit from the NDEP Bureau of Waste Management.

All land application areas in the nutrient management plan are owned by the dairy. There are approximately 1640 tillable acres with planned corn silage, alfalfa, grass, and wheat

rotations. Other crops might be grown depending upon environmental and economic factors. The cropping system is outlined in the NMP. The narrative NMP describes how agronomic application rates will be calculated. Manure or wastewater will be applied based upon the nitrogen needs of the crop unless the Phosphorus Index Risk Assessment indicates otherwise. Because the dairy is new, planned crops and acres may change, but the procedures outlined in the NMP will be followed, and any changes will be noted in the facility records. The NMP includes all potential acres, and only the distribution of acres within a field may change as land is divided up into management units.

Logged By: KK

Total Depth: 18.5

Date Logged: 8/22/13

Water Depth: 14'

Drill Type: Case CX160 Excavator

Ground Elev.: 4657.9 - 14' = 4643.9

Depth in Feet	Graphic Log	Sample Type	<input checked="" type="checkbox"/> Shelby Tube	<input checked="" type="checkbox"/> Split Spoon	<input checked="" type="checkbox"/> Ziplock Sample	Blows/Foot	Moisture Content, %	Dry Unit Weight, pcf	Liquid Limit, %	Plasticity Index, %	Gravel, % (3" - #4 Sieve)	Sand, % (#4 - #200 Sieve)	Fines, % (< #200 Sieve)	R-VALUE	Expansion Index
			<input checked="" type="checkbox"/> California	<input type="checkbox"/> Bulk Sample	<input type="checkbox"/> Static Water Sample										
SOIL DESCRIPTION															

0		0 -1' Medium Brown Silty Sand with organics (SM)													
1		1' - 3.5' Light Brown Cemented Silty Sand (SM)													
2															
3															
4		3.5' - 6' Light Brown Silty Sand (SM)													
5															
6		6' - 15' Medium Brown Silt with Clay (CL) with mottling throughout													
7															
8															
9															
10															
11															
12															
13															
14		 at 14' Groundwater Encountered													
15		15' - 16' Medium Brown Poorly Graded Sand (SP)													
16		16' - 17' Reddish Brown Poorly Graded Sand (SP)													
17		17' - 17.5' Medium Brown Sandy Lean Clay (CL)													
18		17.5' - 18.5' Reddish Brown Poorly Graded Sand (SP)													
19		Test Pit Terminated Due to Caving													18.5

	Lumos & Associates, Inc. 178 S. Maine Street Fallon, NV 89406 Tel: (775) 423-2188 Fax: (775) 423-56567	Smith Valley Dairy Development LOG OF EXPLORATION Job No: 8403.000	PLATE D Date: 8/22/13
---	---	---	--

Logged By: KK

Total Depth: 18.0'

Date Logged: 8/22/13

Water Depth: 15'

Drill Type: Case CX160 Excavator

Ground Elev.: 4660.70 - 15' = 4645.7

Depth in Feet	Graphic Log	Sample Type	Shelby Tube	Split Spoon	Ziplock Sample	Blows/Foot	Moisture Content, %	Dry Unit Weight, pcf	Liquid Limit, %	Plasticity Index, %	Gravel, % (3" - #4 Sieve)	Sand, % (#4 - #200 Sieve)	Fines, % (< #200 Sieve)	R-VALUE	Expansion Index
			California	Bulk Sample	Static Water Sample										
SOIL DESCRIPTION															
0															
0 - 1'															
1 - 5'															
5 - 9'															
9 - 15'															
15'															
15' - 16'															
16' - 16.5'															
16.5' - 17'															
17' - 18'															
18'															
18.0'															

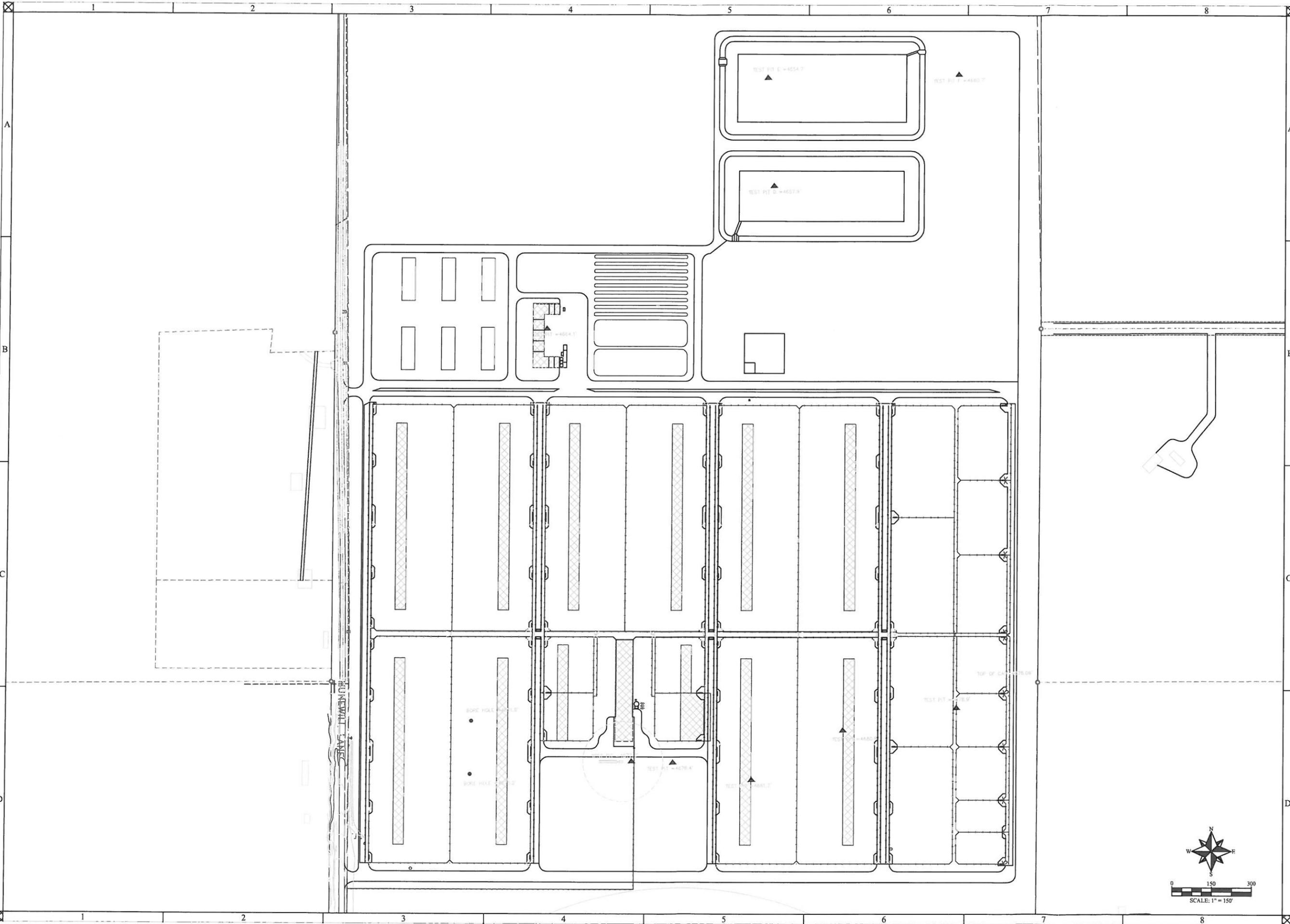
Lumos & Associates, Inc.

 178 S. Maine Street
 Fallon, NV 89406
 Tel: (775) 423-2188
 Fax: (775) 423-56567

Smith Valley Dairy Development
LOG OF EXPLORATION
 Job No: 8403.000
 Date: 8/22/13

PLATE
F

PA 2700-SV2731 - Smith Valley Dairy 01 - Due Diligence 01 - 03 - Concept, Design & Utilities Evt\1325_ST_BASE3.dwg 06/05/2014 Chad DN



DATE:	05/05/2014
SCALE:	AS SHOWN
FILE:	
SHEET:	SMITH VALLEY DAIRY
UNITS:	ENGLISH
DRAWN BY:	
REVISIONS:	
NUMBER:	
DATE:	

AGPRO fessionals, LLC
 DEVELOPERS OF AGRICULTURE
 4350 Highway 66, Longmont, CO 80504
 (970) 535-9318 • fax: (970) 535-9854

**SMITH VALLEY DAIRY
 BORE HOLE LOCATIONS**

SHEET:
B-1

Smith Valley Dairy

Impoundment Construction: Specifications, Liner and Leak Detection Installation

In preparing this summary; much information was taken from the Environmental Protection Agency (EPA) "Guide for Industrial Waste Management" that addresses non-hazardous industrial waste subject to Subtitle D of the Resource Conservation and Recovery Act (RCRA) and Chapter 7 in particular. Dairies and manure are not subject to RCRA, Subtitle D and the wastewater is neither a hazardous nor solid waste. Due to lack of a specific guide for CAFOs, we are using this document.

*Guide for Industrial Waste Management, Chapter 7-Section B: Designing and Installing Liners: Technical Considerations for Surface Impoundments, Landfills, and Waste Piles (PDF) (48pp, 582K, last revised 11/15/2012.
<http://www.epa.gov/osw/nonhaz/industrialguide/chap7bshtm>)*

Henceforth, in this paper this reference will be referred to as the EPA Guide.

Smith Valley Dairy is constructing two new surface impoundments to hold production water and facility surface water runoff from their Concentrated Animal Feeding Operation (CAFO).

IMPOUNDMENT

Impoundment Summary

Design criteria	North Storage Pond	South Storage Pond
Exterior Dimensions (ft)	732 x 350	732 x 300
Side slopes (ratio)	4:1	4:1
Capacity at 2' freeboard (acre-feet)	31.3	39.7

Figure GR-2 shows a plan view of the impoundments with the associated location of the test pits (D, E and F). Test pits were excavated and logged by Lumos & Associates, Inc. with a CX160 Excavator to approximately 20 ft or caving. Groundwater was encountered at 14-15 feet below grade. Soils were classified throughout this depth. The 8 to 15 foot depths below grade were predominately classified as CL (Silt with Clay, Sandy Lean Clay or Lean Clay.) No soil testing was performed on the samples. Test Hole Logs are attached. Permeability of the subsurface clays can be expected 5.5×10^{-4} to 10^{-7} cm/sec range.

The EPA Guide indicates that in-situ soils may have the natural ability to hinder transport and reduce concentration of constituents sufficiently to not need a constructed liner. However, for this site a single liner of 60 mil HDPE liner which will withstand the stress of construction, weight load of the waste, and allow for seaming to bind separate geomembrane panels has been selected. This synthetic liner in addition to the underlain natural clay materials and separation from the groundwater should provide ample protection of groundwaters. The natural insitu clays provide a defacto secondary liner.

Leak Detection

In addition to the liner, the Nevada Division of Environmental Protection (NDEP) has requested a leak detection system (LDS) to be included. Because of the natural in-situ soil and depth to groundwater, AGPROfessionals is proposing an alternative to a double liner or monitoring wells. By the time a concern is detected in groundwater monitoring wells, the problem can be rather significant, so we are offering an alternative solution; a highly permeable medium weight nonwoven geotextile for leachate collection and leak detection.

In conference with the manufacturer (US Fabrics, Mr. Dan Bonn, 2 June 2014, 800-518-2290) geotextile fabrics are often used for leachate collection and transport; they have outstanding water flow properties and offer greater than 10 times the permeability of the natural soils at the site. Permeability criteria for nonwoven geotextiles require that the permeability of the geotextile be at least five times the permeability of the surrounding soil to assure favored drainage path (Guyer, J. Paul, 2009. Introduction to Geotextiles in Pavement and Drainage Applications, <http://www.cedengineering.com/upload/An%20Intro%20to%20Geotextiles%20in%20Pave%20Drain%20Apps.pdf>.)

The geotextile layer will underlay the HDPE liner providing triple function: 1.) added protection of the liner during construction, 2.) air and vapor build up escape route to prevent the liner from developing bubbles (whaling) and 3.) serve as a preferential conduit for wastewater transport. The geotextile will cover the bottom of the impoundments fully and strips of fabric will be lain on the side walls to allow for air/vapor escape. A perforated pipe will be laid in a V-trench extending east and west in the centerline of the ponds to enhance drainage. Leachate will drain on the natural slope of the impoundment from East to West and will be caught in a subsurface trench along the West end and be directed to a wetwell that can be physically observed, monitored and a samples drawn, as needed. The well will be sized such that a pump can be placed for quick evacuation.

The LDS is also known as a leachate collection and removal system. The LDS will allow for monitoring and collection of leachate escaping liner system. The LDS will be monitored on a regular basis. AGPROfessionals recommends a weekly sight inspection of the wetwell to check for standing water.

- If water is visibly present, a depth of water will be measured and recorded. This measurement will be compared against pre-calculated wetwell volumes which relate volumes to gallons of leakage per acre-day. If the volume of leachate detected by the LDS appears to be increasing or is significant, a closer examination will be made to determine possible remediation measures.
- If the LDS indicates a seepage level greater than 50 gallons per acre – day (10% of the allowable maximum), monitoring frequency will increase.

- Nevada BWPC indicates that a maximum allowable leakage rate is 500 gallons per acre - day; and that if the leakage rate exceeds 125 gal/acre-day the facility will develop a plan to identify the source of the leak and submit to the BWPC for approval. If it exceeds 250 gal/acre-day the approved plan will be initiated. If it exceeds 500 gal/acre-day, the permittee will notify BWPC in writing within 5 days and cease discharging into the leaking pond and institute corrective measures.

Quality Assurance / Quality Control for Synthetic Liner Installation

A 60 ml high density polyethylene synthetic liner will be used. The work shall consist of obtaining, placing, and installing a synthetic liner.

The liner system will be certified by a Nevada licensed P.E. who supervised the construction and will include a statement that the pond liner meets the engineering design. The following information will be submitted : the type and thickness of liner material used; manufacturer's specifications of the ability of the material to withstand UV degradation; how the subgrade was prepared prior to installation of the liner; a description of the leachate detection and collection system; engineering drawings of the pond showing the leachate detection and collection system, bottom, sidewalls and subgrade; the date(s) the certifying engineer did a site visit of the installation; and a brief discussion of how the manufacturer's recommendations for installation and field testing of the seams were followed.

Some of the areas that will be included in the P.E.'s inspections:

1. See that all Manufacturer's installation requirements are followed such that the Manufacturer's warranty is upheld.
2. The surface to be lined was rolled and compacted and free of irregularities, undulations, protrusions, vegetation, excessive moisture, loose soil, or abrupt changes in slope.
3. Subgrade Preparation. Subgrade preparation conformed to manufacturer recommendations. The subgrade surface was free of foreign material including stones, cobbles, broken pieces of wood, plastic, or glass.
4. The anchor trench was constructed according to the standard industry practices. The trench was adequately drained to prevent ponding or softening of the side walls. After installation of the liner, the trench was back filled, compacted, and anchored according to the standards.

5. The liner placement plan took into consideration the site drainage, low lying areas, temperature, and prevailing wind velocity and direction. Field panels were deployed one at a time and seamed as soon as possible to minimize the risk of wind or water damage.
6. Field panel deployment did not take place at an ambient temperature below forty degrees (40°) F, unless Low Temperature Welding Procedures are used. All deployed panels were amply ballasted or sand bagged at all times to avoid wind damage.
7. Personnel responsible for placement of the liner did not smoke, wear damaging shoes, or engage in other activities which may have caused damage to the liner. The method of deployment did not cause scratches, crimps, or tear the liner or damage the subgrade. Adequate sand bags were placed on the edges of the liner to avoid wind uplifting.
8. The installer visually inspected the panels as soon as possible after deployment for damage or distressed surfaces.
9. Seams were generally oriented parallel to the line of maximum slope, or along instead of across the slope. In corners and odd shaped geometric locations the number of seams were minimized.
10. The Extrusion Process was used only for repairs and patching and not used for the overall operation. The Fusion Process was used for seaming panels together using hot-wedge type or solid wedge type automated self-propelled apparatus equipped with temperature gauges.
11. The nondestructive seam continuity test was performed during daylight hours and certified by the contractor.
12. Anchorage. Liners were be anchored to pre-vent uplift due to wind or slippage down the side slope.
13. Safety. Design included appropriate safety features to minimize the hazards of the structure. Warning signs, fences, ladders, ropes, bars, rails, and other devices were provided, as appropriate, to ensure the safety of humans and livestock.
14. Pump and Agitator Placements. If agitation operations may result in abrasion or other mechanical damage to the liner, then protective measures were provided, as needed, to ensure the integrity of the liner, such as increasing the liner thickness above the minimum values indicated above or providing protective ramps and aprons at agitation locations.

Operations and Maintenance Plan

A plan for operation and maintenance (O&M) of the liner and structure will be prepared. The plan will be consistent with the purposes of the type of liner chosen, intended life, safety requirements and design criteria. The plan will contain requirements including but not limited to:

1. Design capacity and liquid level of the structure.
2. A description of the normal operation, safety concerns and maintenance requirements.
3. Repair procedures.
4. Periodic inspection of the following:
 - Visible portions of the liner for tears punctures, or other damage;
 - Liner interface with inlets, outlets, ramps, or other appurtenances for damage;
 - Liquid level in the structure;
 - Ballooning of the liner indicating presence of gas beneath the liner and
 - Physical inspection of Leak Detection wetwell.

Trapezoidal Channel Section

Participant: Smith Valley
Location: At north pond spillway
County: County, NV

Designer: Agpro
Date: 06/06/2014

Checker: _____
Date: _____

Hydraulics Formula, Version 2.2.1

Dairy Facility

Slope: 0.0005 ft/ft
'n' value: 0.015

Hydraulic Radius: 1.24
Area: 46.50 sq ft
Velocity: 2.56 ft/sec
Capacity: 119.16 cfs

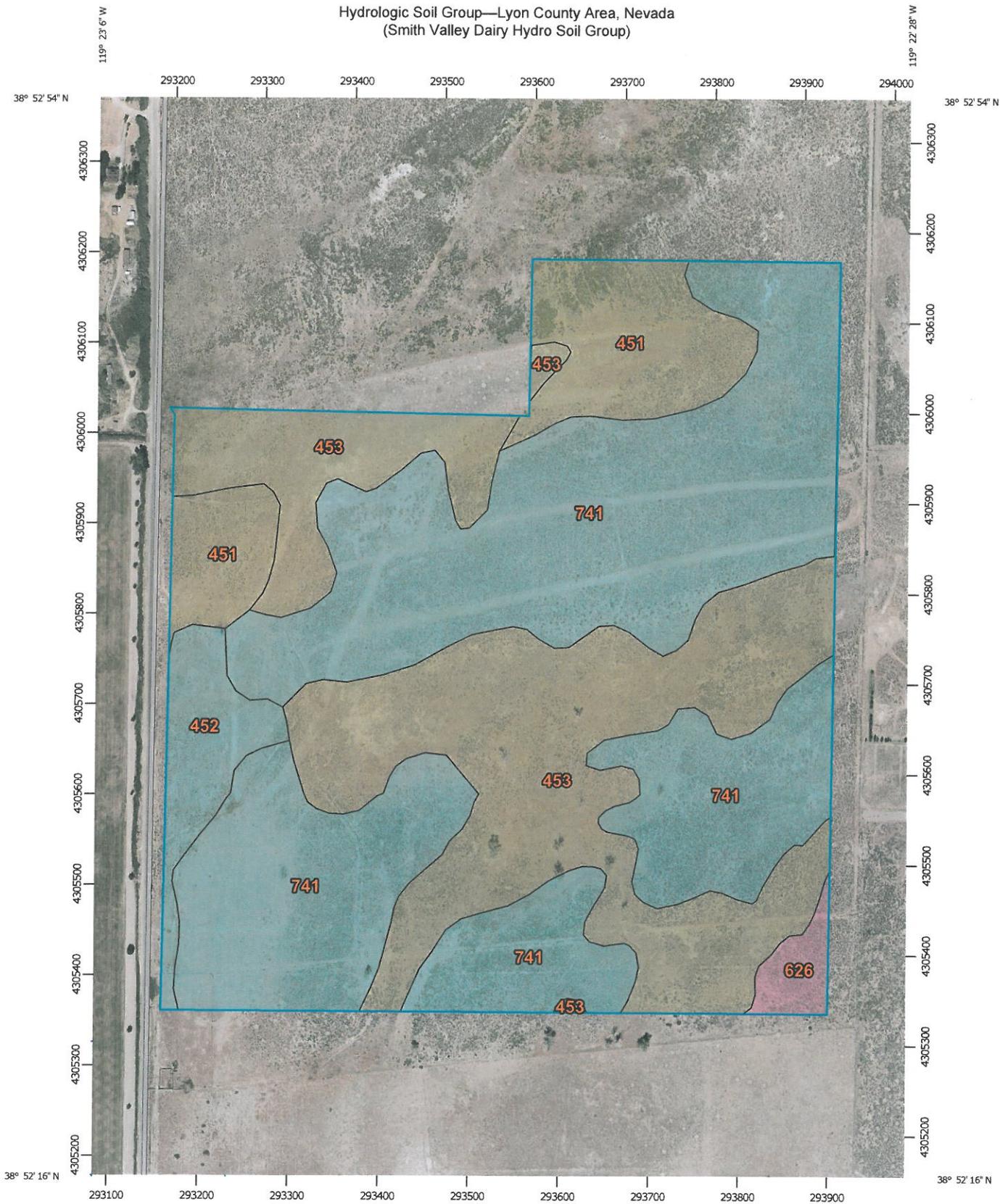
Sideslope: 4:1
Bottom Width: 25 ft
Depth of Flow: 1.5 ft.
Width @ surface 37 ft

Client: Smith Valley Dairy
 County: _____ State: NV
 Practice: Peak Flow for Spillway Design
 Calculated By: Agpro Date: 6/6/2014
 Checked By: _____ Date: _____

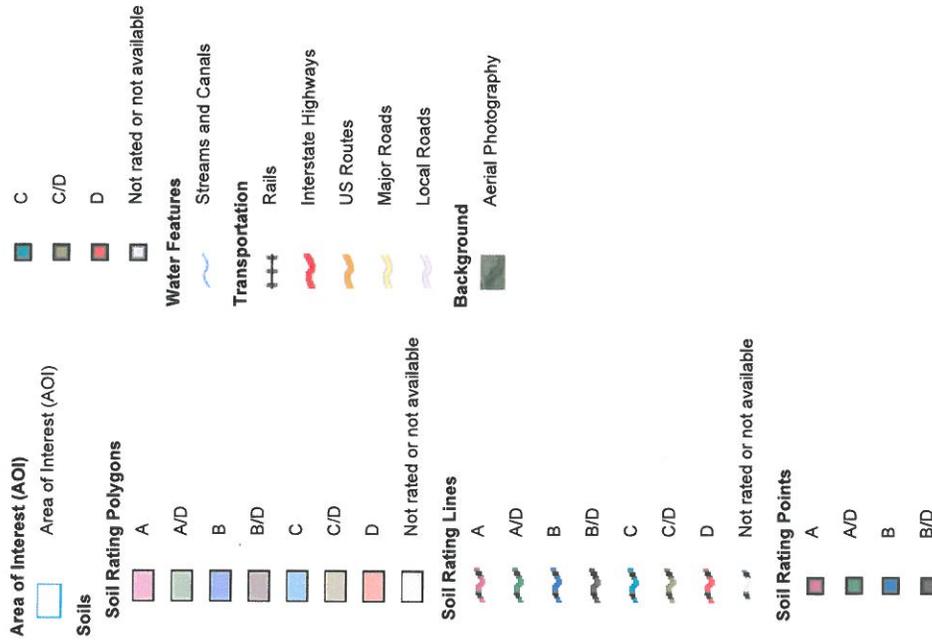
Drainage Area: 140 Acres (provided from RCN Calculator)
 Curve Number: 82 (provided from RCN Calculator)
 Watershed Length: 500 Feet
 Watershed Slope: .7 Percent
 Time of Concentration: 0.34 Hours (calculated value)
 Rainfall Type: II

Storm Number	1	2	3	4	5	6	7
Frequency (yrs)	25						
24-Hr rainfall (in)	2.07						
Ia/P Ratio	0.21	0.00	0.00	0.00	0.00	0.00	0.00
Used	0.21	0.00	0.00	0.00	0.00	0.00	0.00
Runoff (in)	0.70						
(ac-ft)	8.17	0.00	0.00	0.00	0.00	0.00	0.00
Unit Peak Discharge (cfs/acre/in)	0.909	0.000	0.000	0.000	0.000	0.000	0.000
Peak Discharge (cfs)	88						

Hydrologic Soil Group—Lyon County Area, Nevada
(Smith Valley Dairy Hydro Soil Group)



MAP LEGEND



MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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 map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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

Soil Survey Area: Lyon County Area, Nevada
Survey Area Data: Version 9, Nov 12, 2013

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 1, 2010—Jul 3, 2011

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.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Lyon County Area, Nevada (NV625)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
451	Obanion loamy coarse sand	C/D	13.1	9.6%
452	Obanion sandy loam, drained	C	5.5	4.0%
453	Obanion sandy loam, saline-alkali	C/D	44.7	32.8%
626	Saralegui loamy sand, undulating	A	1.8	1.4%
741	Wedertz-Wellington-Saralegui complex, 0 to 2 percent slopes	C	71.0	52.1%
Totals for Area of Interest			136.1	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

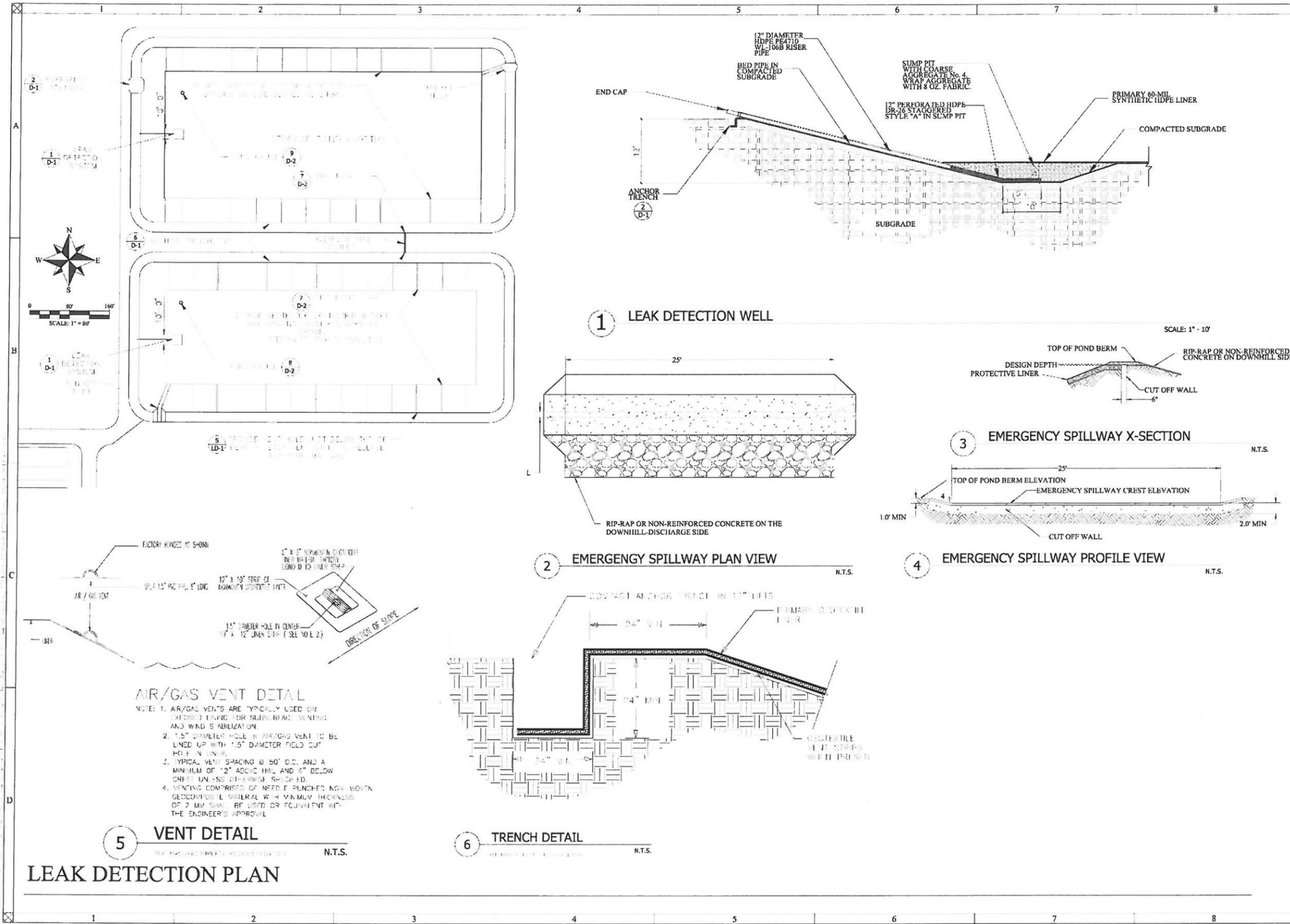
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Curve number Computation

Client: Smith Valley Dairy
 County: _____ State: NV
 Practice: Peak Flow for Spillway Design
 Calculated By: Agpro Date: 6/6/2014
 Checked By: _____ Date: _____

COVER DESCRIPTION	Acres (CN)			
	Hydrologic Soil Group			
	A	B	C	D
OTHER AGRICULTURAL LANDS Farmsteads -----	2(59)	-	138(82)	-
Total Area (by Hydrologic Soil Group)	2		138	
TOTAL DRAINAGE AREA: 140 Acres		WEIGHTED CURVE NUMBER: 82		



2
D-1

1
D-1

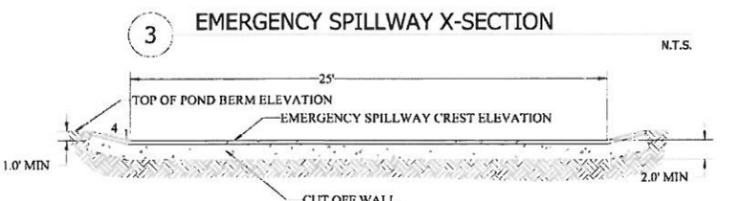
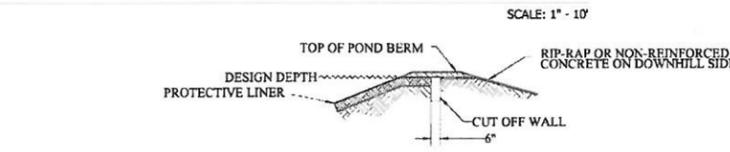
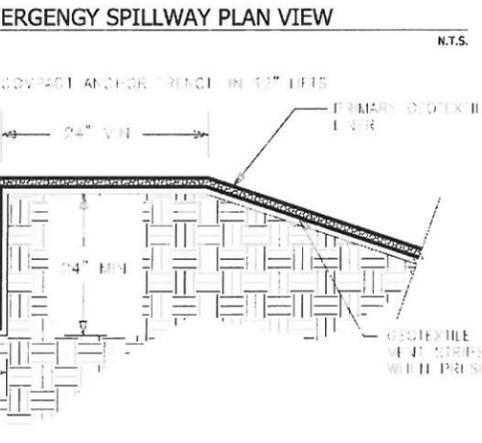
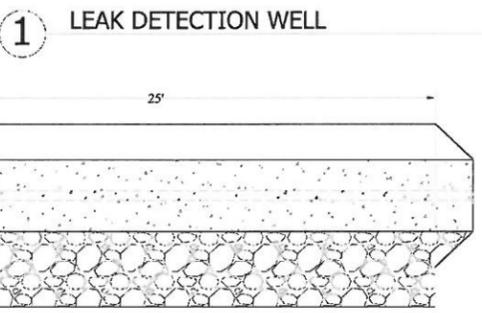
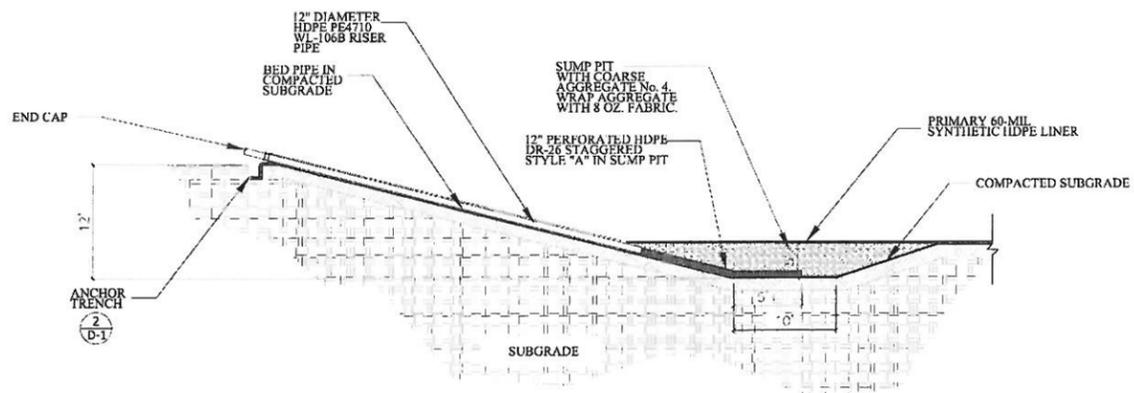
1
D-1

5
D-1

5
D-1

LEAK DETECTION PLAN

SMITH VALLEY DAIRY POND DETAILS 1



AIR/GAS VENT DETAIL
 NOTE: 1. AIR/GAS VENTS ARE TYPICALLY USED ON XICROB LINED FOR SUBSTRATE VENTING AND WIND STABILIZATION.
 2. 1.5" DIAMETER HOLE IN AIR/GAS VENT TO BE LINED UP WITH 1.5" DIAMETER FIELD CUT-HOLE IN LINER.
 3. TYPICAL VENT SPACING @ 50' O.C. AND A MINIMUM OF 12" ABOVE HILL AND 6" BELOW CREST UNLESS OTHERWISE SPECIFIED.
 4. VENTING COMPRISED OF NEEDLE PUNCHED NON WOVEN GEOTEXTILE MATERIAL WITH MINIMUM THICKNESS OF 2 MM SHALL BE USED OR EQUIVALENT WITH THE ENGINEER'S APPROVAL.

DATE:	AS SHOWN
SCALE:	AS SHOWN
FILE:	
NO.:	
DATE:	
BY:	
CHKD BY:	
REVISIONS:	
NO.:	
DATE:	

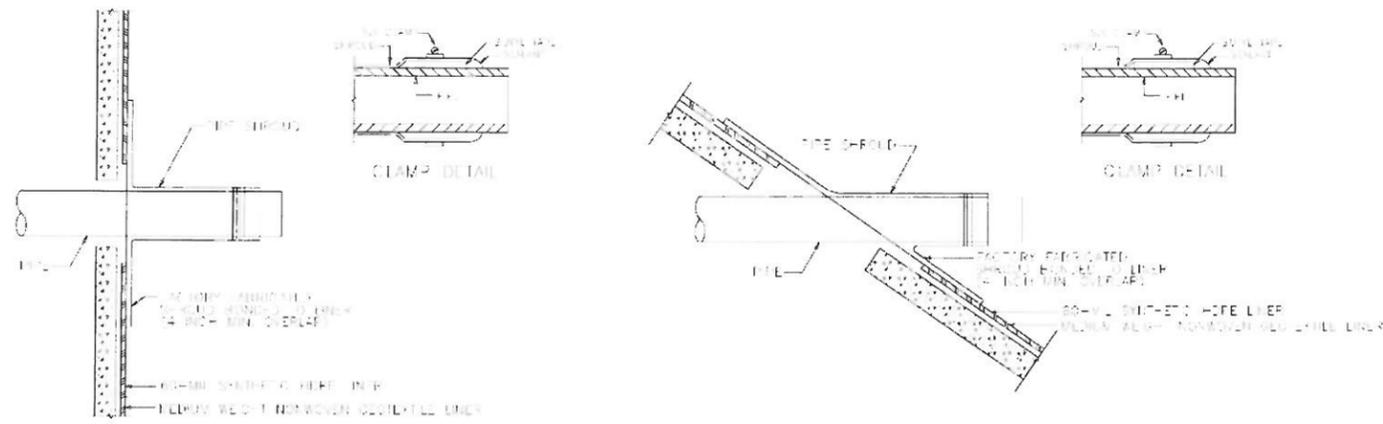
AGPRO fessionals, LLC
 developers of innovation
 4350 Highway 66, Longmont, CO 80504
 (970) 555-9318 • fax: (970) 535-9854



SMITH VALLEY DAIRY
POND DETAILS 1
 PART OF THE SOUTHEAST 1/4 OF SECTION 25, TOWNSHIP 4 NORTH, RANGE 65 WEST,
 OF THE 6TH P.M., COUNTY OF WELLS, COLORADO

SHEET:
D-1

SMITH VALLEY DAIRY
 POND DETAILS 1



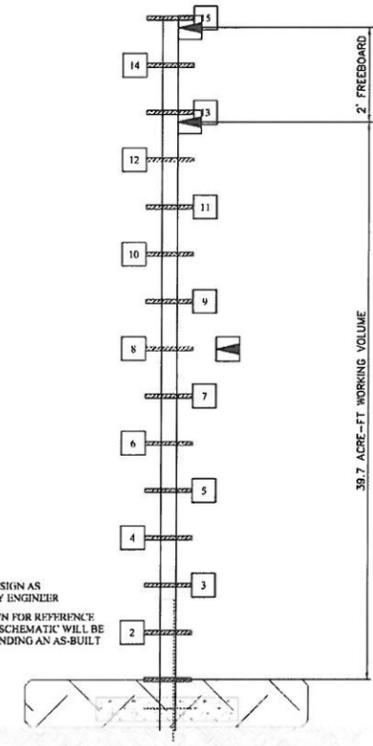
PIPE BOOT DETAIL - 90 DEGREE

PIPE BOOT DETAIL - SPECIFIED ANGLE

7 PIPE BOOT DETAILS

FOR FINISH DETAILS, REFER TO DRAWING

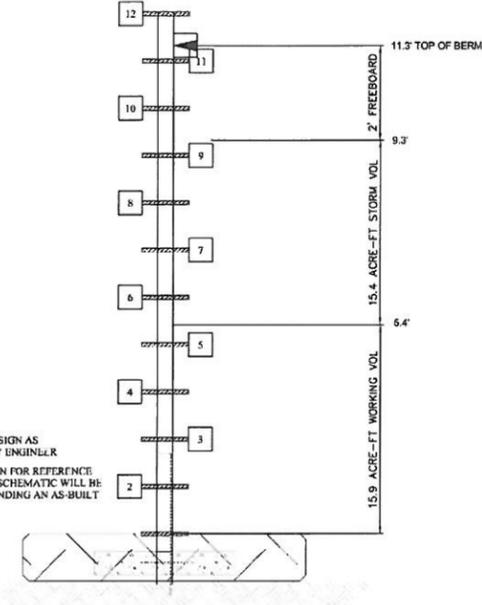
N.T.S.



* OR OTHER DESIGN AS APPROVED BY ENGINEER
 ** GAUGE SHOWN FOR REFERENCE ONLY, FINAL SCHEMATIC WILL BE PROVIDED PENDING AN AS-BUILT SURVEY

8 SOUTH POND DEPTH GAUGE DETAIL

N.T.S.



* OR OTHER DESIGN AS APPROVED BY ENGINEER
 ** GAUGE SHOWN FOR REFERENCE ONLY, FINAL SCHEMATIC WILL BE PROVIDED PENDING AN AS-BUILT SURVEY

9 NORTH POND DEPTH GAUGE DETAIL

N.T.S.

TITLE	01/24/2013
SCALE	AS SHOWN
FILE	
APP	AWP/D/CSM
DATE	ENCLD
DESIGNER	
CHECKER	
DATE	

AGPRO Professionals, LLC
 DEVELOPERS OF AGRICULTURE
 4350 Highway 66, Longmont, CO 80504
 (970) 535-9318 • fax: (970) 535-9854



SMITH VALLEY DAIRY
POND DETAILS 2
 PART OF THE SOUTHEAST 1/4 OF SECTION 25, TOWNSHIP 4 NORTH, RANGE 65 WEST,
 OF THE 6TH P.M. COUNTY OF WELD, COLORADO

SHEET:
D-2

SMITH VALLEY DAIRY
 POND DETAILS 2

DATE:	June 6, 2014
SCALE:	---
FILE:	---
SIZE:	ANSI (24x36)
UNITS:	ENGLISH
DRAWN BY:	---
REVISED BY:	---
REVISIONS:	---
NUMBER:	---
DATE:	---



AGPRO professionals
 DEVELOPERS OF AGRICULTURE
 3050 67th Avenue, Suite 200, Greeley, CO 80634
 (970) 535-9318 • fax: (970) 535-9854

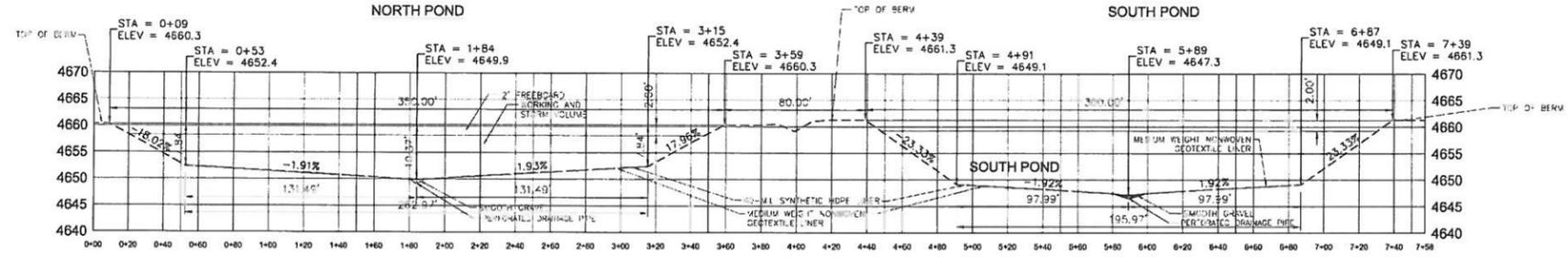


SMITH VALLEY DAIRY
POND PLAN AND CROSS SECTIONS

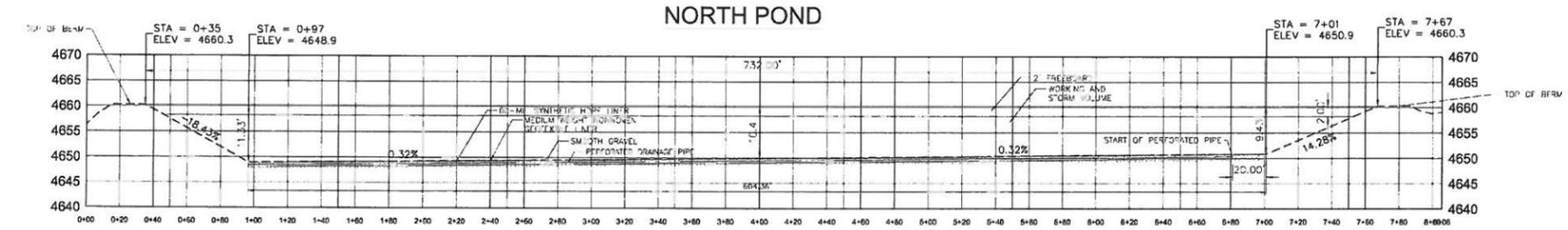
SHEET:
PD-1

SMITH VALLEY DAIRY
 POND PLAN AND CROSS SECTIONS

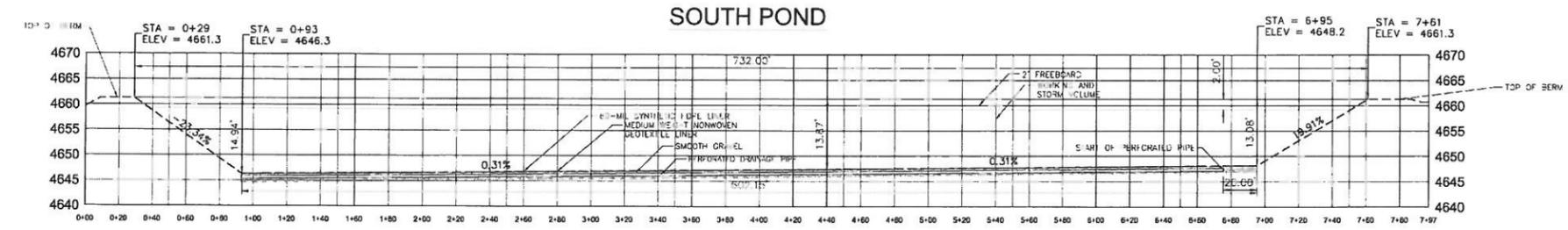
POND PROFILES LOOKING EAST
 SCALE: 1" = 40'-0" 1H:3V



POND PROFILE LOOKING NORTH
 SCALE: 1" = 40'-0" 1H:3V



POND PROFILE LOOKING NORTH
 SCALE: 1" = 40'-0" 1H:3V

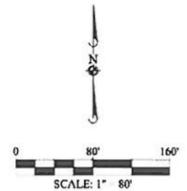
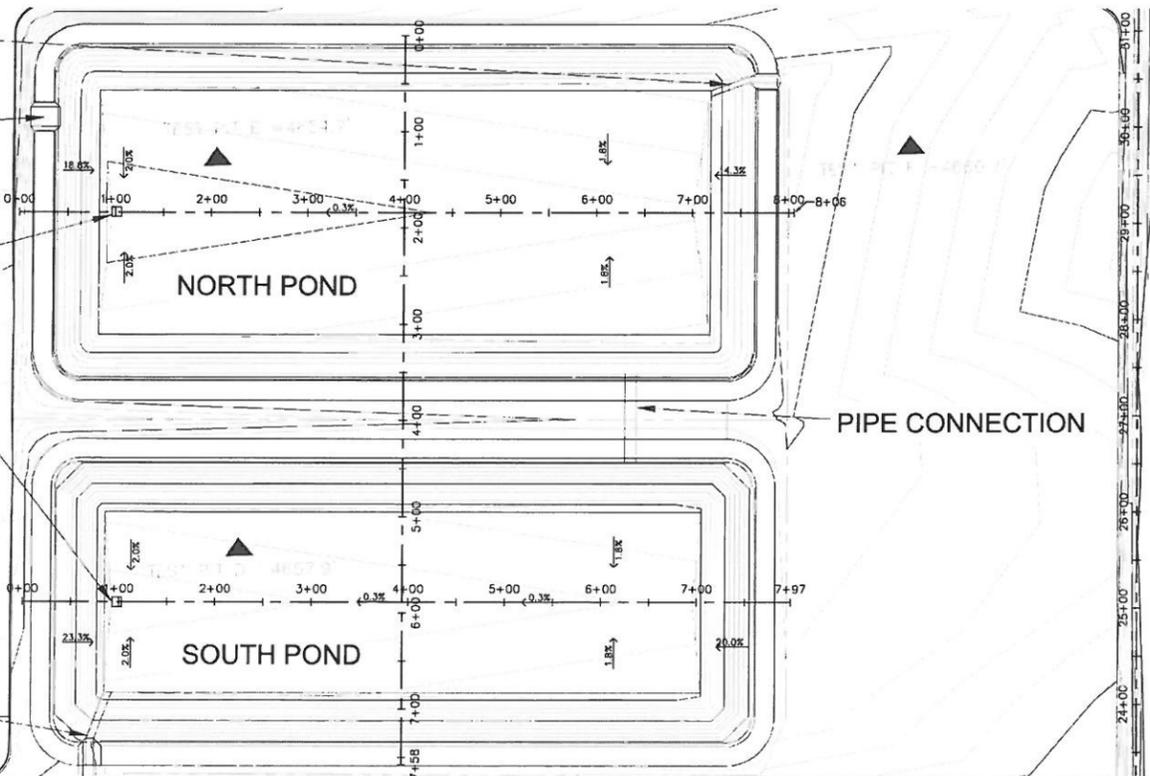


CHANNEL INLET W/ EROSION PROTECTION

EMERGENCY SPILLWAY

LEAK DETECTION COLLECTION PIT

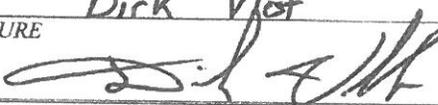
CHANNEL INLET W/ EROSION PROTECTION



Nutrient Management and Operations/Maintenance Plan

**Smith Valley Dairy
Lyon County, Nevada
CAFO Nutrient Management (NMP) and Operations/Maintenance Plan**

I. GENERAL INFORMATION			
Facility Name:	Smith Valley Dairy	Lat/Long:	38.87, -119.38
Owner/Operator:	Dirk Vlot		
Facility Physical Address:	40 Hunewill Lane		
City:	Wellington	State:	Nevada
		Zip Code:	89444
Facility Phone:	N/A	Email/Cell No.:	Valvlot7@aol.com; 559-731-3475

CERTIFICATION STATEMENT	
<p><i>I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.</i></p>	
A. NAME AND OFFICIAL TITLE (PRINT OR TYPE)	B. PHONE NUMBER
Dirk Vlot	559 731-3475
C. SIGNATURE	D. DATE SIGNED
	9/3/13

II. NUTRIENT MANAGEMENT PLAN INFORMATION¹	
NMP Public Notice Date: _____	NMP Approval Date: _____
NMP Implementation Date: _____	NMP Revision Date ² : _____
Permit Expiration Date: _____	
<p>¹To be used by NDEQ if desired.</p> <p>²Note to CAFOs: To revise an NMP, the CAFO must provide the NDEQ the most current version of the NMP and identify changes from the previous version (preferably in track changes or otherwise highlighted and clearly identified). The Ag Program will review the revised NMP to ensure that it meets applicable requirements including effluent standards. If the NMP changes necessitate revision to the terms incorporated into the CAFO's permit, the NDEQ will determine if such changes are substantial as described in by state regulations.</p> <p>If the changes are deemed to be non-substantial, the NDEQ will revise the terms of the NMP that are already incorporated into the permit, notify the owner or operator, and inform the public of such changes (public notice not required). The revised NMP will then be added to the permit record.</p> <p>If the changes to the terms of the NMP are deemed substantial, the DNEQ will provide public notice regarding the proposed changes. Information submitted by the CAFO in support of the NMP changes will be available for public review and comment upon request during this time. Once changes to the terms of the NMP are incorporated into the permit, the NDEQ will notify the CAFO and inform the public of the final decision concerning changes to the terms and conditions of the permit.</p> <p>ASSOCIATED RECORDS: A current and approved version of the Nutrient Management Plan is kept on-site at the permitted facility at all times.</p>	

III. STORAGE OF MANURE AND PROCESS WASTEWATER

Adequate storage of manure and process wastewater is maintained, including the implementation of procedures to ensure proper operation and maintenance of the impoundments and tanks.

The following procedures are followed by the facility:

- (A) Except during the designed storm event, manure and process wastewater stored in impoundments and terminal tanks is removed as necessary to maintain a minimum of two feet of freeboard.
- (B) Whenever the design capacity of impoundments and tanks is less than the volume required to store runoff from the designed storm event, the structures are dewatered to a level that restores the required capacity as soon as soils on a land application site have the water holding capacity to receive process wastewater.

Storage Needs

Process wastewater volume generated annually by the facility: 31 million gallons

Process Wastewater Storage Information

Impoundment/ Tank/Drainage Basin ID	Total Capacity Required to Hold all Wastes Accumulated During the Storage Period (acre-feet)	Total Capacity Required to Contain Storm Event Runoff and Direct Precipitation (acre-feet)	Total Capacity Available (acre-feet)
North & South Ponds	54.9 (Nov-Mar)	15.3	71

Manure Storage Information:

Manure Storage Area ID	Amount of Manure Produced (tons/year)	Total Amount of Non-Pen Area Manure Storage Available (estimated tons)
Compost/Manure Storage	29,417	150,000

Manure is transferred to a third party? Yes No Initially not, but as facility grows, manure may be given away.

Note: Manure may be stockpiled in and around pens and anyplace on the facility that drains to an impoundment.

ASSOCIATED RECORDS:

The facility maintains the following records to ensure adequate storage of manure and process wastewater:

- 1) This NMP documents the current design of all manure storage structures, including volume of solids accumulation, design treatment volume, total design volume, and approximate number of days of storage capacity.
- 2) Records documenting that manure and process wastewater stored in impoundments are removed (i.e. pumping records) as necessary to maintain a minimum of two feet of freeboard.
- 3) The amount of manure taken by neighbors.

IV. ANIMAL MORTALITY MANAGEMENT

Animal mortalities (i.e., dead animals) are managed to prevent discharge of pollutants to surface water. Mortalities remain on the production area until disposal and are managed to ensure that they are not disposed of in a liquid manure, storm water, or process wastewater storage system that is not specifically designed to treat animal mortalities.

Expected animal mortality rate: approximately 3-8%

Method of Animal Mortalities Handling (check all that are applicable):

- Composting (routine mortalities)
- Rendering (routine mortalities)
- Burial (catastrophic mortalities)
- Other: landfill (catastrophic mortalities)

Burial of mortalities will be in accordance with all federal, state, and local rules and regulations, and in accordance with NRCS Standard Code 316.

Mortality Storage Area ID	Drainage	Impoundment/ Tank/Drainage Basin ID
Compost/Manure Storage	<i>Drains to</i>	Collection Pit
	<i>Drains to</i>	
	<i>Drains to</i>	
	<i>Drains to</i>	

ASSOCIATED RECORDS:

The facility maintains the following records to document proper management of mortalities:

- 1) This NMP serves to document that animal mortalities are not disposed of in liquid manure, storm water, or process wastewater storage system that is not specifically designed to treat animal mortalities. Such records are maintained for a period of five years from the date created.

V. DIVERSION OF CLEAN WATER

Clean water is diverted, as appropriate, from the production area (i.e., from holding pens, manure and process wastewater storage systems, manure stockpiles, composting areas, etc.).

Clean water diversions used (check all that apply and indicate location where diversion is used):

- | | |
|--|---|
| | Location Used: |
| <input type="checkbox"/> Berms | _____ |
| <input type="checkbox"/> Channels | _____ |
| <input checked="" type="checkbox"/> Natural Topography | <u>Surrounding terrain is nearly flat</u> |
| <input checked="" type="checkbox"/> Other | <u>Perimeter farm road is raised 2 feet</u> |

ASSOCIATED RECORDS:

The facility maintains the following records to document appropriate diversion of clean water from production area:

- 1) Periodically inspect the production area and storm water run-on diversion devices and structures.

VI. PREVENTION OF DIRECT CONTACT OF ANIMALS WITH SURFACE WATER

Confined animals are prevented from having direct contact with surface water that is defined as waters of the United States.

Waters of the United States means, in part:

- a) All waters... susceptible to use in interstate or foreign commerce...;
- b) All interstate waters...;
- c) All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands¹ (including wetlands adjacent to waters identified in (a) through (e) of this definition), sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds the use, degradation, or destruction of which would affect or could affect interstate or foreign commerce including any such waters:
 - 1) Which are or could be used by interstate or foreign travelers for recreational or other purposes;
 - 2) From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or
 - 3) Which are used or could be used for industrial purposes...;
- d) All impoundments of waters otherwise defined as waters of the United States under this definition²; and
- e) Tributaries of waters identified in paragraphs (a) through (d) of this definition.

¹ Wetlands means those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

² Waste treatment systems, including treatment ponds or lagoons designed to meet the requirements of the federal Clean Water Act (other than cooling ponds as defined in 40 CFR 423.11(m) which also meet the criteria of this definition) are not waters of the U.S. This exclusion applies only to manmade bodies of water which neither was originally created in waters of the U.S. (such as disposal area in wetlands) nor resulted from the impoundment of waters of the U.S.

1. Waters of the United States flow through the production area? Yes No
2. Animals have access to waters of the United States? Yes No
3. If yes, list the measures (e.g. fencing) used in the production area to prevent direct contact of animals with waters of the United States: _____

Note: The facility is located in a self contained drainage basin which is isolated from waters of the US

ASSOCIATED RECORDS:

The facility maintains the following records to document that animals are prevented from direct contact with waters of the United States:

- 1) This NMP serves to document the prevention of direct contact of confined animals with waters of the U.S.

VII. CHEMICAL OIL HANDLING

Chemicals are properly handled on-site and are not disposed of in any manure, storm water, or process wastewater storage system unless specifically designed to treat such chemicals and other contaminants. See the attached document regarding manure/wastewater spill containment.

Chemical disposal location: Oils and petroleum products are not stored at the dairy

- Chemicals are used and empty containers are disposed of in accordance with manufacturer's guidelines
- No chemicals are used at the facility
- Other: _____

Chemicals storage location: N/A

- Chemicals are not stored in a room with a floor drain that discharges outside (i.e., into the production area)
- Storage is covered
- Storage has secondary containment
- Chemicals are stored in proper containers
- Other: _____

ASSOCIATED RECORDS:

The facility maintains the following records to demonstrate proper handling of chemicals:

- 1) This NMP serves to document that chemicals handled on-site are not disposed of in any manure, storm water, or process wastewater storage system unless specifically designed to treat such chemicals.

VIII. CONSERVATION PRACTICES

Site-specific conservation practices are identified and implemented to control runoff of pollutants to surface water.

Conservation practices include, but are not limited to the following:

- It is recommended that solid manure be incorporated into the soils as soon as possible after application, unless the application site has perennial vegetation or is no-till cropped.
- Application of process wastewater to furrow- or flood-irrigated land application sites is done in a manner that prevents any process wastewater runoff into surface waters.
- When process wastewater is sprinkler-applied, the water holding capacity of the soil is not exceeded.
- Nutrients shall not be applied to frozen, snow-covered, or saturated soils if the potential risks for runoff exist.
- Waste should not be applied on soils that frequently flood during the period when flooding is expected.
- Avoid winter application for spring seeded crops.
- Air temperature must be >50 degrees F for 7 days before incorporation and the rate shall not be made on frozen/snow-covered ground.
- Manure or process wastewater is not applied within 200 feet of domestic water supply wells.

The facility implements the following best management practices to control runoff of pollutants to surface water. (check all that apply)

Conservation Practice	*Land Application Site ID Where Practice is Implemented
<input type="checkbox"/> Buffer	
<input checked="" type="checkbox"/> Setback	All fields have a minimum 35' setback from ditches where water is able to run into a public ditch.
<input checked="" type="checkbox"/> Conservation Tillage	Cover crops and strip tillage are utilized on fields
<input type="checkbox"/> Constructed Wetland	
<input type="checkbox"/> Infiltration Field	
<input type="checkbox"/> Grass Filter	
<input type="checkbox"/> Terrace	
<input checked="" type="checkbox"/> Tail Water Pit	F 1-5
<input type="checkbox"/> Process wastewater is not allowed to reach end of field	
<input type="checkbox"/> Other (describe):	
<input type="checkbox"/> Other (describe):	
<input type="checkbox"/> Other (describe):	

*For land application sites where surface water is located in or down-gradient of the site.

ASSOCIATED RECORDS:

The facility maintains the following records to document site-specific conservation practices:

- 1) This NMP serves to document that site-specific conservation practices have been identified and implemented to control runoff of pollutants to surface water.

IX. SAMPLING & TESTING OF MANURE, PROCESS WASTEWATER AND SOIL

Manure and soil are analyzed according to the schedule below. The results are used to determine application rates for manure and process wastewater. The following protocols are used to ensure appropriate sampling and testing of manure, process wastewater and soil.

Manure is transferred to a third party? Yes¹ No

Process wastewater is transferred to a third party? Yes¹ No

	Required Sampling Frequency	Required Analysis	Sampling Protocol	Testing Protocol
Manure⁵	Annually	Total Nitrogen Ammonia-N Nitrate-N (NPDES) Total Phosphorus Total Potassium Percent Solids	<input checked="" type="checkbox"/> USU testing lab <input type="checkbox"/> Other <i>Specify:</i>	Lab certified through the state of Nevada laboratory certification program
Process Wastewater⁵	Annually	Total Nitrogen Ammonia-N Nitrate-N (NPDES) Total Phosphorus Total Potassium Percent Solids	<input checked="" type="checkbox"/> USU testing lab <input type="checkbox"/> Other <i>Specify:</i>	Lab certified through the state of Nevada laboratory certification program
Soil Nitrate	Annually ⁶	Nitrate in necessary depth zone(s)	<input checked="" type="checkbox"/> USU testing lab ⁴ <input type="checkbox"/> Other <i>Specify:</i>	Lab certified through the state of Nevada laboratory certification program or a NAPT-PAP certified lab if a suitable state lab cannot be found.
Soil pH, EC, OM, Phosphorus, potassium, sodicity if sodium is a concern	Annually ⁶	³ Phosphorus in necessary depth zone(s)	<input checked="" type="checkbox"/> USU testing lab ⁴ <input type="checkbox"/> Other <i>Specify:</i>	Lab certified through the state of Nevada laboratory certification program or a NAPT-PAP certified lab if a suitable state lab cannot be found.

¹ Note to CAFOs: Prior to transferring manure or process wastewater to other persons, Large CAFOs must provide the recipient of the manure or process wastewater with the most current nutrient analysis. Large CAFOs must retain for five years records of the date, recipient name and address, and approximate amount of manure or process wastewater transferred to another person.

² Manure and process wastewater are sampled and tested for nitrate annually, but an average nutrient value may be used for calculating land application rates once it is established.

³ Appropriate soil sampling depths for phosphorus will be 1 foot for conducting the Phosphorus index risk assessment but may be shallower for no-till or perennial forage phosphorus application determination.

⁴ Soil will be routinely sampled to 1 foot for annual crops or 6" for perennial grass and no-till.

⁵ Listed are NRCS required analytes for land application of nutrients. Per terms of the permit, fecal coliforms in manure and wastewater, and pH, chlorides, TDS, TSS, and BOD₅ of wastewater may also need to be monitored. If all manure is given away, it should be analyzed for Total N, Total P and fecal coliforms. See permit Factsheet for specifics.

⁶ Soil may be sampled once every 5 years in fields with perennial crops or the same crop as the previous year. Facilities which are obtaining a EPA NPDES discharge permit will sample all fields receiving manure and wastewater annually prior to application.

ASSOCIATED RECORDS:

The facility maintains the following records to document manure, process wastewater and soil testing:

- 1) The references for protocols used for appropriate sampling and testing of manure, process wastewater and soil are maintained on-site for at least five years from the date created.
- 2) Results from sampling and testing of manure, process wastewater and soil are maintained on-site for at least five years from the date created.

X. LAND APPLICATION

Land application of manure or process wastewater is done in accordance with site-specific nutrient management practices that ensure appropriate agricultural utilization of the nutrients in the manure or process wastewater.

Map(s) of land application sites are included in **Appendix A**.

Fields utilized for land application of manure and/or process wastewater are listed in Table B-1 in **Appendix B**.

Intended crops for each land application field are listed in Table B-2 in **Appendix B**. However, any crop listed might be planted, as determined by economics, field conditions at planting, and expected irrigation water availability.

Yield goals for each crop are included in **Appendix C** and are based upon historical yield data, soil productivity information, climatic conditions, nutrient test results, level of management, and local research results considering comparable production conditions, industry-demonstrated yield, and nutrient utilization information.

The methodology outlined in this section is adhered to each year in order to determine nutrient application rates, as a term of the permit. Nutrient applications and field nutrient balances are projected for the next five years, but these projections are for planning purposes only.

The basic application rates are determined in accordance with NRCS Code 590, or as otherwise listed in **Appendix D** and are based on the following:

- The amount of N and P in the manure that will be plant available is determined using one of the fertilizer suggestions for each crop.
- Nitrogen application rates (commercial fertilizer + plant available manure N) will not exceed crop N requirements (listed in Table 3), plus additional N needs, minus N credits:

$$\begin{array}{r} \text{Gross N Recommendation} \\ + \text{ Extra N Needed} \\ - \text{ Past Year Legume N Credit} \\ - \text{ Past 2 Years Manure N Credit} \\ - \text{ Organic Matter N Credit} \\ - \text{ Soil Residual Nitrate} \\ \hline \text{Total N Application} \\ \text{(Manure + Commercial Fertilizer)} \end{array}$$

- Nitrogen credits including past year legume credits, past 2 years manure credits, organic matter credit, and soil residual N will be determined in accordance with NRCS Code 590, or other sources as listed in **Appendix D**, for each crop.
- Nitrogen needs might include nitrogen to mineralize high residue from the previous crop, for grazing a grain crop, as a starter where no fertilizer is required, or to fertilize a second crop grown and harvested in the same crop year.
- Given the variable mineralization potential of manure and losses of soil nitrate, it is not uncommon to need to adjust nitrogen applications during the growing season. **Appendix D** outlines tools and methods that might be used.
- The outcome of field-specific assessment of potential for nitrogen and phosphorus transport to surface water for each field, using the USDA, NRCS Phosphorus Index Risk Assessment tool or other Division-approved method. The Nevada Phosphorus Index Risk Assessment is detailed in **Appendix E**.
- Application calculations are included in **Appendix F**, including projected manure and process wastewater applications and field nutrient balances for five years.

ASSOCIATED RECORDS:

The facility maintains the following records to document land application in accordance with site-specific nutrient management practices:

- 1) Documentation demonstrating that protocols established for land application of manure or process wastewater is conducted in accordance with site-specific nutrient management practices (allowable land application rate calculations).
- 2) Calculation records demonstrating appropriate agricultural utilization of the nutrients in the manure or process wastewater (dates, rates, and N or P applied).
- 3) Crops grown, management problems, and yields for each field.
- 4) Weather conditions during land application.

XI. LAND APPLICATION EQUIPMENT INSPECTIONS

Manure and process wastewater is applied as uniformly as possible with properly calibrated equipment.

- 1) Nutrient application equipment is calibrated at least annually? Yes No
- 2) Method(s) of process wastewater application? Pivot, Sideroll sprinklers
- 3) Method(s) of manure application? Truck mounted box spreader
- 4) Nutrient application equipment is inspected within the six month period prior to the first application of manure or process wastewater (required for NPDES permits)? Yes No N/A
- 5) Nutrient application equipment is inspected daily when wastewater is being applied (required for NPDES permits)? Yes No N/A

ASSOCIATED RECORDS:

The facility maintains the following records to document equipment inspections:

- 1) Records documenting the date of periodic leak inspections of equipment used for land application of manure or process wastewater.

XII. SETBACK REQUIREMENTS

Manure and process wastewater setbacks, where manure and wastewater are not applied, are as follows:

- 1) A 35' setback is used between land application sites and any down-gradient surface waters of the state, open tile line intake structures, sinkholes, agricultural wellheads, or other conduits to surface waters of the state.
- 2) A 100' setback or 35-foot vegetated buffer is used between land application sites and all down-gradient water of the U.S., open tile intake structures, sinkholes, agricultural wellheads, or other conduits to waters of the U.S. (required for NPDES permits)
- 3) A 200' setback setback is used between land application sites and domestic wellheads.

The following combination of setbacks, buffers and/or approved alternatives are used, as indicated below:

	Compliance Practice Implemented [(1) or (2) above]:	Land Application Site ID Where Practice is Implemented ¹ :
Down-gradient Surface Waters	1	SM3
Open Tile Line Intake Structure		
Sinkholes		
Agricultural Wellheads	1	SH3, F5
Other Conduits to Surface Waters	3	F4/5, H1, SH1, SH3, SM1, SM5

¹Only identify fields in which a specific buffer must be maintained because of the proximity of the feature to the land application site. Do not identify naturally occurring setbacks or buffers.

ASSOCIATED RECORDS:

The facility maintains the following records to document setback requirements:

- 1) This NMP serves to document setbacks used.
- 2) Maintain records of Department approval of any setback alternatives.

APPENDIX A

NUTRIENT MANAGEMENT PLAN TERMS (1 – 6)

1) LAND APPLICATION FIELD MAPS & SOIL SURVEY

CONSERVATION PRACTICES/SETBACKS

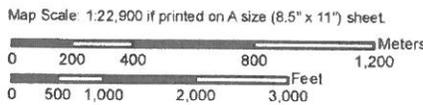
The attached map depicts overall land application sites, surface water features, and buffer needs. As the facility is developed, pivots will be installed on some fields, or fields may be subdivided into management units. Therefore spreadable acreages of each field may change, but total acreage will not. On site records will be kept reflecting these changes.

Fields F1-5 all drain to farm ditches that flow to the tailwater pond in the NW corner of the property. No runoff enters off-site (public) ditches. Tile drains on this field drain to the tailwater pond.

Where rainfall runoff flows into a public ditch, 35' waste application setbacks will be maintained. Manure and wastewater will not be applied over a public ditch.

Several wells within land application sites are identified on the buffer map. 35' and 200' setbacks from irrigation and drinking water wells, respectively, will be maintained.

Soil Map—Lyon County Area, Nevada
(Cowifornia Dreamen Land App Sites)



MAP LEGEND

	Area of Interest (AOI)		Very Stony Spot
	Soils		Wet Spot
	Soil Map Units		Other
	Special Point Features	Special Line Features	
	Blowout		Gully
	Borrow Pit		Short Steep Slope
	Clay Spot		Other
	Closed Depression	Political Features	
	Gravel Pit		Cities
	Gravelly Spot		PLSS Township and Range
	Landfill		PLSS Section
	Lava Flow	Water Features	
	Marsh or swamp		Streams and Canals
	Mine or Quarry	Transportation	
	Miscellaneous Water		Rails
	Perennial Water		Interstate Highways
	Rock Outcrop		US Routes
	Saline Spot		Major Roads
	Sandy Spot		Local Roads
	Severely Eroded Spot		
	Sinkhole		
	Slide or Slip		
	Sodic Spot		
	Spoil Area		
	Stony Spot		

MAP INFORMATION

Map Scale: 1:22,900 if printed on A size (8.5" x 11") sheet.
 The soil surveys that comprise your AOI were mapped at 1:24,000.
 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 11N NAD83

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

Soil Survey Area: Lyon County Area, Nevada
 Survey Area Data: Version 8, Sep 17, 2012
 Date(s) aerial images were photographed: 7/12/2006

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.

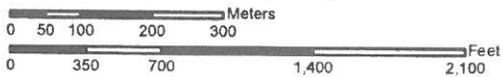
Map Unit Legend

Lyon County Area, Nevada (NV625)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
321	Haybourne loam	355.8	15.1%
353	Hotsprings gravelly loamy coarse sand, 0 to 2 percent slopes	242.8	10.3%
354	Hotsprings-Holbrook complex, 2 to 4 percent slopes	24.1	1.0%
451	Obanion loamy coarse sand	249.5	10.6%
452	Obanion sandy loam, drained	204.3	8.7%
453	Obanion sandy loam, saline-alkali	72.2	3.1%
561	Rebel sandy loam, 0 to 2 percent slopes	947.0	40.2%
613	Sagoupe loam, wet	42.5	1.8%
625	Saralegui sandy loam, 0 to 2 percent slopes	4.9	0.2%
626	Saralegui loamy sand, undulating	12.1	0.5%
741	Wedertz-Wellington-Saralegui complex, 0 to 2 percent slopes	148.0	6.3%
742	Wedertz-Wellington coarse sandy loams, 2 to 4 percent slopes	54.3	2.3%
Totals for Area of Interest		2,357.5	100.0%

Soil Map—Lyon County Area, Nevada
(Cowifornia Dreamen Land App Site Sec 26/23)



Map Scale: 1:9,730 if printed on A size (8.5" x 11") sheet.



MAP LEGEND

	Area of Interest (AOI)		Very Stony Spot
	Soils		Wet Spot
	Soil Map Units		Other
Special Point Features			
	Blowout		Gully
	Borrow Pit		Short Steep Slope
	Clay Spot		Other
	Closed Depression		Political Features
	Gravel Pit		Cities
	Gravelly Spot		Water Features
	Landfill		Streams and Canals
	Lava Flow		Transportation
	Marsh or swamp		Rails
	Mine or Quarry		Interstate Highways
	Miscellaneous Water		US Routes
	Perennial Water		Major Roads
	Rock Outcrop		Local Roads
	Saline Spot		
	Sandy Spot		
	Severely Eroded Spot		
	Sinkhole		
	Slide or Slip		
	Sodic Spot		
	Spoil Area		
	Stony Spot		

MAP INFORMATION

Map Scale: 1:9,730 if printed on A size (8.5" x 11") sheet.
The soil surveys that comprise your AOI were mapped at 1:24,000.

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 11N NAD83

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

Soil Survey Area: Lyon County Area, Nevada
Survey Area Data: Version 8, Sep 17, 2012

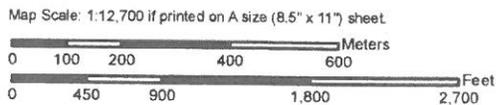
Date(s) aerial images were photographed: 7/12/2006

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.

Map Unit Legend

Lyon County Area, Nevada (NV625)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
451	Obanion loamy coarse sand	98.1	23.9%
452	Obanion sandy loam, drained	15.4	3.7%
453	Obanion sandy loam, saline-alkali	104.6	25.4%
561	Rebel sandy loam, 0 to 2 percent slopes	18.1	4.4%
626	Saralegui loamy sand, undulating	15.0	3.6%
741	Wedertz-Wellington-Saralegui complex, 0 to 2 percent slopes	156.4	38.0%
1145	Water	3.8	0.9%
Totals for Area of Interest		411.4	100.0%

Soil Map—Lyon County Area, Nevada
(Smith Ranch)



MAP LEGEND

	Area of Interest (AOI)		Very Stony Spot
	Soils		Wet Spot
	Soil Map Units		Other
	Blowout	Special Line Features	
	Borrow Pit		Gully
	Clay Spot		Short Steep Slope
	Closed Depression		Other
	Gravel Pit	Political Features	
	Gravelly Spot		Cities
	Landfill		PLSS Township and Range
	Lava Flow		PLSS Section
	Marsh or swamp	Water Features	
	Mine or Quarry		Streams and Canals
	Miscellaneous Water	Transportation	
	Perennial Water		Rails
	Rock Outcrop		Interstate Highways
	Saline Spot		US Routes
	Sandy Spot		Major Roads
	Severely Eroded Spot		Local Roads
	Sinkhole		
	Slide or Slip		
	Sodic Spot		
	Spoil Area		
	Stony Spot		

MAP INFORMATION

Map Scale: 1:12,700 if printed on A size (8.5" x 11") sheet.
 The soil surveys that comprise your AOI were mapped at 1:24,000.
 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 11N NAD83

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

Soil Survey Area: Lyon County Area, Nevada
 Survey Area Data: Version 8, Sep 17, 2012
 Date(s) aerial images were photographed: 7/12/2006

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.

Map Unit Legend

Lyon County Area, Nevada (NV625)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
451	Obanion loamy coarse sand	13.8	2.1%
561	Rebel sandy loam, 0 to 2 percent slopes	32.4	5.1%
613	Sagouspe loam, wet	19.3	3.0%
741	Wedertz-Wellington-Saralegui complex, 0 to 2 percent slopes	233.0	36.4%
742	Wedertz-Wellington coarse sandy loams, 2 to 4 percent slopes	341.3	53.4%
Totals for Area of Interest		639.7	100.0%

APPENDIX B

NUTRIENT MANAGEMENT PLAN TERMS

2) LAND APPLICATION INFORMATION

NMP TERMS - 2) LAND APPLICATION FIELDS

All land application fields are listed below.

Table B-1-a – Land Application Fields

Field Identification	Latitude¹	Longitude²	Spreadable Acres³
F1	38.8764	-119.3969	55
F2	38.8729	-119.3970	55
F3	38.8695	-119.3948	19
F4	38.8728	-119.3892	217
F5	38.8610	-119.3892	231
SH1	38.8640	-119.3800	154
SH2	38.8565	-119.3804	160
SH3	38.8492	-119.3804	160
SH4	38.8459	-119.3777	40
SM1	38.8660	-119.3599	(25)
SM2	38.8630	-119.3605	(25)
SM3	38.8590	-119.3627	(70)
SM4	38.8592	-119.3558	(70)
SM5	38.8547	-119.3639	(40)
SM6	38.8547	-119.3591	(40)
SM7	38.8547	-119.3543	(40)
SMITH RANCH (SM) TOTAL*			385
H	38.8723	-119.3793	160
Total			1636

¹Enter latitude in decimal degrees.

²Enter longitude in decimal degrees [number should be negative (eg. -104.3315)].

³Field acreages reduced by any setbacks, buffers, or otherwise unspreadable areas.

***Smith Ranch acreages are for current configuration of fields. Pivots will be installed, utilizing more ground. This acreage indicates the maximum acreage which may be available for land application as the fields change size.**

Table B-1-b – Major soil properties

Field	Map Unit	Soil Component Name	Surface Texture	Slope Range (%)	Water Table* (cm)	Drainage Class	Available Water Holding Capacity Top 150 cm (5 feet) (cm)	KSat 0-50 cm (0-20 in) (Micro m/sec)	Salinity (mmhos/cm)
F1-4	451	Obanion	lcos	0-2	38	Poor	23	51.7274	0-4
“	452	Obanion	sl		84	Very poor	24	16.5902	0-4
F5	561	Rebel	sl	0-2	>200	Well	19.3	28	0
SH1	613	Sagouspe	l, wet	0-2	77	Somewhat poor	15.3	59.4510	0-2
“	321	Haybourne	l	0-2	>200	Well	16	17.5686	0
SH2	321	Haybourne	l	0-2	>200	Well	16	17.5686	0
“	742	Wedertz-Wellington	cosl	2	>200	Well	13.6	14.1098	0
SH3-4	561	Rebel	sl	0-2	>200	Well	19.3	28	0
“	321	Haybourne	l	0-2	>200	Well	16	17.5686	0
H	451/3	Obanion	lcos/sl, saline/alk	0-2	38	Poor	23-25	51/16	0-4 8-16
“	741	Wedertz-Wellington-Saralegui complex	cosl	0-2	>200	Well	13.7	14.1098	0-2
SM1-7	742	Wedertz-Wellington	Cosl	2-4	>200	Well	13.6	14.098	0

* NA=No water table Coarse textured soils are sands, loamy sands, sandy loams. Medium-textured soils are silts, silt loams, loams, sandy clay loams. Fine textured are sandy clays, clay loams, silty clay loams, silty clays, and clays.

NMP TERMS - 2) LAND APPLICATION CROPS

Potential crops or other uses for each land application field are listed below.

Table –B-2 – Potential Land Application Field Crops

Field Identification	Crop	Realistic Yield Goal	Yield Unit (bushels, tons, etc.)	Source (see Appendix C)
All	Alfalfa	6.5	tons	Farm records
All	Corn Silage	28	tons	NASS * 1.1
All	Corn Grain	162	bu	NASS * 1.1
All	Grass	5	tons	Farm records
All	Wheat	107	bu	NASS * 1.1
All	Small grain haylage	3.3 DM/8.25 Wet	tons	NASS * 1.1
All	Sorghum Silage	20	tons	CSU 568A
All	Spring Small Grain	107	bu	NASS * 1.1

APPENDIX C

NUTRIENT MANAGEMENT PLAN TERMS

3) EXPECTED CROP YIELD INFORMATION

Yield goals are based upon a variety of sources and are indicated in Table B-2:

Most yield goals in Table B-2 are based upon Ag Statistics (NASS) for the state and crop – 2-5 years of data + 10%, or upon farm data

Calculations will be used if a grain yield goal is known but not a forage yield goal for the same crop, based upon the following data:

Olsen Lab – “Guidelines for Fertilizer Recommendations, Plant Tissue Analysis, and Water Analysis”

Forage sorghum yield goal (t/a) x 20 = grain yield

Sorghum silage yield goal (t/a) x 6 = grain yield

Servi-Tech Lab (Crop File 1.02.022)

Small grain hay (t/a) x 14 = grain yield

Small grain silage (t/a) x 6 = grain yield

APPENDIX D

NUTRIENT MANAGEMENT PLAN TERMS

3) NUTRIENT BUDGET INFORMATION

Formulas for gross nitrogen needs are provided using recommendations from Cooperative Extension publications. Recommendations from Stukenholtz Lab or A&L Western Lab may also be used as printed on the soil test reports. These laboratories are regionally based in Idaho and California, respectively.

Soil nitrate from 0-12" will be subtracted from the gross nitrogen need, as will mineralization of nitrogen from manure and wastewater applied in the previous year, unless it is accounted for in the year of application. Organic matter credits will be given at a rate of 30 lbs N/% organic matter.

Manure will be sampled annually and wastewater will be sampled per permit requirements. Plant available nitrogen will be determined using nutrient availability as identified in Appendix D of this NMP. The laboratory's plant available assessment, as indicated on the lab results, may also be used.

4) NUTRIENT BUDGET INFORMATION

Formulas for calculating nutrient budgets:

4) NUTRIENT BUDGET INFORMATION

Cooperative Extension Nutrient Budget Information:

Crop:	Manure and Process Wastewater Application Rate Calculated Using:	Description of Method to be Used (calculation, look-up table, etc.):
Corn Silage	<input checked="" type="checkbox"/> CSUCE Published Fertilizer Suggestions <input type="checkbox"/> Adjacent State CE-Published Fertilizer Suggestions <input type="checkbox"/> CNMP Method that meets USDA-NRCS standards <input type="checkbox"/> CO NRCS NMP guidelines <input type="checkbox"/> Department-approved Method	$35 + (7.5 * YG \text{ (tons/a)})$ Tables 7a. CSU Bulletin #568A
Corn Grain	<input checked="" type="checkbox"/> CSUCE Published Fertilizer Suggestions <input type="checkbox"/> Adjacent State CE-Published Fertilizer Suggestions <input type="checkbox"/> CNMP Method that meets USDA-NRCS standards <input type="checkbox"/> CO NRCS NMP guidelines <input type="checkbox"/> Department-approved Method	$35 + (1.2 * YG \text{ (bu/acre)})$ Tables 7b. CSU Bulletin #568A
Sorghum Silage	<input checked="" type="checkbox"/> CSUCE Published Fertilizer Suggestions <input type="checkbox"/> Adjacent State CE-Published Fertilizer Suggestions <input type="checkbox"/> CNMP Method that meets USDA-NRCS standards <input type="checkbox"/> CO NRCS NMP guidelines <input type="checkbox"/> Department-approved Method	$9 * YG \text{ (tons/A)}$ Tables 7d. CSU Bulletin #568A
Sorghum Grain	<input checked="" type="checkbox"/> CSUCE Published Fertilizer Suggestions <input type="checkbox"/> Adjacent State CE-Published Fertilizer Suggestions <input type="checkbox"/> CNMP Method that meets USDA-NRCS standards <input type="checkbox"/> CO NRCS NMP guidelines <input type="checkbox"/> Department-approved Method	$1.2 * YG \text{ (lbs/A)}$ Tables 7c. CSU Bulletin #568A
Small Grain Hay & Silage	<input checked="" type="checkbox"/> CSUCE Published Fertilizer Suggestions <input type="checkbox"/> Adjacent State CE-Published Fertilizer Suggestions <input type="checkbox"/> CNMP Method that meets USDA-NRCS standards <input type="checkbox"/> CO NRCS NMP guidelines <input type="checkbox"/> Department-approved Method	$\text{yield goal (lbs/a DM)} * (\% \text{ protein}/6.25/100)$ multiply silage yield by 0.4 to get dry matter of silage Crop Removal Where protein is not known, 9% is used (KSU Bulletin MF-2227)
Oat Hay & Silage	<input checked="" type="checkbox"/> CSUCE Published Fertilizer Suggestions <input type="checkbox"/> Adjacent State CE-Published Fertilizer Suggestions <input type="checkbox"/> CNMP Method that meets USDA-NRCS standards <input type="checkbox"/> CO NRCS NMP guidelines <input type="checkbox"/> Department-approved Method	$YG \text{ (tons wet)} * 2000 \text{ lb/t} * 1.6\% \text{ N}/100$ Multiply silage yield by 0.4 to get dry matter of silage Crop removal, CSU 568A.
Spring Seeded Small Grain	<input checked="" type="checkbox"/> CSUCE Published Fertilizer Suggestions <input type="checkbox"/> Adjacent State CE-Published Fertilizer Suggestions <input type="checkbox"/> CNMP Method that meets USDA-NRCS standards <input type="checkbox"/> CO NRCS NMP guidelines <input type="checkbox"/> Department-approved Method	$125 \text{ lbs N per } 100 \text{ bu/A, minus } 20 \text{ lb N/a for each } 10 \text{ bu/A difference}$ CSU Do-It-Yourself Manure Mgt Plan
Winter Wheat Grain	<input type="checkbox"/> CSUCE Published Fertilizer Suggestions <input checked="" type="checkbox"/> Adjacent State CE-Published Fertilizer Suggestions <input type="checkbox"/> CNMP Method that meets USDA-NRCS standards <input type="checkbox"/> CO NRCS NMP guidelines <input type="checkbox"/> Department-approved Method	$YG \text{ (bu/a)} * 1.75$ KSU Bulletin C-529 Wheat Production Handbook, 1997

4) NUTRIENT BUDGET INFORMATION

Cooperative Extension Nutrient Budget Information:

Crop:	Manure and Process Wastewater Application Rate Calculated Using:	Description of Method to be Used (calculation, look-up table, etc.):
Alfalfa	<input type="checkbox"/> CSUCE Published Fertilizer Suggestions <input type="checkbox"/> Adjacent State CE-Published Fertilizer Suggestions <input checked="" type="checkbox"/> CNMP Method that meets USDA-NRCS standards <input type="checkbox"/> CO NRCS NMP guidelines <input type="checkbox"/> Department-approved Method	Yield Goal * 56.6 lbs N/ton Crop Removal, Nevada NRCS
Grass/hay or grass/legume	<input checked="" type="checkbox"/> CSUCE Published Fertilizer Suggestions <input type="checkbox"/> Adjacent State CE-Published Fertilizer Suggestions <input type="checkbox"/> CNMP Method that meets USDA-NRCS standards <input type="checkbox"/> CO NRCS NMP guidelines <input type="checkbox"/> Department-approved Method	185 lbs N/ton +/- 40 lbs N per ton for each ton yield goal more or less than a 4 ton yield goal. Reference is CSU 568A.

Suggested broadcast P application rates (lbs. P₂O₅/acre).*

	NaHCO ₃ -P (ppm)			
	0 - 6	7 - 14	15 - 22	>22
	lbs. P ₂ O ₅ /acre			
Corn, irrigated and dryland	80	40	0	0
Dry Beans	80	40	0	0
Sorghum	80	40	0	0
Potatoes	240	180	120	60
Sugarbeets	100	75	50	0
Sunflowers	80	40	0	0
Wheat	80	40	0	0
Alfalfa, irrigated				
new stand	200	150	50	0
established	100	75	0	0
Alfalfa, dryland				
new stand	60	40	0	0
established	45	30	0	0
Grass and grass legume mixtures				
new stand	80	40	0	0
established	80	40	0	0

* Band application rates for row crops are half of the suggested broadcast rate.

Phosphorus and Potassium Credits

90% of the P and 93% of the K in wastewater and manure is assumed to be available (NRCS, Nevada).

Nitrogen Credits

Available Nitrogen in Wastewater (CSU Bulletin 568A)

1st year N availability in wastewater, sprinkler applied (Organic N * 30%) + (NH₄-N * 55%)

1st year N availability in wastewater, flood applied (Organic N * 30%) + (NH₄-N * 78%)

2nd year N availability in wastewater (Organic N * 10%)

3rd year N availability in wastewater (Organic N * 7%)

Available Nitrogen in Manure (minimum values) (CSU personal communication, UN Nebguide G1335)

1st year N availability in manure (Organic N * 25%) + (NH₄-N * % available below)

2nd year N availability in manure (Organic N * 10%)

3rd year N availability in manure (Organic N * 7%)

Available Nitrogen in Slurry (minimum values) (CSU Bulletin 568A)

1st year N availability in fresh slurry (Organic N * 35%) + (NH₄-N * % available below)

2nd year N availability in slurry (Organic N * 15%)

3rd year N availability in slurry (Organic N * 7%)

Available Nitrogen in Compost (minimum values) (UCD Manure Technical Bulletin Series Manure N Mineralization, and UN Nebguide G1335)

1st year N availability in compost (Organic N * 10-20%) + (NH₄-N * % available below)

2nd year N availability in compost (Organic N * 5-10%)

3rd year N availability in compost (Organic N * 5-10%)

Research is varied in regards to compost mineralization, but the more mild climates of University of California and Oregon State University publications indicate that N mineralization from compost is from 0-10%. C:N ratio and % total N affect this. University of Nebraska indicates that mineralization is 18-20%. It is expected that in the first 5 years of operation, a 10% rate will be used. If total % N is >3%, it could be appropriate to use the higher number. After 5 years of manure and/or compost application to the new facility when a steady state of the organic N pool is reached, mineralization research and residual soil nitrate will be re-evaluated.

NH₄-N % available, solid manure, compost, and slurry (UN NebGuide G1335).

Inject or immediate incorporation – 95%

Incorporate within 1 day – 50-70%

Incorporate 2-5 days – 0-50%

Incorporate >5 days – 0%

The laboratory's plant available nutrient schedule may also be used. In fields which receive a similar amount of manure or wastewater each year, the 2 year mineralization rate may be added together and credited all in one year for simplicity.

Legume Credit- Previous crop, alfalfa

>80% stand 100-140 lbs N/A

60-80% stand 60-100 lbs N/A

<60% stand 30-60 lbs N/A

Additional nitrogen needs

Crop decomposition

Up to 20 lbs/A additional nitrogen may need to be applied to carbonaceous crop residues.

Starter fertilizer

Regardless of the recommendations for nutrient application, up to 35 lbs of N and 35 lbs P₂O₅ may be added as a starter fertilizer at or just prior to planting in order to ensure nutrient availability to seedlings, promoting a more vigorous plant more capable of utilizing nutrients already in the soil. Any commercial fertilizer applied will be counted towards the total recommendation and subtracted from the gross recommendation in the N credit section (“other”) of the rate determination sheet. If 35 lbs N are not required to grow the crop, this amount of starter will still be used.

Small grain grazing

Where small grains are fall grazed, additional nutrient needs based upon animal intake or a flat rate (30-50 lbs N/a) (CSU).

In Season N adjustments

The formulas provided represent the maximum amount of N to be applied with advanced planning. It is not uncommon for nitrogen rates to be adjusted during the growing season. The following outlines procedures which may be used to make in season adjustments. Only one test will be used at any given time of plant growth to provide a recommendation. However, additional tests may be used at other stages of crop growth. For instance, it is possible that a soil test at side dressing could indicate the soil is likely to have enough nitrogen to grow a crop, but a tissue test at the reproductive phase of growth could show the plant is now deficient in nitrogen and needs more N.

Pre-Sidedress Nitrate Test (PSNT)

1 foot soil samples are analyzed for nitrate when corn is 6 to 12” tall. Guidance documents from Cooperative Extension, either from CSU or from a surrounding state, will be used to interpret results.

Tissue testing

Plant samples will be analyzed for nitrogen at the appropriate time, and from the appropriate location on the plant for the given crop. The results will be compared with expected nitrogen content for the plant at the specified growth stage. Deficiencies will be managed with additional N.

Leaf chlorophyll meters & near infrared sensors

There are a number of meters on the market which detect the amount of chlorophyll in leaves. By comparing the chlorophyll meter readings from the reference strips to those from the rest of the field, N sufficiency and the need for additional N can be determined. Latest research will be used to interpret meter readings. Suggestions include: Pennsylvania State University’s tool may be used at first side dress when the corn is at the V6-V8 growth stages (Fact Sheet 53: *The Early Season Chlorophyll Meter Test for Corn*) and Purdue University’s tool may be used later in the season when the crop is at the V8-V12 growth stages through pollination (Fact Sheet: AY-317-W, *Determining Nitrogen Fertilizer Side dress Application Needs in Corn Using a Chlorophyll Meter*). Interpretation of NIR sensors will be made with the latest available data.

Visual analysis

Visual symptoms are an excellent diagnostic tool to determine nutrient limitations in crop fields. The visual characteristics displayed when plants are nutrient deficient vary by plant species and variety,

stage of growth, and severity of the deficiency, and they are well documented and available as a reference from numerous Extension and industry sources. Visual symptoms of nitrogen deficiency may be used to adjust nitrogen recommendations. Many factors will be taken into account to determine the need for nitrogen, including but not limited to unusual weather conditions, previous crop history, source and amount of nitrogen already applied, crop stage of growth, soil physical properties, disease, insect, herbicide injury, and other factors related to root growth. Typically 20-40 lbs N will be recommended.

Nitrogen reference strip

Several reference strips are established through the field where more than enough nitrogen has been applied and is known to not be limiting. These strips are established for comparison to potential problem spots in the field. It is useful to have reference strips when interpreting soil tests and tissue tests. It is crucial that reference strips be established for a chlorophyll meter be calibrated for each field, previous crop, hybrid, fertilizer and/or manure application and differing soil types. Reference strips vary in size and are dependent upon field characteristics and equipment size, but they are often 12,000 square feet for each 60 acres of crop of each hybrid. If the reference strip is developed using commercial fertilizer, it will receive 10-25% above the recommended rate for the field (Purdue University Fact Sheet AY-317-W), and if manure is used to produce the reference strip, it will be applied at 100% above the recommended rate (Iowa State University Fact Sheet PM 2026, *Sensing Nitrogen Stress in Corn*). This latter rate is appropriate because there are many sources of variability when using manure, and the reference strip must be fully fertilized.

APPENDIX E

NUTRIENT MANAGEMENT PLAN TERMS

5) FIELD ASSESSMENTS

A Phosphorus Index Risk Assessment is completed when bicarbonate P_2O_5 levels are greater than 50 ppm. No fields require a Phosphorus Index Risk Assessment at this time.

RUSLE2 and WEPS results for individual fields are attached if required for the Phosphorus Index Risk Assessment.

NRCS does not have a nitrogen leaching index at this time.

APPENDIX F

NUTRIENT MANAGEMENT PLAN TERMS

6) FIELD NUTRIENT BALANCE CALCULATIONS

Crop rotations are the currently planned rotations, but rotations vary based upon markets, field and climatic conditions, water availability, and the need for feed. Any crop in table B-2 may be planted, using the yield goals of Table B-2 and the formulas in Appendix D to determine agronomic balance, without the need for changes to the NMP. The Smith Ranch (fields SM 1-7) will change configuration (size) and crop as pivots are installed, therefore recommendations for combined fields planted to corn silage are also provided.

Starter fertilizer is planned, but when yearly calculations are done, starter fertilizer could be replaced with manure or wastewater by using the organic material to provide the same amount of nutrients that the recommendation is based upon.

The facility is new, and the amount of manure and wastewater will change in the next few years, as will application timing and method, and the use of starter fertilizer. This NMP spells out how nutrient balances will be developed and will be used in the event that applications or crops vary. Where the likelihood of either manure wastewater being applied was high, recommendations were made for both sources. Where it is low, recommendations were made for only one source.

The wastewater analysis used is an average from a large dairy facility located in Yerrington, NV (lbs/1000 gal).

NH₄-N – 1.94

Organic N – 4.35

Total P₂O₅ – 0.36

Manure analysis used is from Utah State University/Colorado State University Regional Publication Manure Best Management Practices, and CSU Bulletin 568A, Best Management Practices for Manure Utilization (lbs/ton).

NH₄-N – 5

Organic N – 8

Total P₂O₅ – 16

Method and timing of application of nutrients are provided on rate determination sheets.

Total Manure Production:

Table 4: Solid Manure Produced and Associated Nutrients											
<i>ASAE D384.1 - Dec 2001</i>				Moisture (%)	Manure (lbs. / day / 1000#)	Manure (ft ³ / day / 1000#)	TS (lbs. / day / 1000#)	VS (lbs. / day / 1000#)	Nitrogen (lbs. / day / 1000#)	Phosphorus (lbs. / day / 1000#)	Potassium (lbs. / day / 1000#)
Animal Type	Number of Hd	Wt./hd, lbs.	Total Wt., lbs.								
Milk Cows	3,200	1,400	4,480,000	86.0	86.0	1.40	12.0	10.0	0.45	0.094	0.29
Dry Cows	592	1,550	917,600	86.0	86.0	1.40	12.0	10.0	0.45	0.094	0.29
Springers	144	1,050	151,200	86.0	86.0	1.40	12.0	10.0	0.45	0.094	0.29
Heifers	3,312	750	2,484,000	86.0	86.0	1.40	12.0	10.0	0.45	0.094	0.29
Totals	7,248		8,032,800								
Total Daily Production					690,821	11,246	96,394	80,328	3,615	755	2,330
Total Annual Production					252,149,592	4,104,761	35,183,664	29,319,720	1,319,387	275,605	850,272
Manure produced w/ moisture content of				86.0%	126,075	tons					
Manure as hauled w/ moisture content of				46.0%	32,686	tons					
Compost produced w/ moisture content of				40.0%	29,417	tons					

Land Base Requirement:

200 acres of alfalfa or 330 acres of corn silage are needed to utilize the nutrients produced in parlor wastewater and runoff in an average rainfall year, and 2,648 acres of corn silage will be needed to utilize the nutrients in manure.

Land Application Requirements for Average Years' Stormwater & Process Water - Sprinkler Applied				
Maximum pumping requirement (68.3 A.F.), gallons		22,254,107		
Total Nitrogen contained in liquid, lbs.		89,016		**Total-N = 4.0 lbs./1,000 gal
Ammonium-Nitrogen contained in liquid, lbs.		44,508		**NH ₃ -N = 2.0 lbs./1,000 gal
Organic-Nitrogen contained in liquid, lbs.		44,508		Organic-N = 2.0 lbs./1,000 gal
Ammonium-Nitrogen available after irrigation, lbs.		24,480		45.0% Sprinkler-Irrigation loss**
Organic-Nitrogen available 3rd year, lbs.		20,919		47% Equilibrium mineralization rate for organic-N**
Nitrogen available to plants (PAN) yr. after yr., lbs.		45,398		
Soil Organic Matter, %	1.0			
Irrigation Water NO ₃ content, ppm	5.0			
Residual soil NO ₃ (2 ft), ppm	16.0		Alfalfa	Corn Silage
Expected Yield (grain, Bu/acre; silage, tons/acre)			6	28
N req. w/ listed O.M., soil N, & Irr. Water NO ₃ , (lb./acre)			225	137
Acres req. if effluent applied via sprinkler irrigation			202	331

Based on CSU Extension Bulletin #538 & #0.565

**Taken from CSU's Bulletin No. 568A *Best Management Practices for Manure Utilization*

Land Application Requirements - Solid Manure				
Nitrogen produced annually, 100% used, rest given		1,319,387		
Nitrogen loss during storage & handling, lbs.		527,755		40% lost as ammonia
Total Nitrogen in manure before application, lbs.		791,632		
Ammonium-Nitrogen contained in manure, lbs.		304,778		*NH ₄ -N = 38.5% of total N in solid manure
Organic-Nitrogen contained in manure, lbs.		486,854		*Organic-N = 61.5% of total N in solid manure
NH ₄ -N available after spreading (no incorporation), lbs.		236,203		*NH ₄ -N loss = 22.5% within 4 days of application
Organic-Nitrogen available 3rd year, lbs.		267,770		55% Equilibrium mineralization rate for organic-N*
Nitrogen available to plants (PAN) yr. after yr., lbs.		503,973		
Soil Organic Matter, %	1.0			
Irrigation Water NO ₃ content, ppm	5.0			
Residual soil NO ₃ (2 ft), ppm	16.0		Corn Silage	
Expected Yield (tons)			28	
N req. w/ listed O.M. & residual soil N, lb./acre			137	
Acres req.			3,680	

Based on CSU Extension Bulletin #538

*Taken from CSU's Bulletin No. 568A *Best Management Practices for Manure Utilization*

Farm: Smith Valley Dairy

Field: SH 1N

Soil test results	P (Olsen), ppm	K (NH4OAc), ppm	OM, %	EC (mmhos/cm)	pH
	6.26.13	11.3	5	142	1.8
	Application rate based upon Nitrogen				
P-Index Score	N/A				

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)		N Credits		Previous Manure (lbs/a)	Legume (lbs/a)	Commercial Fertilizer (lbs/a)	Recommended Nutrient Application Rate (lbs/acre)		Manure Type	Plant Available Manure Nutrients lbs/1000 gal or lb/ton		Manure Application Rate gallons/acre tons/a	Total Manure Applied per Field gallons tons
			N	P2O5	N	P2O5				N	P2O5		N	P2O5		
2014	CS	28	150	40	0	50	20	20	16	80	24	pond	2.37	0.33	33,890	2,609,533
2015	CS	28	150	40	15	0	20	20	16	116	24	pond	2.37	0.33	48,767	3,755,057
2016	CS	28	150	40	21	0	20	20	16	109	24	pond	2.37	0.33	46,036	3,544,806
2017	CS	28	150	40	20	0	20	20	16	110	24	pond	2.37	0.33	46,538	3,583,396
2018	CS	28	150	40	20	0	20	20	16	110	24	pond	2.37	0.33	46,446	3,576,313

Starter 10-8-4, 200#, wastewater applied in fall, spring, summer, via pivot or sprinkler. Double P for broadcast applications and retest following year.

Field: SH 1S

Soil test results	P (Olsen), ppm	K (NH4OAc), ppm	OM, %	EC (mmhos/cm)	pH
	6.26.13	11.3	5	142	1.8
	Application rate based upon Nitrogen				
P-Index Score	N/A				

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)		N Credits		Previous Manure (lbs/a)	Legume (lbs/a)	Commercial Fertilizer (lbs/a)	Recommended Nutrient Application Rate (lbs/acre)		Manure Type	Plant Available Manure Nutrients lbs/1000 gal or lb/ton		Manure Application Rate gallons/acre tons/a	Total Manure Applied per Field gallons tons
			N	P2O5	N	P2O5				N	P2O5		N	P2O5		
2014	CS	28	150	40	0	20	20	16	130	24	pond	2.37	0.33	54,987	4,234,025	
2015	CS	28	150	40	24	0	20	20	106	24	pond	2.37	0.33	44,895	3,456,894	
2016	CS	28	150	40	20	0	20	20	111	24	pond	2.37	0.33	46,747	3,599,532	
2017	CS	28	150	40	20	0	20	20	110	24	pond	2.37	0.33	46,407	3,573,352	
2018	CS	28	150	40	20	0	20	20	110	24	pond	2.37	0.33	46,470	3,578,157	

Starter 10-8-4, 200#, wastewater applied in fall, spring, summer, via pivot or sprinkler. Double P for broadcast applications and retest following year.

Field: SH 2

Soil test results	P (Olsen), ppm	K (NH4OAc), ppm	OM, %	EC (mmhos/cm)	pH
	6.26.13	4.5	3.3	99	1.6
	Application rate based upon Nitrogen				
P-Index Score	N/A				

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)		N Credits		Previous Manure (lbs/a)	Legume (lbs/a)	Commercial Fertilizer (lbs/a)	Recommended Nutrient Application Rate (lbs/acre)		Manure Type	Plant Available Manure Nutrients lbs/1000 gal or lb/ton		Manure Application Rate gallons/acre tons/a	Total Manure Applied per Field gallons tons
			N	P2O5	N	P2O5				N	P2O5		N	P2O5		
2014	CS	28	181	40	0	50	20	20	16	111	24	pond	2.37	0.33	46,751	7,480,169
2015	CS	28	181	40	20	0	20	20	16	140	24	pond	2.37	0.33	59,267	9,482,754
2016	CS	28	181	40	26	0	20	20	135	24	pond	2.37	0.33	56,970	9,115,191	
2017	CS	28	181	40	25	0	20	20	136	24	pond	2.37	0.33	57,392	9,182,655	
2018	CS	28	181	40	25	0	20	20	136	24	pond	2.37	0.33	57,314	9,170,272	

Starter 10-8-4, 200#, wastewater applied in fall, spring, summer, via pivot or sprinkler. Double P for broadcast applications and retest following year.

Farm: Smith Valley Dairy

Field: SH 1N

Soil test results	Date	NO ₃ -N	P (Olsen), ppm	K (NH ₄ OAc) ppm	OM	EC (mmhos/cm)	pH
	6.26.13	11.3	5	142	1.8	0.8	7.6
P-Index Score	Application rate based upon Nitrogen						
	N/A						

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)		N Credits		Previous Manure (lbs/a)	Legume (lbs/a)	Commercial Fertilizer (lbs/a)	Recommended Nutrient Application Rate (lbs/acre)		Manure Type	Plant Available Manure Nutrients lbs/1000 gal or lb/ton		Manure Application Rate gallons/acre tons/a	Total Manure Applied per Field gallons tons
			N	P2O5	N	P2O5				N	P2O5		N	P2O5		
2014	CS	28	150	40	0	50	0	20	16	80	24	Manure	4.5	14.4	18	1,374
2015	CS	28	150	40	14	0	14	20	16	116	24	Manure	4.5	14.4	26	1,986
2016	CS	28	150	40	21	0	21	20	16	110	24	Manure	4.5	14.4	24	1,877
2017	CS	28	150	40	20	0	20	20	16	111	24	Manure	4.5	14.4	25	1,896
2018	CS	28	150	40	20	0	20	20	16	111	24	Manure	4.5	14.4	25	1,893

Starter 10-8-4, 200#, manure applied in fall, spring, via spreader truck. Double P for broadcast applications and retest following year.

Soil test results	Date	NO ₃ -N	P (Olsen), ppm	K (NH ₄ OAc) ppm	OM	EC (mmhos/cm)	pH
	6.26.13	11.3	5	142	1.8	0.8	7.6
P-Index Score	Application rate based upon Nitrogen						
	N/A						

Field: SH 1S

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)		N Credits		Previous Manure (lbs/a)	Legume (lbs/a)	Commercial Fertilizer (lbs/a)	Recommended Nutrient Application Rate (lbs/acre)		Manure Type	Plant Available Manure Nutrients lbs/1000 gal or lb/ton		Manure Application Rate gallons/acre tons/a	Total Manure Applied per Field gallons tons
			N	P2O5	N	P2O5				N	P2O5		N	P2O5		
2014	CS	28	150	40	0	20	0	20	16	130	24	Manure	4.5	14.4	29	2,230
2015	CS	28	150	40	23	0	23	20	16	107	24	Manure	4.5	14.4	24	1,833
2016	CS	28	150	40	19	0	19	20	16	111	24	Manure	4.5	14.4	25	1,904
2017	CS	28	150	40	20	0	20	20	16	111	24	Manure	4.5	14.4	25	1,891
2018	CS	28	150	40	20	0	20	20	16	111	24	Manure	4.5	14.4	25	1,894

Starter 10-8-4, 200#, manure applied in fall, spring, via spreader truck. Double P for broadcast applications and retest following year.

Soil test results	Date	NO ₃ -N	P (Olsen), ppm	K (NH ₄ OAc) ppm	OM	EC (mmhos/cm)	pH
	6.26.13	4.5	3.3	99	1.6	0.6	7.7
P-Index Score	Application rate based upon Nitrogen						
	N/A						

Field: SH2

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)		N Credits		Previous Manure (lbs/a)	Legume (lbs/a)	Commercial Fertilizer (lbs/a)	Recommended Nutrient Application Rate (lbs/acre)		Manure Type	Plant Available Manure Nutrients lbs/1000 gal or lb/ton		Manure Application Rate gallons/acre tons/a	Total Manure Applied per Field gallons tons
			N	P2O5	N	P2O5				N	P2O5		N	P2O5		
2014	CS	28	181	40	0	50	0	20	16	111	24	Manure	4.5	14.4	25	3,940
2015	CS	28	181	40	20	0	20	20	16	141	24	Manure	4.5	14.4	31	5,017
2016	CS	28	181	40	25	0	25	20	16	136	24	Manure	4.5	14.4	30	4,825
2017	CS	28	181	40	24	0	24	20	16	137	24	Manure	4.5	14.4	30	4,859
2018	CS	28	181	40	24	0	24	20	16	137	24	Manure	4.5	14.4	30	4,853

Starter 10-8-4, 200#, manure applied in fall, spring, via spreader truck. Double P for broadcast applications and retest following year.

Farm: Smith Valley Dairy

Field: SH3

Soil test results	Date	NO ₃ -N	P (Olsen), K (NH ₄ OAc)	EC
	6.26.13	5.5	ppm 3	(mmhos/cm) 0.6
			ppm 86	ppm 1.7
			Application rate based upon Nitrogen	
P-Index Score	N/A			

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)		N Credits		Previous Manure (lbs/a)	Legume (lbs/a)	Commercial Fertilizer (lbs/a)	Recommended Nutrient Application Rate (lbs/acre)		Manure Type	Plant Available Manure Nutrients lbs/1000 gal or lb/ton		Manure Application Rate gallons/acre	Total Manure Applied per Field gallons
			N	P2O5	N	P2O5				N	P2O5		N	P2O5		
2014	CS	28	174	40	0	0	20	16	154	24	24	pond	2.37	0.33	65,063	10,410,127
2015	CS	28	174	40	0	28	20	16	126	24	24	pond	2.37	0.33	53,121	8,499,407
2016	CS	28	174	40	0	23	20	16	131	24	24	pond	2.37	0.33	55,313	8,850,109
2017	CS	28	174	40	0	24	20	16	130	24	24	pond	2.37	0.33	54,911	8,785,740
2018	CS	28	174	40	0	24	20	16	130	24	24	pond	2.37	0.33	54,985	8,797,554

Starter 10-8-4, 200#, wastewater applied in fall, spring, summer, via pivot or sprinkler. Double P for broadcast applications and retest following year.

Soil test results	Date	NO ₃ -N	P (Olsen), K (NH ₄ OAc)	EC
	6.26.13	6	ppm 5	(mmhos/cm) 0.5
			ppm 70	ppm 1.6
			Application rate based upon Nitrogen	
P-Index Score	N/A			

Field: SH4

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)		N Credits		Previous Manure (lbs/a)	Legume (lbs/a)	Commercial Fertilizer (lbs/a)	Recommended Nutrient Application Rate (lbs/acre)		Manure Type	Plant Available Manure Nutrients lbs/1000 gal or lb/ton		Manure Application Rate gallons/acre	Total Manure Applied per Field gallons
			N	P2O5	N	P2O5				N	P2O5		N	P2O5		
2014	alfalfa	6.5	298	200	0	0	20	16	278	184	184	pond	2.37	0.33	117,426	4,697,046
2015	alfalfa	6.5	298	100	0	51	0	0	247	100	100	pond	2.37	0.33	104,312	4,172,483
2016	alfalfa	6.5	298	100	0	45	0	0	253	100	100	pond	2.37	0.33	106,719	4,268,764
2017	alfalfa	6.5	298	100	0	46	0	0	252	100	100	pond	2.37	0.33	106,277	4,251,092
2018	alfalfa	6.5	298	100	0	46	0	0	252	100	100	pond	2.37	0.33	106,358	4,254,335

Starter 10-8-4, 200#, wastewater applied in fall, spring, summer, via pivot or sprinkler. P recommendation assumes broadcast application. Retest each year.

Soil test results	Date	NO ₃ -N	P (Olsen), K (NH ₄ OAc)	EC
	6.26.13	6	ppm 17	(mmhos/cm) 1.2
			ppm 525	ppm 0.6
			Application rate based upon Nitrogen	
P-Index Score	N/A			
	*soil sample taken from a different part of property but is believed to represent current field.			

Field: H1

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)		N Credits		Previous Manure (lbs/a)	Legume (lbs/a)	Commercial Fertilizer (lbs/a)	Recommended Nutrient Application Rate (lbs/acre)		Manure Type	Plant Available Manure Nutrients lbs/1000 gal or lb/ton		Manure Application Rate gallons/acre	Total Manure Applied per Field gallons
			N	P2O5	N	P2O5				N	P2O5		N	P2O5		
2014	CS	28	205	0	0	0	20	16	185	-16	-16	pond	2.37	0.33	78,228	12,516,456
2015	CS	28	205	0	34	0	20	16	151	-16	-16	pond	2.37	0.33	63,870	10,219,132
2016	CS	28	205	0	28	0	20	16	158	-16	-16	pond	2.37	0.33	66,505	10,640,792
2017	CS	28	205	0	29	0	20	16	156	-16	-16	pond	2.37	0.33	66,021	10,563,399
2018	CS	28	205	0	29	0	20	16	157	-16	-16	pond	2.37	0.33	66,110	10,577,604

Starter 10-8-4, 200#, wastewater applied in fall, spring, summer, via pivot. P high, pH and K very high and salts are moderately high. Monitor use of manure and wastewater.

Farm: Smith Valley Dairy

Field: SH3

Soil test results	Date	NO ₃ -N	P (Olsen), ppm	K (NH ₄ OAc) ppm	OM	EC (mmhos/cm)	pH
	6.26.13	5.5	3	86	1.7	0.6	7
P-Index Score		N/A		Application rate based upon Nitrogen			

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)			N Credits			Manure Type	Plant Available Nutrients			Manure Application Rate gallons/acre tons/a	Total Manure Applied per Field gallons tons
			N	P	O ₅	Legume (lbs/a)	Previous Manure (lbs/a)	Commercial Fertilizer (lbs/a)		Recommended Nutrient Application Rate (lbs/acre)	N	P		
2014	CS	28	174	40	16	0	0	20	Manure	4.5	14.4	24	34	5,483
2015	CS	28	174	40	16	0	20	20	Manure	4.5	14.4	24	28	4,508
2016	CS	28	174	40	16	0	20	20	Manure	4.5	14.4	24	29	4,681
2017	CS	28	174	40	16	0	20	20	Manure	4.5	14.4	24	29	4,650
2018	CS	28	174	40	16	0	20	20	Manure	4.5	14.4	24	29	4,656

Starter 10-8-4, 200#, manure applied in fall, spring, via spreader truck. Double P for broadcast applications and retest following year.

Field: SH4

Soil test results	Date	NO ₃ -N	P (Olsen), ppm	K (NH ₄ OAc) ppm	OM	EC (mmhos/cm)	pH
	6.26.13	6	5	70	1.6	0.5	7
P-Index Score		N/A		Application rate based upon Nitrogen			

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)			N Credits			Manure Type	Plant Available Nutrients			Manure Application Rate gallons/acre tons/a	Total Manure Applied per Field gallons tons
			N	P	O ₅	Legume (lbs/a)	Previous Manure (lbs/a)	Commercial Fertilizer (lbs/a)		Recommended Nutrient Application Rate (lbs/acre)	N	P		
2014	alfalfa	6.5	298	200	16	0	0	20	Manure	4.5	14.4	184	62	2,474
2015	alfalfa	6.5	298	100	0	0	0	0	Manure	4.5	14.4	100	55	2,212
2016	alfalfa	6.5	298	100	0	0	0	0	Manure	4.5	14.4	100	56	2,258
2017	alfalfa	6.5	298	100	0	0	0	0	Manure	4.5	14.4	100	56	2,250
2018	alfalfa	6.5	298	100	0	0	0	0	Manure	4.5	14.4	100	56	2,252

Starter 10-8-4, 200#, manure applied in fall, spring or summer via spreader truck. P recommendation assumes broadcast application. Retest each year.

Field: SM1

Soil test results	Date	NO ₃ -N	P (Olsen), ppm	K (NH ₄ OAc) ppm	OM	EC (mmhos/cm)	pH
	6.26.13	8	4	165	2	1	7.6
P-Index Score		N/A		Application rate based upon Nitrogen			

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)			N Credits			Manure Type	Plant Available Nutrients			Manure Application Rate gallons/acre tons/a	Total Manure Applied per Field gallons tons
			N	P	O ₅	Legume (lbs/a)	Previous Manure (lbs/a)	Commercial Fertilizer (lbs/a)		Recommended Nutrient Application Rate (lbs/acre)	N	P		
2014	Wheat	107	98	40	16	0	0	20	Manure	4.5	14.4	24	17	436
2015	Wheat	107	98	40	16	0	0	20	Manure	4.5	14.4	24	14	358
2016	Wheat	107	98	40	16	0	0	20	Manure	4.5	14.4	24	15	372
2017	Wheat	107	98	40	16	0	0	20	Manure	4.5	14.4	24	15	370
2018	Wheat	107	98	40	16	0	0	20	Manure	4.5	14.4	24	15	370

Starter 10-8-4, 200#, manure applied in fall, spring, summer, via spreader truck. Double P for broadcast applications and retest following year.

Farm: Smith Valley Dairy

Field: SM2

Soil test results	P (Olsen), ppm	K (NH4OAc), ppm	OM	EC (mmhos/cm)	pH
Date	6.26.13	29	9	230	1.1
P-Index Score	N/A Application rate based upon Nitrogen				

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)		N Credits		Commercial Fertilizer (lbs/a)	Recommended Nutrient Application Rate (lbs/acre)	Manure Type	Plant Available Manure Nutrients		Manure Application Rate gallons/acre tons/a	Total Manure Applied per Field gallons tons
			N	P2O5	Legume (lbs/a)	Previous Manure (lbs/a)				N	P2O5		
2014	grass/alfalfa	5	83	40	0	0	0	40	Manure	4.5	14.4	18	459
2015	grass/alfalfa	5	83	40	0	0	0	40	Manure	4.5	14.4	15	377
2016	grass/alfalfa	5	83	40	0	0	0	40	Manure	4.5	14.4	16	392
2017	grass/alfalfa	5	83	40	0	0	0	40	Manure	4.5	14.4	16	389
2018	grass/alfalfa	5	83	40	0	0	0	40	Manure	4.5	14.4	16	390

Manure applied in fall, spring, summer, via spreader truck. P recommendation assumes broadcast application. Retest each year of the rotation.

Field: SM3

Soil test results	P (Olsen), ppm	K (NH4OAc), ppm	OM	EC (mmhos/cm)	pH
Date	6.26.13	7	3	60	1.7
P-Index Score	N/A Application rate based upon Nitrogen				

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)		N Credits		Commercial Fertilizer (lbs/a)	Recommended Nutrient Application Rate (lbs/acre)	Manure Type	Plant Available Manure Nutrients		Manure Application Rate gallons/acre tons/a	Total Manure Applied per Field gallons tons
			N	P2O5	Legume (lbs/a)	Previous Manure (lbs/a)				N	P2O5		
2014	grass/alfalfa	5	144	80	0	0	0	80	Manure	4.5	14.4	32	2237
2015	grass/alfalfa	5	144	80	0	0	0	80	Manure	4.5	14.4	26	1839
2016	grass/alfalfa	5	144	80	0	0	0	80	Manure	4.5	14.4	27	1910
2017	grass/alfalfa	5	144	80	0	0	0	80	Manure	4.5	14.4	27	1897
2018	grass/alfalfa	5	144	80	0	0	0	80	Manure	4.5	14.4	27	1900

Manure applied in fall, spring, summer, via spreader truck. P recommendation assumes broadcast application. Retest each year of the rotation.

Field: SM5

Soil test results	P (Olsen), ppm	K (NH4OAc), ppm	OM	EC (mmhos/cm)	pH
Date	6.26.13	6	5	90	1.8
P-Index Score	N/A Application rate based upon Nitrogen				

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)		N Credits		Commercial Fertilizer (lbs/a)	Recommended Nutrient Application Rate (lbs/acre)	Manure Type	Plant Available Manure Nutrients		Manure Application Rate gallons/acre tons/a	Total Manure Applied per Field gallons tons
			N	P2O5	Legume (lbs/a)	Previous Manure (lbs/a)				N	P2O5		
2014	CS	28	169	40	0	20	16	24	Manure	4.5	14.4	33	1328
2015	CS	28	169	40	0	20	16	24	Manure	4.5	14.4	27	1092
2016	CS	28	169	40	0	20	16	24	Manure	4.5	14.4	28	1134
2017	CS	28	169	40	0	20	16	24	Manure	4.5	14.4	28	1126
2018	CS	28	169	40	0	20	16	24	Manure	4.5	14.4	28	1128

Starter 10-8-4, 200#, manure applied in fall or spring via spreader truck. Double P for broadcast applications.

Farm: Smith Valley Dairy

Field: SM6

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)			N Credits			Manure Type	Plant Available Nutrients			Manure Application Rate gallons/acre tons/a	Total Manure Applied per Field gallons tons		
			N	P	O	Legume (lbs/a)	Commercial Fertilizer (lbs/a)	Previous Manure (lbs/a)		Legume (lbs/a)	Commercial Fertilizer (lbs/a)	Recommended Nutrient Application Rate (lbs/acre)			N	P
2014	Wheat	107	12	0	0	0	0	0	10	8	2	-8	4.5	14.4	0	0
2015	Wheat	107	12	0	0	0	0	0	10	8	2	-8	4.5	14.4	0	0
2016	Wheat	107	12	0	0	0	0	0	10	8	2	-8	4.5	14.4	0	0
2017	Wheat	107	12	0	0	0	0	0	10	8	2	-8	4.5	14.4	0	0
2018	Wheat	107	12	0	0	0	0	0	10	8	2	-8	4.5	14.4	0	0

Starter 10-8-4, 100#. When nitrate is reduced to allow manure applications, it may be applied in fall, spring, summer, via spreader truck.

Field: SM4W

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)			N Credits			Manure Type	Plant Available Nutrients			Manure Application Rate gallons/acre tons	Total Manure Applied per Field gallons tons		
			N	P	O	Legume (lbs/a)	Commercial Fertilizer (lbs/a)	Previous Manure (lbs/a)		Legume (lbs/a)	Commercial Fertilizer (lbs/a)	Recommended Nutrient Application Rate (lbs/acre)			N	P
2014	CS	28	198	40	0	0	0	0	20	16	178	24	4.5	14.4	39	1381
2015	CS	28	198	40	0	32	0	20	16	146	146	24	4.5	14.4	32	1136
2016	CS	28	198	40	0	26	0	20	16	152	24	24	4.5	14.4	34	1179
2017	CS	28	198	40	0	27	0	20	16	151	24	24	4.5	14.4	33	1172
2018	CS	28	198	40	0	27	0	20	16	151	24	24	4.5	14.4	34	1173

Starter 10-8-4, 200#. manure applied in fall, spring via spreader truck. Double P for broadcast applications and retest following year.

Field: SM4E

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)			N Credits			Manure Type	Plant Available Nutrients			Manure Application Rate gallons/acre tons	Total Manure Applied per Field gallons tons		
			N	P	O	Legume (lbs/a)	Commercial Fertilizer (lbs/a)	Previous Manure (lbs/a)		Legume (lbs/a)	Commercial Fertilizer (lbs/a)	Recommended Nutrient Application Rate (lbs/acre)			N	P
2014	Wheat	107	87	40	0	0	0	0	20	16	67	24	4.5	14.4	15	519
2015	Wheat	107	87	40	0	12	0	20	16	55	24	24	4.5	14.4	12	427
2016	Wheat	107	87	40	0	10	0	20	16	57	24	24	4.5	14.4	13	443
2017	Wheat	107	87	40	0	10	0	20	16	57	24	24	4.5	14.4	13	440
2018	Wheat	107	87	40	0	10	0	20	16	57	24	24	4.5	14.4	13	441

Starter 10-8-4, 200#. manure applied in fall, spring, summer, via spreader truck. Double P for broadcast applications and retest following year.

Farm: Smith Valley Dairy

Field: SM7

Soil test results		P (Olsen), K (NH4OAc)		EC	
Date	NO ₃ -N	ppm	ppm	(mmhos/cm)	pH
6.26.13	18	4	80	0.6	6.4
P-Index Score		Application rate based upon		Nitrogen	
N/A					

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)			N Credits			Manure Type	Plant Available Nutrients			Total Manure Applied per Field gallons			
			N	P	O ₅	Legume (lbs/a)	Commercial Fertilizer (lbs/a)	Previous Manure (lbs/a)		N	P	O ₅		lbs/1000 gal or lb/ton	gallons/acre	tons/a
2014	Wheat	107	101	40	40	0	0	20	16	16	16	81	24	14.4	18	716
2015	Wheat	107	101	40	40	0	0	20	16	16	16	66	24	14.4	15	589
2016	Wheat	107	101	40	40	0	0	20	16	16	16	69	24	14.4	15	611
2017	Wheat	107	101	40	40	0	0	20	16	16	16	68	24	14.4	15	607
2018	Wheat	107	101	40	40	0	0	20	16	16	16	68	24	14.4	15	608

Starter 10-8-4, 200#, manure applied in fall, spring, summer, via spreader truck. Double P for broadcast applications and retest following year.

Field: SM 1-2

Soil test results		P (Olsen), K (NH4OAc)		EC	
Date	NO ₃ -N	ppm	ppm	(mmhos/cm)	pH
6.26.13	18.5	6.5	198	1.6	7.5
P-Index Score		Application rate based upon		Nitrogen	
N/A					

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)			N Credits			Manure Type	Plant Available Nutrients			Total Manure Applied per Field gallons			
			N	P	O ₅	Legume (lbs/a)	Commercial Fertilizer (lbs/a)	Previous Manure (lbs/a)		N	P	O ₅		lbs/1000 gal or lb/ton	gallons/acre	tons/a
2014	CS	28	130	40	40	0	0	20	16	16	16	110	24	14.4	25	1,227
2015	CS	28	130	40	40	0	0	20	16	16	16	110	24	14.4	25	1,227
2016	CS	28	130	40	40	0	0	20	16	16	16	110	24	14.4	25	1,227
2017	CS	28	130	40	40	0	0	20	16	16	16	110	24	14.4	25	1,227
2018	CS	28	130	40	40	0	0	20	16	16	16	110	24	14.4	25	1,227

Starter 10-8-4, 200#, manure applied in fall, spring, summer, via spreader truck. Double P for broadcast applications and retest following year.

Field: SM 3-7

Soil test results		P (Olsen), K (NH4OAc)		EC	
Date	NO ₃ -N	ppm	ppm	(mmhos/cm)	pH
6.26.13	15.3	5.7	85	1.3	7.2
P-Index Score		Application rate based upon		Nitrogen	
N/A					

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)			N Credits			Manure Type	Plant Available Nutrients			Total Manure Applied per Field gallons			
			N	P	O ₅	Legume (lbs/a)	Commercial Fertilizer (lbs/a)	Previous Manure (lbs/a)		N	P	O ₅		lbs/1000 gal or lb/ton	gallons/acre	tons/a
2014	CS	28	151	40	40	0	0	20	16	16	16	131	24	14.4	29	9,746
2015	CS	28	151	40	40	0	0	20	16	16	16	131	24	14.4	29	9,745
2016	CS	28	151	40	40	0	0	20	16	16	16	131	24	14.4	29	9,745
2017	CS	28	151	40	40	0	0	20	16	16	16	131	24	14.4	29	9,745
2018	CS	28	151	40	40	0	0	20	16	16	16	131	24	14.4	29	9,745

Starter 10-8-4, 200#, manure applied in fall, spring, summer, via spreader truck. Double P for broadcast applications and retest following year.

Farm: Smith Valley Dairy

Field: F4S

Soil test results	P (Olsen), ppm	K (NH4OAc), ppm	OM, %	EC (mmhos/cm)
Date	NO ₃ -N, ppm	9.3	147	2.5
6.26.13	7.3			0.8
P-Index Score	Application rate based upon			

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)		N Credits		Previous Manure (lbs/a)	Legume (lbs/a)	Commercial Fertilizer (lbs/a)	Recommended Nutrient Application Rate (lbs/acre)		Manure Type	Plant Available Manure Nutrients (lbs/1000 gal or lb/ton)		Manure Application Rate (gallons/acre)	Total Manure Applied per Field (gallons tons)
			N	P2O5	N	P2O5				N	P2O5		N	P2O5		
2014	Trit/Alfalfa	8.3/6.5	359	150	0	0	0	0	0	359	150	pond	2.37	0.33	151,485	12,118,819
2015	Alfalfa	6.5	267	75	0	0	66	0	0	201	75	pond	2.37	0.33	84,694	6,775,491
2016	Alfalfa	6.5	267	75	0	0	37	0	0	230	75	pond	2.37	0.33	96,953	7,756,228
2017	Alfalfa	6.5	267	75	0	0	42	0	0	224	75	pond	2.37	0.33	94,703	7,576,220
2018	Alfalfa	6.5	267	75	0	0	41	0	0	225	75	pond	2.37	0.33	95,116	7,609,259

Wastewater applied in fall, spring, summer, via pivot or sprinkler. P recommendation assumes broadcast application. Retest following year.

Field: F1

Soil test results	P (Olsen), ppm	K (NH4OAc), ppm	OM, %	EC (mmhos/cm)
Date	NO ₃ -N, ppm	7	260	1.8
6.26.13	4			2
P-Index Score	Application rate based upon Nitrogen			

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)		N Credits		Previous Manure (lbs/a)	Legume (lbs/a)	Commercial Fertilizer (lbs/a)	Recommended Nutrient Application Rate (lbs/acre)		Manure Type	Plant Available Manure Nutrients (lbs/1000 gal or lb/ton)		Manure Application Rate (gallons/acre)	Total Manure Applied per Field (gallons tons)
			N	P2O5	N	P2O5				N	P2O5		N	P2O5		
2014	Trit/Alfalfa	8.3/6.5	392	150	0	0	0	0	0	392	150	pond	2.37	0.33	165,359	9,094,726
2015	Alfalfa	6.5	300	75	0	0	72	0	0	228	75	pond	2.37	0.33	96,021	5,281,137
2016	Alfalfa	6.5	300	75	0	0	42	0	0	258	75	pond	2.37	0.33	108,747	5,981,099
2017	Alfalfa	6.5	300	75	0	0	47	0	0	252	75	pond	2.37	0.33	106,411	5,852,625
2018	Alfalfa	6.5	300	75	0	0	46	0	0	253	75	pond	2.37	0.33	106,840	5,876,206

Wastewater applied in fall, spring, summer, via pivot or sprinkler. P recommendation assumes broadcast application. Retest following year. Salts moderately high. Monitor use of wastewater.

Field: F2

Soil test results	P (Olsen), ppm	K (NH4OAc), ppm	OM, %	EC (mmhos/cm)
Date	NO ₃ -N, ppm	21	235	1.7
6.26.13	5			0.9
P-Index Score	Application rate based upon Nitrogen			

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)		N Credits		Previous Manure (lbs/a)	Legume (lbs/a)	Commercial Fertilizer (lbs/a)	Recommended Nutrient Application Rate (lbs/acre)		Manure Type	Plant Available Manure Nutrients (lbs/1000 gal or lb/ton)		Manure Application Rate (gallons/acre)	Total Manure Applied per Field (gallons tons)
			N	P2O5	N	P2O5				N	P2O5		N	P2O5		
2014	Trit/Alfalfa	8.3/6.5	391	0	0	0	0	0	0	391	0	pond	2.37	0.33	165,105	9,080,802
2015	Alfalfa	6.5	299	0	0	0	72	0	0	227	0	pond	2.37	0.33	95,814	5,269,768
2016	Alfalfa	6.5	299	0	0	0	42	0	0	257	0	pond	2.37	0.33	108,532	5,969,262
2017	Alfalfa	6.5	299	0	0	0	47	0	0	252	0	pond	2.37	0.33	106,198	5,840,874
2018	Alfalfa	6.5	299	0	0	0	46	0	0	253	0	pond	2.37	0.33	106,626	5,864,439

Wastewater applied in fall, spring, summer, via pivot or sprinkler.

Farm: Smith Valley Dairy

Field: F3

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)		Previous Manure (lbs/a)	N Credits (lbs/a)		Commercial Fertilizer (lbs/a)	Recommended Nutrient Application Rate (lbs/acre)		Manure Type	Plant Available Manure Nutrients lbs/1000 gal or lb/ton		Manure Application Rate gallons/acre	Total Manure Applied per Field gallons tons
			N	P2O5		Legume (lbs/a)	Legume (lbs/a)		N	P2O5		N	P2O5		
2014	Trif/Alfalfa	8.3/6.5	391	200	0	0	0	0	391	200	pond	2.37	0.33	164,852	3,132,194
2015	Alfalfa	6.5	298	100	72	0	0	0	227	100	pond	2.37	0.33	95,607	1,816,538
2016	Alfalfa	6.5	298	100	42	0	0	0	257	100	pond	2.37	0.33	108,317	2,056,019
2017	Alfalfa	6.5	298	100	47	0	0	0	251	100	pond	2.37	0.33	105,984	2,013,697
2018	Alfalfa	6.5	298	100	46	0	0	0	252	100	pond	2.37	0.33	106,412	2,021,832

Wastewater applied in fall, spring, summer, via pivot or sprinkler. P recommendation assumes broadcast application. Retest each year.

Soil test results		P (Olsen), K (NH4OAc)		OM		EC (mmhos/cm)	
Date	NO3-N	ppm	ppm	ppm	ppm	ppm	ppm
6.26.13	6	4	190	1.6	0.6	8.2	
P-Index Score		N/A		Application rate based upon Nitrogen			

Soil test results		P (Olsen), K (NH4OAc)		OM		EC (mmhos/cm)	
Date	NO3-N	ppm	ppm	ppm	ppm	ppm	ppm
6.26.13	7.3	9.3	147	2.5	0.8	8.1	
P-Index Score		N/A		Application rate based upon Nitrogen			

Field: F4N

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)		Previous Manure (lbs/a)	N Credits (lbs/a)		Commercial Fertilizer (lbs/a)	Recommended Nutrient Application Rate (lbs/acre)		Manure Type	Plant Available Manure Nutrients lbs/1000 gal or lb/ton		Manure Application Rate gallons/acre	Total Manure Applied per Field gallons tons
			N	P2O5		Legume (lbs/a)	Legume (lbs/a)		N	P2O5		N	P2O5		
2014	CS	28	124	20	0	0	20	16	104	4	pond	2.37	0.33	43,764	5,995,629
2015	CS	28	124	20	19	0	20	16	85	4	pond	2.37	0.33	35,731	4,895,165
2016	CS	28	124	20	16	0	20	16	88	4	pond	2.37	0.33	37,205	5,097,149
2017	CS	28	124	20	16	0	20	16	88	4	pond	2.37	0.33	36,935	5,060,076
2018	CS	28	124	20	16	0	20	16	88	4	pond	2.37	0.33	36,985	5,066,881

Starter 10-8-4, 200#, wastewater applied in fall, spring, summer, via pivot or sprinkler. Double P recommendation for broadcast application. Retest yearly.

Soil test results		P (Olsen), K (NH4OAc)		OM		EC (mmhos/cm)	
Date	NO3-N	ppm	ppm	ppm	ppm	ppm	ppm
6.26.13	6.2	3	64.2	1.9	0.6	7.6	
P-Index Score		N/A		Application rate based upon Nitrogen			

Field: F5

Year	crop	Expected Yield tons or bu/acre	Gross Nutrient Needs (lbs/acre)		Previous Manure (lbs/a)	N Credits (lbs/a)		Commercial Fertilizer (lbs/a)	Recommended Nutrient Application Rate (lbs/acre)		Manure Type	Plant Available Manure Nutrients lbs/1000 gal or lb/ton		Manure Application Rate gallons/acre	Total Manure Applied per Field gallons tons
			N	P2O5		Legume (lbs/a)	Legume (lbs/a)		N	P2O5		N	P2O5		
2014	Trif/Alfalfa	8.3/6.5	381	200	0	0	0	0	381	200	pond	2.37	0.33	160,751	37,133,494
2015	Alfalfa	6.5	289	100	70	0	20	16	199	84	pond	2.37	0.33	83,820	19,362,409
2016	Alfalfa	6.5	289	100	36	0	20	16	232	84	pond	2.37	0.33	97,940	22,624,191
2017	Alfalfa	6.5	289	100	43	0	20	16	226	84	pond	2.37	0.33	95,349	22,025,509
2018	Alfalfa	6.5	289	100	41	0	0	0	247	100	pond	2.37	0.33	104,263	24,084,761

Wastewater applied in fall, spring, summer, via pivot or sprinkler. P recommendation assumes broadcast application. Retest each year.

APPENDIX G

EMERGENCY ACTION PLAN AND SAFETY PRECAUTIONS

Summary Action Plan

Facility Name	Smith Valley Dairy	
Emergency Numbers	Ambulance, Fire, Police Sheriff Dept.: Smith Valley Fire Department Nevada Hwy patrol	911 775-463-6600 or 577-5020 775-465-2577 775-687-5300
Non-Emergency Numbers	Nevada Department of Agriculture	
	Elko	775-738-8076
	Las Vegas	702-486-4690
	Reno	775-688-1182
	Winnemucca	775-623-6502
	NDot	775-664-2890
	Lyon County Road Department	775-463-6551
Recovery Equipment	Heavy equipment is located on farm at various staging locations within 1 mile or closer to the feedlot facility. Type of equipment includes large farm tractors, front end loaders.	
Action Plan	<p>Spills from manure and wastewater containment structures: In event of such failure, containment of the spill will be addressed by properly draining the structures, with effluent allowed to evaporate or be applied to cropland fields. Structures will then be repaired or replaced according to a certified engineering design.</p> <p>Spills during Pumping: In the event of such failure, containment of the spill will be address by constructing a dike (an earthen embankment) around the spill. Effluent will be allowed to evaporate or be pumped into a transport tanker for delivery to the storage lagoon. Structures will then be repaired or replaced according to a certified engineering design.</p> <p>Spills during transport: In the event of such failure, containment of the spill will be addressed by constructing a dike around the spill, ceasing the transport of effluent, and allowing the effluent to evaporate or be pumped into a transport tanker for delivery to the storage lagoon. Structure or equipment will then be repaired or replaced accordingly.</p>	

APPENDIX H

SUGGESTED RECORDKEEPING FORMS

(inclusion in this NMP does not constitute a requirement for these forms to be used)

APPENDIX I

REFERENCES

(inclusion in this NMP does not constitute a requirement for these references to be used unless specifically indicated in the NMP)

SOIL ANALYSIS INFORMATION SHEET

USU ANALYTICAL



USU Analytical Labs
Ag Science Rm 166
Logan UT 84322-4830
(435) 797-2217 or Fax (435) 797-2117
www.usual.usu.edu



Date: _____
Name: _____
Address: _____

County: _____
Phone : _____
Fax: _____
Email : _____

	Sample Numbers			
	1	2	3	4
Sample I.D.	_____	_____	_____	_____
Sample Depth	_____	_____	_____	_____
Tests Desired*	_____	_____	_____	_____

*TESTS DESIRED	Price/sample
1. Routine (pH, salinity, texture, P, K, recommendations)	14.00
2. Basic (Phosphorus + Potassium only =P+K).....	10.00
3. Manure application - (Routine + Nitrate-N**)	24.00
4. Micro Plus (Routine + micronutrients).....	24.00
5. Complete (pH, salinity, texture, P, K, Nitrate-N**, micronutrients, sulfate, organic matter)	50.00
6. UDOT Required (pH, salinity, SAR, organic matter, particle size, >2mm)	50.00
Individual Component Analysis	
Please contact the lab for individual analyses/additional analyses	
**Nitrate-N analysis requires special sampling/handling. See procedures on reverse side.	

**TESTS REQUIRE 2 CUPS OF SOIL/SAMPLE -
FILL BOX COMPLETELY FULL**

COMMENTS or special problems: _____

Total cost of analysis: \$ _____

Check # _____ Cash
 Credit Card
_____ exp _____
 Visa Master card Discover

**PLEASE INCLUDE PAYMENT WITH SAMPLE TO PREVENT
DELAY ON SAMPLE PROCESSING.**

LAWN • GARDEN • ORCHARD

Crops to be Grown	Sample Numbers			
	1	2	3	4
1. Garden/flowers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Lawn	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Shrubs/trees	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Fruit trees	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

MATERIALS APPLIED DURING PAST YEAR

1. Manure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Leaves/ grass/residues	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Commercial fertilizer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

FIELD CROPS

Crops to be Grown	Sample Numbers			
	1	2	3	4
IRRIGATED				
1. Alfalfa 100%	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Grass Hay 100%	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Legume /Grass Hay % Legume	_____	_____	_____	_____
4. Grass Pasture	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Legume/Grass Pasture % Legume	_____	_____	_____	_____
6. Corn (silage)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Corn for grain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Wheat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Barley/Oats	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Potatoes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Turf (golf/sports)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

NON-IRRIGATED

13. Grain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Alfalfa	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Grass Pasture	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. Reclamation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

YIELD GOAL**

Acres in field	_____	_____	_____	_____
CROP LAST YEAR				
Yield per acre	_____	_____	_____	_____
Was straw/stover removed?	_Yes <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	_No <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

MANURE FOR THIS CROP:

Tons per acre _____
**use realistic goals for your conditions

SOIL SAMPLING PROCEDURE

Good samples are required to derive useful information from soil tests.

WHEN: Any time of the year; early fall is often preferred. Allow two weeks to get results before buying fertilizer. For special nitrate tests, sample in the spring (see instructions below).

TOOLS: (a) A clean plastic container for each depth to be sampled. (b) Sampling auger or tube (USU Extension Office) or a shovel will serve for plow-layer samples.

AREA: Select an area having uniform color, texture, drainage, and the same cropping and fertilizer treatment last year. Leave out non-typical spots or sample them separately. For each area to be sampled, take separate samples from 8 to 10 locations in a pattern that will represent the entire area.

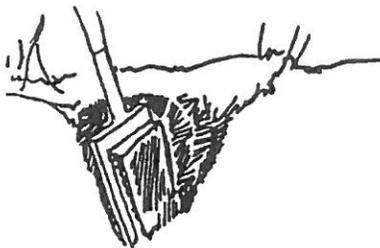
DEPTH: (a) Standard topsoil sample: from surface down to 12 inches; (b) Turf samples: surface down to 6 inches (4 inches for golf greens); (c) For special nitrate tests, see instructions below.

TAKING THE SAMPLE: Scrape away surface litter. Avoid manure spots. If previous fertilizer was banded, take special care to get a representative sample.

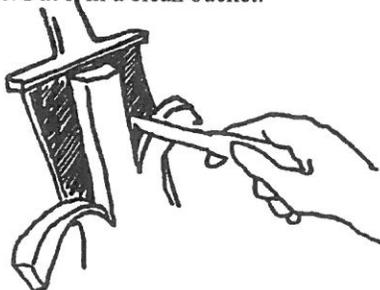
(a) Using a soil tube or auger: follow the instructions given with the tool.

(b) Using shovel:

1. Dig a V-shaped hole to plow depth. Remove a 1-inch slice of soil from one side.



2. Discard the edges of the slice until your sample is about 1 or 2 inches wide. Put it in a clean bucket.

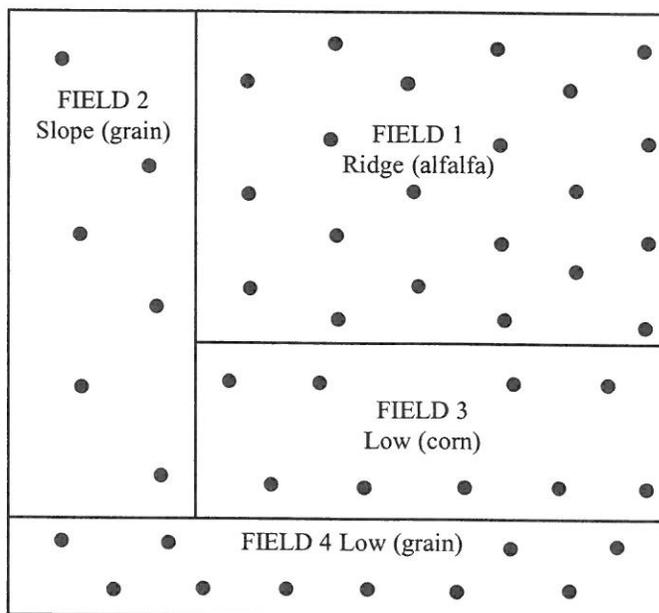


3. Repeat 1 and 2 for other samples for the sampling areas.

SAMPLE HANDLING: Combine the samples from the field in a clean container. Mix them well, then **take about 1 pint (to fill the soil box provided)** to send for analysis. Assign it an

identification and record details in your files.

SHIPPING: Send samples prepaid by parcel post or express, accompanied by this description form and a check payable to USU Analytical Laboratories, Logan, UT 84322-4830. Retain a copy for your files.

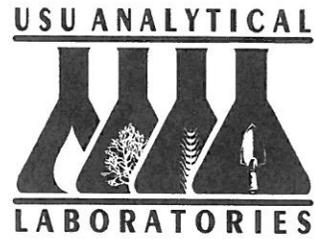


SPECIAL SAMPLING for nitrate-N or suspected salinity problems:

- Sample for nitrate-N in the spring.
- Take samples 0 to 12 inches deep as described above. Put these in one container.
- Starting at the bottom of the hole in (b), sample the 12 to 24-inch (or 12 to 36-inch) depth. Put these subsoil samples into a separate container. Mix and label the combined subsoil sample as above.
- Spread samples out on a clean surface and air-dry them before mailing (or deliver them to the lab within 24 hours).

MANURE ANALYSIS INFORMATION SHEET

USU Analytical Labs
 Ag Science Room 166
 Logan UT 84322-4830
 (435) 797-2217 or Fax (435) 797-2117
 www.usual.usu.edu



Date: _____
Name: _____
Address: _____

County: _____
Phone: _____
Fax: _____
Email: _____

Sample number		
1	2	3

Sample ID: _____

Manure type (Y)			
Milking cows	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Heifer/dry cows	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Beef feeder	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Calves	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sheep	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Horse	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Turkey, grower	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Swine, grower	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Swine, sow	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Poultry, pullet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Poultry, layer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other	_____	_____	_____

Comments: _____

	Sample number		
	1	2	3
Storage system (Y)			
<i>Solid</i>			
Bunker	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stacked	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Open lot scrape	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Slurry/liquid</i>			
Pit or tank	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pond (<6 feet)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pond (>6 feet)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Compost</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Length of storage (Y)			
0 to 3 months	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3 to 6 months	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6 to 12 months	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12+ months	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bedding included (Y)			
Yes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
No	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bedding type:			
Present results in:			
lb/ton (solids)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
lb/1000 gallons	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
lb/acre-inch	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Test	Price per sample
------	------------------

Total elemental composition: N, P, K, Ca, Mg, Na, S, B, Zn, Cu, Fe, Mn; moisture, pH and salinity (EC)	\$40.00
--	----------------

Total cost of analysis: \$ _____
 Check # _____ **Cash**
 Credit Card # _____ **exp** _____
 Visa **Master card** **Discover**

PLEASE INCLUDE PAYMENT WITH SAMPLE TO PREVENT DELAY ON SAMPLE PROCESSING.

GUIDELINES FOR SAMPLING MANURE

Manure and wastewater sampling is messy and unpleasant. When sampling, acknowledge this fact and prepare ahead of time to collect the samples. Use rubber boots and gloves (if necessary), proper sampling tools (described below), clean buckets, and heavy-duty plastic bags or jars to ship the sample.

Manure is highly variable. In order to obtain a representative sample of manure or wastewater you will have to collect several small *subsamples* and combine them together into *one composite sample*. Follow the guidelines below for sampling solid and liquid manure sources.

Sampling Solids

When sampling manure solids, *remove the surface 6 to 8 inch crust* from the pile. Use a clean auger, probe, or shovel to *core into the pile as far as possible* and retrieve a subsample. Take samples from all sides, collecting *a minimum of six subsamples* from each pile. Place the subsamples into a clean bucket and mix well. Transfer approximately one pound (2 to 3 pints volume) of manure into a heavy duty, sealable plastic bag. Double bag the sample, mark the bag in pen with the sample identification, and place in a cooler or freezer. Ship the sample to the analytical lab as soon as possible. *Do not dry the manure sample before shipping* since the lab must determine moisture content in order to report manure nutrient values on an “as is” basis.

Sampling Liquids and Slurries

There are three ways to sample liquids and slurries:

1. Sample directly from the storage structure using a water sampler. A simple water sampler can be constructed by mounting a tin can on the end of a wooden dowel or old broom handle. Walk around the structure and collect a minimum of six subsamples of the liquid. If possible, mix or otherwise agitate the liquid prior to sampling.
2. Sample from a valve inserted in a recovery line or directly from the structure outlet. Collect a minimum of six subsamples, two at the beginning, two at the middle, and two at the end of the pumping cycle.
3. Place cups or cans in the field to collect manure as it is applied through a sprinkler system. Place a minimum of six cans in the field to collect the subsamples.

Combine the liquid subsamples in a clean bucket and mix thoroughly. Transfer approximately 1 to 2 pints of liquid into a clean sample jar. Label the jar with the sample identification. Pack the samples carefully to prevent breakage. Ship the sample to the analytical lab as soon as possible.

Presentation of Results

Results will be adjusted for the moisture content of the sample as it was submitted to the lab and presented on an “as is” basis (pounds per ton for solids, pounds per 1000 gallons or pounds per acre-inch for slurries and liquids). Additional information on interpreting a manure and wastewater analysis will be included with your test results.

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

ANIMAL MORTALITY FACILITY

(No.)

CODE 316

DEFINITION

An on-farm facility for the treatment or disposal of livestock and poultry carcasses for routine and catastrophic mortality events.

PURPOSE

This practice supports one or more of the following purposes:

- Reduce impacts to surface and groundwater resources
- Reduce the impact of odors
- Decrease the spread of pathogens

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to livestock and poultry operations where animal carcass treatment or disposal is needed.

This practice includes disposal of both routine and catastrophic animal mortality; however, it may not apply to catastrophic mortality resulting from disease. In cases of disease related catastrophic mortality, this standard is applicable only when directed by the appropriate state or federal authority (typically the state veterinarian or USDA APHIS) to use the methods in this standard.

CRITERIA

General Criteria Applicable to All Purposes

Design animal mortality facilities to handle routine mortality and/or catastrophic mortality.

The planning and design of animal mortality facilities or processes must conform to all federal, State and local laws, rules and

regulations. This includes provisions for closing and/or removing the facility where required.

Design of all structural components integral to the animal mortality facility shall meet the structural loads and design criteria as described in NRCS conservation practice standard Waste Storage Facility (313), and conservation practice standard Roofs and Covers (367), unless otherwise designated.

Divert all runoff away from the animal mortality facility.

Use safety devices such as fencing, warning signs, and refrigeration unit locks where necessary.

Address bio-security concerns in all aspects of planning, installation, and operation and maintenance of an Animal Mortality Facility.

Location. Locate the facility where movement of odors toward neighbors will be minimized.

Locate the facility down gradient from springs or wells where possible or take steps necessary to prevent contamination.

Locate animal mortality facilities above the 100-year floodplain elevation unless site restrictions require location within the floodplain. If located in the floodplain, protect the facility from inundation or damage from a 25 -year flood event.

Ensure that the location of the animal mortality facility is consistent with the overall site plan for the livestock or poultry operation. Locate the facility for acceptable ingress and egress and where it will not interfere with other travel patterns on the farm.

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service State Office or visit the Field Office Technical Guide.

**NRCS, NV
September 2010**

Spread ash according to NRCS conservation practice standard Nutrient Management (590) or provide for other acceptable means of disposal.

Location. Locate the incinerator/gasifier a minimum of 20 feet from any structure. Place the unit on a concrete pad with the fuel source as distant as practical. If the incinerator is covered with a roof, at least six inches of air space is required between the chimney and any combustible roof parts.

Criteria Applicable to Catastrophic Mortality

General. Burial and composting are the only processes addressed by this standard. Collect and treat catastrophic mortality as soon as practical.

Location. Locate the animal mortality facility site as far away from neighboring dwellings and the poultry or livestock operation as site conditions permit.

Locate on sites with restricted percolation and a minimum of two feet between the bottom of the facility and the seasonal high water table unless special design features are incorporated that address seepage. Use AWMFH Appendix 10D for selection of sites where seepage will be restricted with normal construction techniques.

Burial Pit

General. Bury catastrophic mortality on-site or as otherwise directed by state and local regulatory agencies. Time the burial of catastrophic mortality to minimize the effects of mortality expansion during the early stages of the decay process. Where possible and permitted by state law, leave large mortality uncovered or lightly covered until bloating has occurred, or use methods to reduce or eliminate bloating. Retain topsoil to re-grade the disposal site after the ground has settled as the decay process is completed. Place stockpiled soil no closer than 20 feet from the edge of the burial pit.

Remove or render inoperable all field tile (subsurface drains) within the operational area of the burial pit.

Soil Suitability

Perform onsite soils investigation to determine the suitability of the site for a burial pit. Locate burial pits on soils which do not flood and which do not have a water table within two feet of the bottom of the burial pit. Avoid areas which have the presence of hard bedrock, bedrock crevices, or highly permeable strata at or directly below the proposed trench bottom. These sites are undesirable because of the difficulty in excavation and the potential pollution of underground water.

Size and Capacity. Size pits to accommodate catastrophic mortality using appropriate weight to volume conversions. Dig the pit bottoms to be relatively level. Lengths may be limited by soil suitability and slope. If more than one pit is required, separate the pits by a minimum of three feet of undisturbed or compacted soil. Place a minimum of 2 feet of cover over the mortality. Provide a finished grade for the burial site that is slightly above natural ground elevation to accommodate settling and reduce ponding from precipitation events. Vegetate all disturbed areas according to NRCS Conservation Practice Standard Critical Area Planting (342).

Structural Loading and Design. Use barriers to keep vehicular traffic at least four feet from the pit edge.

Use pit excavation techniques which are OSHA compliant. For pits that are four to five feet deep, provide a step or bench 18 inches wide and one foot deep dug around the perimeter of the main pit so that the remaining vertical wall will not exceed four feet. For pits greater than five feet deep, provide earthen walls that are sloped back at 2 horizontal and 1 vertical or flatter.

Composting

General. Use composting as described in NEH Part 637, Chapter 2 – Composting (NEH 637.0210 and NEH 637.0211)) and NEH Part 651, Chapter 10 – Composting (NEH 651.1004(f)).

Protect composting mortality from precipitation as necessary, or provide an appropriate filter area or means for collecting contaminated runoff. Cover

6. Periodic inspections
7. Prompt repair or replacement of damaged components
8. Site references and/or manufacturer or installer for trouble shooting.

Additional O&M for Incinerators and Gasifiers

1. Use incinerators and gasifiers only for the disposal of animal carcasses.
2. Operate units properly to maximize equipment life and minimize emission problems.
3. Load the units according to the manufacturer's recommendations.
4. Remove ashes frequently to maximize combustion and prevent damage to equipment. Include methods for collecting and disposing of the ash material remaining after incineration.
5. Inspect the units periodically to ensure that all components are operating as planned and in accordance with the manufacturer's recommendations.

Additional O&M for Refrigeration units

1. Operate refrigeration units properly to maximize equipment life and minimize potential problems.
2. Load the refrigeration unit according to manufacturer's recommendations and do not exceed the design capacity.
3. Use refrigeration units only for the dead animals associated with the planned operation.
4. Inspect the refrigeration unit periodically for leaks, structural integrity and temperature.

Additional O&M for Composters

1. Include a recipe of ingredients which gives the layering/mixing sequence.
2. Provide maximum and minimum temperatures for operation, land application rates, moisture level, management of odors, testing, etc.
3. Inspect the compost facility regularly when the facility is empty.

4. Replace or repair any damaged structural components.
5. Closely monitor temperatures above 165°F. Take action immediately to cool piles that have reached temperatures above 185°F.

Include the method, procedure, and record keeping requirements for proper utilization of compost.

Additional O&M for Catastrophic Mortality

Identify locations for catastrophic animal mortality disposal. Maintain recordkeeping of number, average weight, cause, and date of animal deaths. Provide the landowner with contact information for state authorities since they may have specific requirements dependent upon cause of death, livestock species and housing.

Where composting is used for catastrophic mortality disposal, identify in the O&M plan the most likely compost medium, possible compost recipes, operational information, and equipment that will need to be readily available.

REFERENCES

- Nutsch, A., J. McClaskey, and J. Kastner, Eds., 2004. Carcass disposal: a comprehensive review, National Agricultural Biosecurity Center, Kansas State University, Manhattan, Kansas.
- USDA, NRCS. 1992. National Engineering Handbook, Part 651, Agricultural Waste Management Field Handbook. Washington, D.C.
- USDA, NRCS. 2000. National Engineering Handbook, Part 637, Chapter 2, Composting, Washington, D.C.

**STATEMENT OF WORK
Animal Mortality Facility (316)**

Nevada 9/28/10

Contact: State Conservation Engineer

These deliverables apply to this individual practice. For other planned practice deliverables refer to those specific Statements of Work.

DESIGN

Deliverables:

1. Design documentation that will demonstrate that the criteria in NRCS practice standard have been met and are compatible with other planned and applied practices.
 - a. Practice purpose(s) as identified in the conservation plan
 - b. List of required permits to be obtained by the client
 - c. Compliance with NRCS national and state utility safety policy (NEM Part 503-Safety, Subpart A - Engineering Activities Affecting Utilities 503.00 through 503.06)
 - d. Practice standard criteria related computations and analyses to develop plans and specifications including but not limited to:
 - i. Geology and Soil Mechanics (NEM Subpart 531a)
 - ii. Capacity
 - iii. Structural, Mechanical and Appurtenance design
 - iv. Environmental Considerations (e.g. air quality, bio-security)
 - v. Safety Considerations (NEM Part 503-Safety, Subpart A, 503.10 through 503.12)
2. Written plans and specifications including sketches and drawings shall be provided to the client that adequately describes the requirements to install the practice and obtain necessary permits...
3. Design Report and Inspection Plan as appropriate (NEM Part 511, Subpart B Documentation, 511.11 and Part 512, Subpart D Quality Assurance Activities, 512.30 through 512.32).
4. Operation and Maintenance Plan
5. Certification that the design meets practice standard criteria and comply with applicable laws and regulations (NEM Subpart A, 505.3).
6. Design modifications during installation as required.

INSTALLATION

Deliverables

1. Pre Installation conference with client and contractor.
2. Verification that client has obtained required permits.
3. Staking and layout according to plans and specifications including applicable layout notes.
4. Installation inspection (according to inspection plan as appropriate).
 - a. Actual materials used (Part 512, Subchapter D Quality Assurance Activities, 512.33)
 - b. Inspection records
5. Facilitate and implement required design modifications with client and original designer
6. Advise client/NRCS on compliance issues with all federal, state, tribal, and local laws, regulations and NRCS policies during installation.
7. Certification that the installation process and materials meets design and permit requirements.

CHECK OUT

Deliverables

1. As-Built documentation.
 - a. Extent of practice units applied
 - b. Drawings

USDA-NRCS-Nevada
Section IV, Technical Guide

NRS 571.200 Disposal of carcasses of diseased livestock.

1. The owner or agent in charge of any livestock that has died or has been killed as a result of any infectious, contagious or parasitic disease shall immediately bury the carcasses thereof at least 3 feet underground or cause the carcasses to be consumed by fire, and such carcasses shall not be sold or given away.
2. In order to carry out the requirements of subsection 1, such carcasses may be conveyed on a public highway or public road, or conveyed on land not owned by the owner or agent in charge of such carcasses, in accordance with rules and regulations promulgated by the state quarantine officer.
3. The expense of burying, burning or conveying such carcasses shall be paid by the owner or agent in charge of such carcasses, and such expense shall be a lien upon remaining livestock or other real or personal property of such owner or agent in charge until paid.

Nevada Division of Environmental Protection Good Management Practices

—

Solid Waste Disposal

NRS 444.620 provides that "*No plan for a solid waste management system adopted pursuant to NRS 444.440 to 444.616, inclusive, applies to any agricultural activity or agricultural waste.*" We interpret this provision of the statute as an exemption for on-site disposal of agricultural waste including dead livestock.

NAC 444.640 allows disposal of animal carcasses by open burning, done in accordance with air quality open burning- regulations (NAC 445B.381, discussed below), except that open burning is prohibited at municipal landfills and industrial waste landfills.

NAC 444.694 requires that a separate trench be established for disposal of dead animals at municipal solid waste landfills and that dead animals be covered with soil immediately

—

Water Pollution Control

1. The fundamental concern of NDEP regarding the burial of diseased livestock will be the protection of ground and surface water systems from contamination. Animal carcasses are a potential source of pathogens, excess nutrients or other contaminants. Carcasses should be disposed of in a manner that prevents the movement of these contaminants through leaching, runoff, erosion or air emissions.

2. Burial is a common disposal practice, that when properly conducted, minimizes the movement of contaminants through the environment. The disposal of animal carcasses by burial should prevent the movement of pathogens, excess nutrients and other contaminants through the control of leaching, runoff, erosion and airborne processes.

3. To avoid environmental contamination, we recommend the following practices:

Animals should be buried in properly sited and constructed disposal pits and never in trenches, open pits or landfills. Do not locate disposal sites in natural drainages, near surface water or in areas where the water table is shallow. Burial pits should not be located in flood plains or wetlands.

The fundamental concern of NDEP regarding the burial of diseased livestock will be the protection of ground and surface water systems from contamination. Animal carcasses are a potential source of pathogens, excess nutrients or other contaminants. Carcasses should be disposed of in a manner that prevents the movement of these contaminants through leaching, runoff erosion or air emissions. Burial pits should be constructed to minimize infiltration of fluids through the pit. The bottom of the burial pit should be at least five feet above the seasonal high water table. This distance may need to be increased in areas with highly permeable soils. Specific sites should be evaluated based upon soil type and depth to groundwater to ensure that contaminants from the waste site will not reach the water table.

4. Burial pits should be located:

At least 200 feet from dwellings and/or the nearest water well;

At least 300 feet from a flowing stream or other body of water;

At east 100 feet from ephemeral drainages;

At least 50 feet from an adjacent property line; and

At least 500 feet from a neighboring residence:

5. Animals should be buried within 24 hours of death. Consider covering animals with quick lime during burial to control odors and promote decomposition.

6. Animals should be covered with at least 3 feet of soil that is compacted and mounded to maximize runoff and minimize infiltration;

Air Pollution Control

1. NAC 445B.38 1 prohibits the open burning of wastes. Burning for agricultural purposes and managment is exempted from the prohibition. However, local ordinances or regulations may apply. No open burn variance or permit would be required from NDEP to burn agricultural wastes, including dead livestock.

2. The NDEP recommends, however, that such operations occur at such location and in such manner to avoid impacting any residence or Other occupied facility with smoke. We also recommend that the

Department of Agriculture work closely with the Division of Health to ensure that burning will destroy,

and not spread the disease.

3. In the event that this highly contagious disease does make its way to the U.S. and to Nevada, the NDEP will assist in any way possible to control its spread and protect public health and environmental quality. Please let us know what we can do to assist you.

Manure Applicator Calibration Guide

1. Spreader Capacity is Known. From chart below, select 1) Spreader Capacity: _____ lbs. or gallons; 2) Distance traveled (length) to empty spreader: _____ feet; and 3) Spread pattern width or distance between individual passes: _____ feet. 4) Intersection indicates application rate:

rate: _____

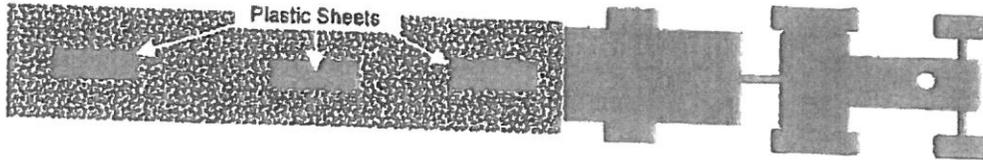
If appropriate values cannot be found in table below, calculate application rate as follows: Rate per acre = Spreader Capacity X 43560 (Width X Length).
 Example: 3000 gallon tank spreader that makes a pass every 4.30-corn rows (10 feet) and empties spreader in 1200 feet is applying 11,000 gallons per acre.

Spread Width-->	2000 gallon tank:					2500 gallon tank:					3000 gallon tank:					3500 gallon tank:					4000 gallon tank:					4500 gallon tank:																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
	10'	15'	20'	25'	30'	35'	10'	15'	20'	25'	30'	40'	50'	10'	15'	20'	25'	30'	40'	50'	10'	15'	20'	25'	30'	40'	50'	10'	15'	20'	25'	30'	40'	50'	10'	15'	20'	25'	30'	40'	50'																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
Length	15	10	7	6	5	4	18	12	9	7	6	5	4	22	15	11	7	5	4	25	17	13	8	6	5	29	19	15	10	7	6	33	22	16	11	8	7	37	25	19	13	9	6	5	41	28	21	14	10	7	6	45	31	23	16	11	8	7	49	33	25	17	12	9	6	53	36	27	19	14	10	7	57	39	30	21	15	11	8	61	41	31	22	16	12	9	65	44	33	24	17	13	10	69	47	35	25	18	14	11	73	50	37	27	19	14	11	77	53	39	28	20	15	12	81	56	41	30	21	16	12	85	59	43	31	22	17	13	89	62	45	32	23	18	14	93	65	47	33	24	19	15	97	68	49	34	25	20	16	101	71	51	35	25	21	17	105	74	53	36	26	22	18	109	77	55	37	27	23	19	113	80	57	39	28	24	20	117	83	60	41	30	25	21	121	86	63	43	31	26	22	125	89	66	45	32	27	23	129	92	69	47	33	28	24	133	95	72	49	34	29	25	137	98	75	51	35	30	26	141	101	78	53	36	31	27	145	104	81	55	37	32	28	149	107	84	57	38	33	29	153	110	87	59	39	34	30	157	113	90	61	41	35	31	161	116	93	63	43	36	32	165	119	96	65	45	37	33	169	122	99	67	47	38	34	173	125	102	69	49	39	35	177	128	105	71	51	40	36	181	131	108	73	53	41	37	185	134	111	75	55	42	38	189	137	114	77	57	43	39	193	140	117	79	59	44	40	197	143	120	81	61	45	41	201	146	123	83	63	46	42	205	149	126	85	65	47	43	209	152	129	87	67	48	44	213	155	132	89	69	49	45	217	158	135	91	71	50	46	221	161	138	93	73	51	47	225	164	141	95	75	52	48	229	167	144	97	77	53	49	233	170	147	99	79	54	50	237	173	150	101	81	55	51	241	176	153	103	83	56	52	245	179	156	105	85	57	53	249	182	159	107	87	58	54	253	185	162	109	89	59	55	257	188	165	111	91	60	56	261	191	168	113	93	61	57	265	194	171	115	95	62	58	269	197	174	117	97	63	59	273	200	177	119	99	64	60	277	203	180	121	101	65	61	281	206	183	123	103	66	62	285	209	186	125	105	67	63	289	212	189	127	107	68	64	293	215	192	129	109	69	65	297	218	195	131	111	70	66	301	221	198	133	113	71	67	305	224	201	135	115	72	68	309	227	204	137	117	73	69	313	230	207	139	119	74	70	317	233	210	141	121	75	71	321	236	213	143	123	76	72	325	239	216	145	125	77	73	329	242	219	147	127	78	74	333	245	222	149	129	79	75	337	248	225	151	131	80	76	341	251	228	153	133	81	77	345	254	231	155	135	82	78	349	257	234	157	137	83	79	353	260	237	159	139	84	80	357	263	240	161	141	85	81	361	266	243	163	143	86	82	365	269	246	165	145	87	83	369	272	249	167	147	88	84	373	275	252	169	149	89	85	377	278	255	171	151	90	86	381	281	258	173	153	91	87	385	284	261	175	155	92	88	389	287	264	177	157	93	89	393	290	267	179	159	94	90	397	293	270	181	161	95	91	401	296	273	183	163	96	92	405	299	276	185	165	97	93	409	302	279	187	167	98	94	413	305	282	189	169	99	95	417	308	285	191	171	100	96	421	311	288	193	173	101	97	425	314	291	195	175	102	98	429	317	294	197	177	103	99	433	320	297	199	179	104	100	437	323	300	201	181	105	101	441	326	303	203	183	106	102	445	329	306	205	185	107	103	449	332	309	207	187	108	104	453	335	312	209	189	109	105	457	338	315	211	191	110	106	461	341	318	213	193	111	107	465	344	321	215	195	112	108	469	347	324	217	197	113	109	473	350	327	219	199	114	110	477	353	330	221	201	115	111	481	356	333	223	203	116	112	485	359	336	225	205	117	113	489	362	339	227	207	118	114	493	365	342	229	209	119	115	497	368	345	231	211	120	116	501	371	348	233	213	121	117	505	374	351	235	215	122	118	509	377	354	237	217	123	119	513	380	357	239	219	124	120	517	383	360	241	221	125	121	521	386	363	243	223	126	122	525	389	366	245	225	127	123	529	392	369	247	227	128	124	533	395	372	249	229	129	125	537	398	375	251	231	130	126	541	401	378	253	233	131	127	545	404	381	255	235	132	128	549	407	384	257	237	133	129	553	410	387	259	239	134	130	557	413	390	261	241	135	131	561	416	393	263	243	136	132	565	419	396	265	245	137	133	569	422	399	267	247	138	134	573	425	402	269	249	139	135	577	428	405	271	251	140	136	581	431	408	273	253	141	137	585	434	411	275	255	142	138	589	437	414	277	257	143	139	593	440	417	279	259	144	140	597	443	420	281	261	145	141	601	446	423	283	263	146	142	605	449	426	285	265	147	143	609	452	429	287	267	148	144	613	455	432	289	269	149	145	617	458	435	291	271	150	146	621	461	438	293	273	151	147	625	464	441	295	275	152	148	629	467	444	297	277	153	149	633	470	447	299	279	154	150	637	473	450	301	281	155	151	641	476	453	303	283	156	152	645	479	456	305	285	157	153	649	482	459	307	287	158	154	653	485	462	309	289	159	155	657	488	465	311	291	160	156	661	491	468	313	293	161	157	665	494	471	315	295	162	158	669	497	474	317	297	163	159	673	500	477	319	299	164	160	677	503	480	321	301	165	161	681	506	483	323	303	166	162	685	509	486	325	305	167	163	689	512	489	327	307	168	164	693	515	492	329	309	169	165	697	518	495	331	311	170	166	701	521	498	333	313	171	167	705	524	501	335	315	172	168	709	527	504	337	317	173	169	713	530	507	339	319	174	170	717	533	510	341	321	175	171	721	536	513	343	323	176	172	725	539	516	345	325	177	173	729	542	519	347	327	178	174	733	545	522	349	329	179	175	737	548	525	351	331	180	176	741	551	528	353	333	181	177	745	554	531	355	335	182	178	749	557	534	357	337	183	179	753	560	537	359	339	184	180	757	563	540	361	341	185	181	761	566	543	363	343	186	182	765	569	546	365	345	187	183	769	572	549	367	347	188	184	773	575	552	369	349	189	185	777	578	555	371	351	190	186	781	581	558	373	353	191	187	785	584	561	375	355	192	188	789	587	564	377	357	193	189	793	590	567	379	359	194	190	797	593	570	381	361	195	191	801	596	573	383	363	196	192	805	599	576	385	365	197	193	809	602	579	387	367	198	194	813	605	582	389	369	199	195	817	608	585	391	371	200	196	821	611	588	393	373	201	197	825	614	591	395	375	202	198	829	617	594	397	377	203	199	833	620	597	399	379	204	200	837	623	600	401	381	205	201	841	626	603	403	383	206	202	845	629	606	405	385	207	203	849	632	609	407	387	208	204	853	635	612	409	389	209	205	857	638	615	411	391	210	206	861	641	618	4

2. Spreader Capacity Is Unknown.

88

- Cut three or more sheets of equally sized plastic. 22 square feet (3' x 7'4" or 4' X 5'6") is preferred size.
- Weigh empty 5 gallon bucket plus one plastic sheet on a scale: _____ lbs.
- Lay sheets in field with edges secured by stones or other heavy objects.
- Drive tractor at normal speeds and discharge manure at typical rates over plastic sheets. Record tractor gear: _____, engine RPM: _____, and spreader settings: _____



- Check the sheet. Did a reasonably representative application rate fall on the plastic sheet?
- Carefully fold individual sheets without losing manure and place each sheet in separate buckets. Weigh each bucket. Bucket 1: _____ lbs. Bucket 2: _____ lbs. Bucket 3: _____ lbs.
- Subtract weight of empty bucket and plastic (step b) to determine net manure weight in each bucket. Net manure weight for Bucket 1: _____ lbs. Bucket 2: _____ lbs. Bucket 3: _____ lbs.
- Calculate average weight of buckets. Average Net Manure Weight: _____ lbs.
- Calculate application rate. Tons per Acre = (Net Manure Weight X 22) / area of plastic sheet (ft²)
If plastic sheet = 22 ft², then: Tons per Acre = Net Manure Weight

3. Pivot Calibration

If Pivot Flow Rate Is Known:

- Estimate pumping time: _____ hours
- Estimate water flow rate: _____ gallons per minute
- Estimate acres covered: _____ acres
- Estimate application rate:

$$\text{Inches (or ac-in/ac)} = \frac{\text{Pumping Time X Flow Rate}}{\text{Acres X 450}} = \frac{\text{X}}{\text{X 450}} = \text{_____ in.}$$

If Pivot Flow Rate Is NOT Known:

Use this method once a year

- Place 4 to 6 rain gauges (pans or straight sided plastic cups will also work) in line with the pivot center point at roughly equally spaced intervals. Placement on access road away from crop canopy is preferred.
- Measure depth in rain gauges and calculate average.
Gauge #1: _____ in. #2: _____ in. #3: _____ in. #4: _____ in. #5: _____ in. #6: _____ in.
Average Depth: _____ inches

OR

- Identify Rated Pump Pressure and Flow Rate: _____ psi at _____ gpm
- Identify Actual Pump Pressure: _____ psi
- Estimate Actual Flow Rate.

$$\text{GPM}_{\text{actual}} = \text{GPM}_{\text{rated}} \times \sqrt{\frac{\text{P}_{\text{actual}}}{\text{P}_{\text{rated}}}} = \text{_____} \times \sqrt{\frac{\text{_____}}{\text{_____}}} = \text{_____ gpm}$$

- Substitute actual flow rate in part d for "If Flow Rate Is Known" and complete calculation of application rate.

* Square Root

Rick Koelsch, University of Nebraska



Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Elbert C Dickey, Dean and Director of Cooperative Extension, University of Nebraska, Institute of Agriculture and Natural Resources.
University of Nebraska Cooperative Extension educational programs abide with the non-discrimination policies of the University of Nebraska-Lincoln and the United States Department of Agriculture.

UNIVERSITY OF
Nebraska
LINCOLN

Measuring Liquid Manure Application Rates

Marsha Campbell Mathews and Carol A. Frate
University of California Cooperative Extension

Introduction

Knowing the amount of manure nutrients that have been applied is essential for achieving the best crop production, protecting environmental quality and meeting regulatory requirements. There are several methods that can be used to measure, or at least estimate, the amount of liquid manure applied to a field. However, in selecting a method to use, it is important to also consider if the chosen method will enable the operator to easily apply a specific desired target rate of a nutrient at the precise time that it can be best utilized by the crop.

In order to know how many pounds per acre of nitrogen or other crop nutrient are being applied in lagoon water, several types of information are needed:

- the volume of the material that went onto the field (gallons),
- the amount of nitrogen in the water (concentration), and
- the area (acres) onto which the material was applied.

To avoid either under- or over-application of nitrogen, it is necessary to have a practical method of measuring, and ideally controlling, the amount of liquid manure applied. In most cases, a flow meter installed on the lagoon pump outlet is the simplest way to measure application amounts from the lagoon. A flow meter allows the user to easily calculate the amount of liquid manure and nutrients applied and, when combined with a flow control device such as a throttling valve, also makes it easy to adjust the flow rate so that the specific amount of nitrogen called for in a nutrient management plan can be applied to the crop.

Although an installed flow meter is almost always the best choice for managing lagoon nutrients and every effort should be made to install one, in reality other methods may need to be used on a temporary or permanent basis. Each of the other ways of estimating lagoon water application rates, and each has advantages and disadvantages.

In addition to measuring the amount of lagoon nutrients applied, regulations require all other sources of water and nitrogen be measured, so methods for measuring sources such as fresh water and reapplied tailwater are also needed. If some of the water that is applied to a field runs off as tailwater and is not



To calculate the amount of nutrients applied, a sample must be taken of the same material that is being measured. This sampling spigot is well-positioned for ease of use.

returned to the same field, the amount of runoff should be measured as well so that it can be subtracted from the application amounts in order to accurately measure and report the actual rates of water and nutrients that were applied to the crop.

The method or combination of methods selected for making these measurements will be influenced by many factors including cost, irrigation system limitations, and the accuracy of nutrient applications required to maintain yields and avoid groundwater contamination and/or runoff to surface waters. In choosing a method, consider if it is adequate to simply monitor the amount of nutrients that have been or are being applied, or if it is also necessary to proactively apply a specific target nutrient application.

Measuring Volume with a Flow Meter on the Lagoon Water Discharge

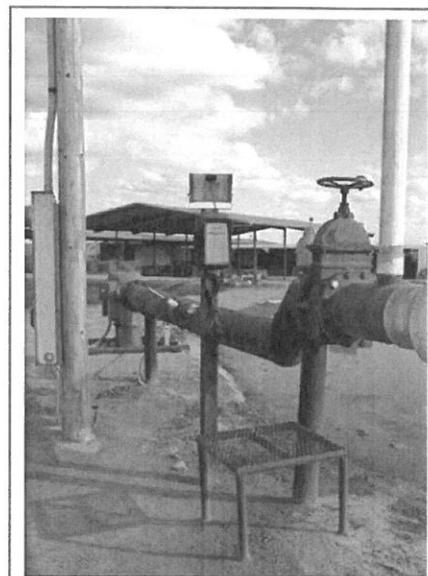
Installing an in-line flow meter on the lagoon water outlet pipe is the easiest method of measuring and controlling nutrient application when using pond water nutrients. Most flow meters will display both the current gpm and the totalized gallons. The amount of nutrients applied to each field is calculated using the starting and ending total gallons from the meter along with the nitrogen concentration in the liquid manure. If both a flow meter and a control valve are installed, the meter can be used to proactively apply a specific quantity of lagoon nutrients.

Having the capacity to control the application rate and apply precise amounts of nitrogen gives the flexibility to apply the nitrogen in several smaller applications over a number of irrigations rather than in one large application during a single irrigation. Applying nitrogen in multiple smaller amounts has several advantages:

- Ensuring that the nitrogen is available to the crop during critical growth periods
- Preventing crop injury from excess salts
- Minimizing leaching losses on light and medium soils
- Minimizing denitrification losses on heavier soils
- Preventing excessive applications by being able to adjust rates in subsequent irrigations if the run time or concentration was not what was expected

To apply a specific application rate, the concentration of lagoon water nitrogen is determined and the length of time for the irrigation is estimated. Then a chart or spreadsheet is consulted which gives the target gpm for the desired nitrogen application rate. The valve on the lagoon outflow is adjusted until the flow meter readout displays the targeted gpm. The flow meter is checked periodically during the irrigation to ensure that the desired application rate is maintained.

It is essential that the right kind of flow meter is installed and that it is installed correctly. There are many types of flow



Affordable flow meters for measuring dairy lagoon water are available with solar or battery power, data loggers and wireless data transfer. The right flow meter can greatly simplify nutrient management recordkeeping, and, when installed with a throttling valve or variable frequency drive controller, make it possible to accurately apply the specific amounts of nitrogen called for in the nutrient plan.

meters available but only a few are appropriate for use in dairy lagoon water because of the presence of debris and solids which clog or foul the mechanisms. Only flow meters commonly used for sewage, pulp, or other similar applications are appropriate for use with lagoon water.

All flow meters have placement requirements to enable them to read accurately. The pipeline where they are located must always be completely full. Sometimes there is already a location where they can be placed such as a vertical pipe, otherwise a metering run must be constructed that provides a section of pipe downstream from the meter where the pipeline is at least 1 pipe diameter higher than the pipe where the sensor is located. Many flow meters also require placement on a straight section of pipe that is at least 5 pipe diameters upstream and 10 pipe diameters downstream from an elbow or tee. A pipe with a 12-inch diameter would need total of 15 feet of straight run. The meter may need to be placed even further away from active valves, which distort the flow pattern more severely than elbows. In general, insertion style electromagnetic meters which measure the velocity of the liquid at one or two points near pipe wall are more sensitive to irregular flow patterns within the pipeline, and require more straight pipe, than full bore (tube style) electromagnetic meters which have multiple sensors surrounding the pipe or wetted Doppler insertion meters that integrate the velocity across the entire cross section of the pipe. The installation of a constructed metering run that meets the placement requirements for the selected meter must be factored in to the cost of the meter.

For additional information on selecting and installing flow meters, see [Flow Meters for Measuring Dairy Lagoon Water](#) and [Installing Flow Meters on Dairies](#) in this series.

Calculating nutrients applied using flow meter data

Record the beginning and ending reading from the flow meter totalizer for each field or area to which lagoon water is applied. The flow meter totalizer is usually set to read in either hundred or thousands of gallons. Be certain you know which multiplier is being used for your meter. If your meter is set to read in hundred of gallons, multiply your readings by 10 before using the following method.

1. How many gallons were applied to the field, as thousand gallons:
$$\text{Ending totalized gallons} - \text{beginning totalized} = \text{gallons applied}$$
2. How many pounds of nitrogen were in that volume
$$\text{ppm or mg/L nitrogen} \times \text{thousand gallons} \times .008345 = \text{pounds nitrogen applied}$$
3. How much was applied to each acre
$$\text{pounds nitrogen applied} \div \text{number of acres} = \text{lbs N applied per acre}$$

Operators who have experience using flow meters report that people often make mistakes when writing down totalizer numbers. It is a good idea to also record the average gpm and run time for each field to double check that the numbers were correctly transcribed. If the flow meter has a data logger, the totalizer reading at the start and end times can be looked up off the downloaded data.

Using a flow meter to apply a specific nitrogen application rate (“Target” Application)

Applying a specific amount of lagoon nitrogen or other nutrient is simple with a flow meter and throttling valve. The flow rate of lagoon water in gallons per minute (gpm) that will result in the desired amount of nitrogen applied is calculated, and the throttling valve or pump controller is adjusted until the flow meter displays that flow rate.

The target gpm is based on the amount of nitrogen needed, the concentration in the pond, and the expected run time. The gpm can be looked up using a chart such as the one below, available at manure.ucdavis.edu, or calculated using the following method:

1. Determine the amount of nitrogen to be applied to the area to be irrigated.

$$\text{Lbs N/acre} \times \text{number of acres to be irrigated} = \text{lbs N needed}$$

2. Calculate the amount of nitrogen in the lagoon water from the analysis.

$$\text{Mg/L or ppm N} \times .008345 = \text{pounds of nitrogen per 1000 gallons}$$

3. Calculate how many gallons of lagoon water it will take to supply the amount of nitrogen to be applied (See Step 1).

$$\text{pounds of nitrogen to apply} \div \text{lbs of N per 1000 gallons} \times 1000 = \text{total number of gallons of lagoon water}$$

Gallons per minute to achieve a target application rate									
lbs/Kgal	lbs/ac-in	mg/L or ppm	50 lbs N/acre						
			irrigation hours/acre			irrigation minutes/acre			
			1½	1¼	1	50	40	30	20
1.7	45	200	333	399	499	599	749	999	1498
2.5	68	300	222	266	333	399	499	666	999
3.3	91	400	166	200	250	300	374	499	749
4.2	113	500	133	160	200	240	300	399	599
5.0	136	600	111	133	166	200	250	333	499
5.8	159	700	95	114	143	171	214	285	428
6.7	181	800	83	100	125	150	187	250	374
7.5	204	900	74	89	111	133	166	222	333

Applying a specific amount of lagoon nitrogen or other nutrient is simple with a flow meter and throttling valve. Determine the flow rate needed to obtain the desired pounds of lagoon nitrogen based on the pond concentration and expected irrigation run time. Adjust the flow with the throttling valve or pump controller until the meter displays the needed flow rate. Complete charts are available at manure.ucdavis.edu.

4. Divide the number of gallons by the number of minutes it will take to irrigate this area.

$$\text{total gallons of lagoon water} \div \text{minutes} = \text{gallons per minute (gpm)}$$

Be careful when adjusting the flow rate to not go so low as to damage the pump or to allow solids to settle out and plug the pipeline. Determine ahead of time the minimum gpm for your pipeline and don't allow anyone to set a flow rate that is lower than that. If the required pump gpm is too low for the infrastructure to accommodate, consider redesigning the system or running the pump during only part of the irrigation as described in the pump output method section below. Additional options are discussed in [Designing Liquid Manure Transfer Systems](#) in this series.

Minimum gpm to maintain velocity in pipe to prevent solids from settling

feet per second	manure pipeline diameter (inches)												
	2	4	6	8	10	12	15	16	18	20	24	30	36
2	20	78	176	313	489	705	1101	1253	1585	1957	2819	4404	6342
2.3	23	90	203	360	563	810	1266	1441	1823	2251	3241	5065	7293
3	29	117	264	470	734	1057	1652	1879	2378	2936	4228	6606	9513
4	39	157	352	626	979	1409	2202	2505	3171	3915	5637	8808	12,684
5	49	196	440	783	1223	1762	2753	3132	3964	4893	7047	11,010	15,855

Use this chart to determine the minimum gpm that will maintain a high enough velocity to prevent solids from settling out and plugging the pipeline. NRCS recommends a minimum of 2-5 ft/sec for 4-10% suspended solids. Use the higher or lower value depending on your solids level, the slope and roughness of the pipeline, and how difficult it would be to clean out your pipeline should plugging occur.

Measuring Application Volume using Pump Output and Run Time

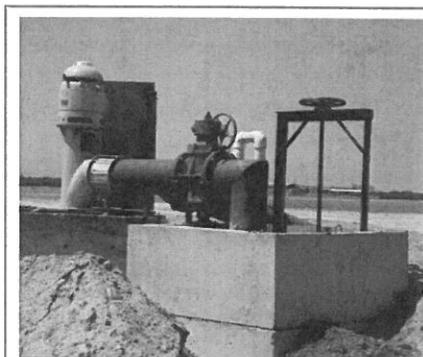
With this method, the output of the pump (gpm) is estimated and the time the pump runs is recorded. Once the concentration of nitrogen in the lagoon water is known, a “lookup” table or simple calculation gives the total pounds of nitrogen applied. The total pounds of nitrogen applied divided by the number of acres gives the pounds of nitrogen applied per acre. This method is prone to inaccuracies and allows only limited flexibility in controlling application rates of lagoon water nutrients. Nonetheless, it avoids the expense of a flow meter and may be the only option in some circumstances.

Seldom does a pump put out exactly the rated amount. Actual pump output is influenced by:

- The depth of water in the pond
- The amount of wear on the pump
- Debris on the impellor
- The distance and elevation the water is being pumped
- The type and diameter of pipeline
- How many solids are in the pumped material

The lower the water level in the pond, the less the pump output. This is true for both floating pumps and stand pumps because it is the difference in elevation between the level of water in the pond and the level of the discharge that determines the amount of energy required to pump the water through the same section of pipe.

Friction, constrictions and elbows increase the amount of head pressure or pumping pressure that it takes to move the same amount of liquid at the same velocity. If the lagoon water is in a pressurized pipeline with multiple discharge points, those discharges that are further away have more losses from friction, bends, constrictions and flatter slope, resulting in lower flow rates when pumping to far fields compared to closer ones at the same pond level.



Pump output and run time is often used as an interim method to estimate the volume of lagoon water applied in situations such as this where the close proximity of the pump and valve to the discharge make it necessary to make modifications to the pipe before a flow meter can be installed.

Measuring Flow Using a Pump Output Chart

In a pumped system, the liquid manure is often lifted from the pond and discharged into a box or standpipe and there is an air gap between the outlet of the pipe and the receiving water. If an air gap exists so that the lagoon water is pumped without backpressure from the freshwater it is mixed with, creating a chart which relates the gpm of the pump output to the depth of water in the pond will make calculating the amount applied more accurate by adjusting the gpm rate used in the calculations according to the depth of the pond at the time of the irrigation.

feet	gpm
below full	
full	1990
1	1910
2	1840
3	1770

Pump output declines as the pond is lowered. Making a chart such as this one can make pump output estimates more accurate. Remember that thick solids also can decrease the pump output by as much as half.

In a gravity or pumped system where the liquid manure is discharged directly into an underground freshwater pipeline, the lagoon flow rate can be greatly influenced by the amount of backpressure in the freshwater pipeline. There are many factors that determine the final lagoon flow rate, which is ultimately a function of the difference between the elevation of the freshwater source such as a canal, the pond level and the field discharge. This can vary throughout the irrigation for many reasons, including

- The depth of water in the pond
- The depth of water in the canal
- the number and degree of opening of the field valves
- the friction losses in the pipe as determined by distance and pipeline interior roughness
- the number of elbows or restrictions
- some fields having a different pipeline diameter
- some areas that are served by pipelines that have a flatter or steeper slope than others

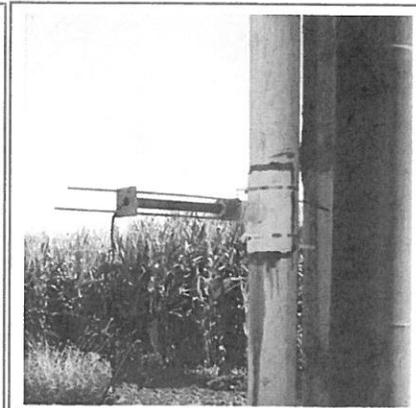
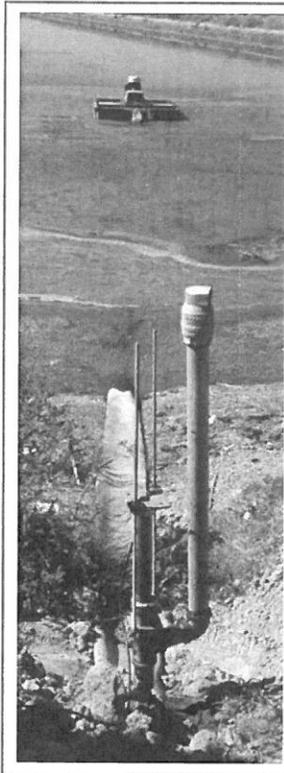
Because of these factors, the flow rate from the pond discharging directly into an underground pipeline is often different for different fields and possibly within the same field even at the same pond elevation and valve opening. This method should be used with caution in a gravity system.

Methods of Measuring Pump Output

One of the difficulties in using the pump output method is determining what the lagoon pump output is. The most common way of testing freshwater pump output is to insert a pitot tube type device into the outflow of the pump. Lagoon pumps are not commonly tested with this method because lagoon water contains particles that clog the device, which somewhat resembles a drinking straw, almost as quickly as it is inserted.

The easiest way to verify the output of the lagoon pump is to temporarily install a flow meter. Even if the installation is temporary, it is still critical to choose the correct flow meter and to have the meter sited in a location that ensures that it is reading accurately. Sometimes it is possible to find a place to install a probe style insertion meter that requires only minor modifications of existing plumbing and still meet the requirements of a full pipe with the minimum length of straight run to ensure a uniform flow cross section. Sloping pipes from floating pumps and vertical pipes that discharge liquid manure into irrigation boxes often have suitable conditions. If sufficient length of straight pipe is not available, there are several options, including:

- Use a wetted Doppler insertion meter which requires less straight run than traditional insertion style electromagnetic meters
- Construct a metering run for installing a temporary meter with the intention of purchasing a permanent meter later
- Temporarily install a probe style magmeter and take velocity readings at multiple points in a transect across the pipe to make a custom profile factor to compensate for a less than ideal placement
- Use a different measurement method, such as the pond drop method described below.



The existing vent (left) was moved over to accommodate temporary installation of an insertion-style meter on the floating pump. The sloping pipeline ensured that the meter was in a full pipe. A PVC saddle on a vertical liquid manure pipe discharging into a concrete standpipe was not difficult to install and was capped when the temporary meter was removed. The rods on these meters allow the sensor probe to be precisely positioned to a specific depth inside the pipe.

An external Doppler meter has the advantage of being able to be strapped onto a pipe without cutting into it, but it is usually difficult to find a location on a dairy that meets the stringent conditions that this type of meter needs to be accurate.

Once a meter is installed, make a chart by recording the pump output at varying pond levels. If desired, the chart could also include the flow rates when a valve is partially closed, including the number of turns or stem height, so that the operator can have more control over application rates. The chart can be used proactively to tell the operator how much to open the valve in order to obtain a desired flow rate at a given lagoon level.

Another way to estimate lagoon pump output is by measuring pond drop (gallons) over time. First, turn off all other inflows and outflows to the pond. Record the exact starting level of the pond on a vertical pole or structure. Record the exact starting time. Run the pump until the pond has dropped a measurable distance, such as a foot. Note the exact ending time and the inches of vertical drop. Measure the dimensions of the surface water in the pond when the pond is at the mid-point of the total anticipated drop. Calculate the number of gallons that were discharged by converting pond acre-inches to gallons (1 ac-in = 27,154.3 gallons) and divide by the number of minutes to get gallons per minute. This procedure can be repeated for as many intervals as desired.

Calculating nutrients applied from GPM and run time

Once the flow rate is known, the rate of nitrogen application can be calculated based on the concentration of the nitrogen in the lagoon water. It may be helpful to estimate ahead of time what that application rate is likely to be using a chart such as the one to the right. The time that the irrigation ran on each field or area must be recorded accurately. The pond level and amount of solids should also be recorded

so that the gpm can be adjusted accordingly. After the application, the amount of water and nutrients that were applied can be calculated using this method:

1. How many gallons were applied to the field, as thousand gallons:
 $\text{Gallons per minute (gpm)} \times \text{hours} \times 60 \text{ minutes/hour} = \text{gallons applied}$
 $\text{Divide by 1000 to get thousand gallons}$
 $\text{Gallons applied} \div 1000 = \text{thousand gallons}$

concentration of N in lagoon	lbs per thousand gal	lbs/ac-in	mg/L or ppm	gallons per minute (GPM)							
				250	500	750	1000	1250	1500	1750	2000
1.7	45	200		25	50	75	100	125	150	175	200
2.5	68	300		38	75	113	150	188	225	263	300
3.3	91	400		50	100	150	200	250	300	350	401
4.2	113	500		63	125	188	250	313	376	438	501
5.0	136	600		75	150	225	300	376	451	526	601
5.8	159	700		88	175	263	350	438	526	613	701
6.7	181	800		100	200	300	401	501	601	701	801
7.5	204	900		113	225	338	451	563	676	789	901

Use a chart such as this one to estimate the rate of nutrient application based on the pond concentration and pump gpm. Complete charts are available at manure.ucdavis.edu

2. How many pounds of nitrogen were in that volume
 $\text{ppm or mg/L nitrogen} \times \text{thousand gallons} \times .008345 = \text{pounds nitrogen applied}$
3. How much was applied to each acre
 $\text{pounds nitrogen applied} \div \text{number of acres} = \text{lbs N applied per acre}$

Applying Targeted Amounts of Nitrogen Using the Pump Output (GPM) Method

A limitation of using pump output to measure application rates is the difficulty in adjusting application rates that are too high. If a throttling valve is used to restrict the flow, it will no longer be possible to determine the amount of liquid and nutrients applied unless a different method such as a temporary flow meter, is used to revise the pump output chart to include the pump output at that valve opening for various pond levels.

Liquid manure added	Nitrogen applied (lbs N/ac)	Application uniformity
During entire irrigation	242	+
When freshwater advance was at 75% of field length	86	++
When freshwater advance was at 85% of field length	31	++++

Another way to decrease the application rate is to run the pump at the full amount but only turn the pump on during the last portion of each irrigation set or check. This method allows the pump to be run at full capacity but for a shorter period of time. The uniformity of the application is also improved, especially in situations where the water takes a long time to move across the field and the upper portions of the field have water on them for a much longer period of time than the lower portions. Turning on the lagoon water pump later into the irrigation also minimizes the solids buildup around the valves by helping to spread the solids out over the whole field.

Since the lagoon pump must be turned on and off for each check or set, if the run times or acres in each set or check are not all the same, the pump run time will need to be calculated individually each time the water is used. Calculate the amount of nitrogen that each area will need to receive by multiplying the desired application rate in pounds per acre by the number of acres to be irrigated. Divide this amount by the pounds of nitrogen per hour that the pump is applying (from chart) to determine the number of hours to run the pump on that check.

Important note on this method:

When the lagoon pump is turned on or off the lagoon water at the discharge of a pressurized system will start or stop immediately because the water in the pipe is a continuous column. However, it may take a long time for the lagoon water to travel from where it is introduced into the fresh water until it actually reaches the field and the irrigation for that check may be over by the time the lagoon water arrives. This lag time needs to be considered and accounted for when determining when to turn on and off the pump.

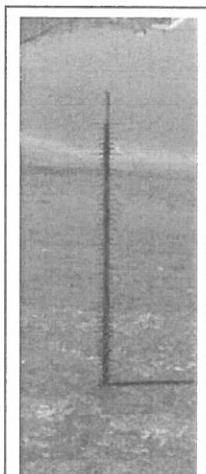
How long to run the pump on each check or set
Run time for lagoon pump to achieve a target application rate

		lbs of nitrogen per hour from pump					
		100	200	300	400	500	600
lbs N for this set	250	2 h 30 m	1 h 15 m	0 h 50 m	0 h 38 m	0 h 30 m	0 h 25 m
	500	5 h 0 m	2 h 30 m	1 h 40 m	1 h 15 m	1 h 0 m	0 h 50 m
	750	7 h 30 m	3 h 45 m	2 h 30 m	1 h 53 m	1 h 30 m	1 h 15 m
	1250	12 h 30 m	6 h 15 m	4 h 10 m	3 h 8 m	2 h 30 m	2 h 5 m
	1500	15 h 0 m	7 h 30 m	5 h 0 m	3 h 45 m	3 h 0 m	2 h 30 m
	1750	17 h 30 m	8 h 45 m	5 h 50 m	4 h 23 m	3 h 30 m	2 h 55 m

Multiply the target application rate (lbs per acre) by the acres in the set to get the total amount of nitrogen needed for this area. Divide this amount by the pounds of nitrogen per hour that the pump is applying (from chart above) to determine the number of hours to run the pump on that check, or use a chart like this, available at manure.ucdavis.edu.

For example, a pump that is putting out 400 lbs of nitrogen per hour will need to be run 1 hour 15 minutes to apply 50 lbs/ac of nitrogen on 10 acres (500 lbs total)

Measuring Application Volume Using the Pond Drop Method



This staff gauge has metal cross bars. Painted markings become difficult to read when coated with scum.

The concept behind the pond drop method is to determine the surface area of the pond in acres, then multiply the pond surface acreage by the number of inches of vertical drop as the pond is used to irrigate a field of known size. Multiplying the area of the pond (in acres) by the drop (in inches) gives the acre-inches of pond water that went out during the irrigation. Acre-inches multiplied by the pounds of nutrient per acre-inch gives the total pounds of nitrogen applied. The pounds of nitrogen applied per acre are determined by dividing the total applied by the number of acres irrigated.

While the pond drop method may appear to be simple and straightforward, in practice it is often challenging to obtain accurate application volumes using this technique. There are many reasons pond drop volumes may be difficult such as odd pond shapes, non-uniform side slopes, the presence of irregular areas of built up solids, other inflows to the pond (the capacity of a flush pump is typically much higher than that of the irrigation pump), two or more interconnected ponds, the difficulty of establishing and using a measuring pole, and the short distance a large pond drops when low rates are applied to a small field. If fresh water is introduced into the pond at the same time as the pond is being drawn down, using pond drop as a method of estimating nutrient application is especially difficult. Irrigations that begin and/or end during the middle of the night can be a problem if the measuring pole cannot be read in the dark by a competent person. Devices for accurately measuring the depth of the pond exist, however, the more economical choice would usually be to invest in a flow meter.

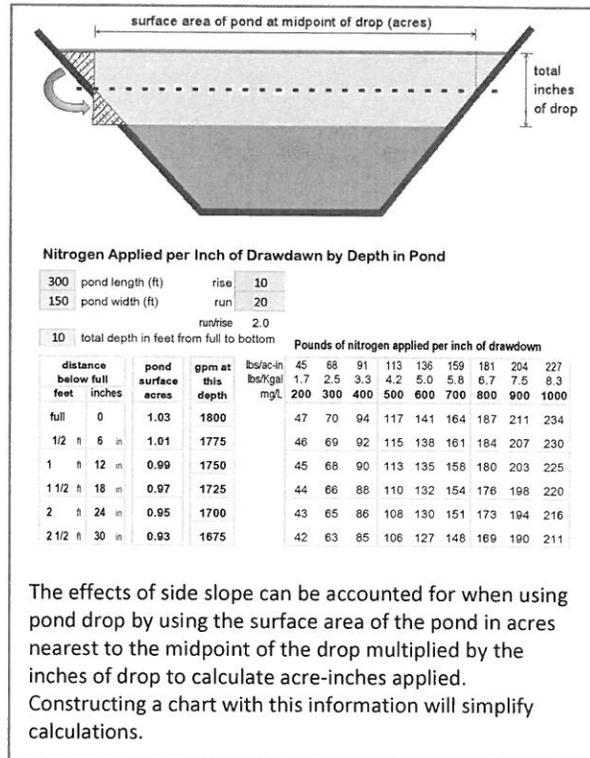
Despite the potential inaccuracies, the pond drop method is often used on dairies to determine how much water has been applied because this method is relatively simple and requires few capital inputs. And there are some situations where the pond drop method can provide very accurate information and can be used not only for measuring application amounts but also to check the accuracy of other

measuring application amounts but also to check the accuracy of other

measurement methods. The pond drop concept is useful for other purposes such as calculating the volume applied from tailwater return ponds.

Because the sides of most ponds are sloped, an inch of drop when the pond is full is not the same volume applied as when the pond drops an inch when the pond is lower. If the slope of the pond is fairly uniform, the pond surface area (length x width in acres) at the half way depth of the drop multiplied by the total inches of drop will give an accurate estimation of the acre-inches of water applied. Having a chart for the pond which gives the surface area of the pond at different depths can simplify calculations. Make the chart either by measuring the pond surface length and width at intervals as the pond is drawn down, or by entering the dimensions of the pond and run and rise of the slope into an Excel template available at manure.ucdavis.edu.

It can be difficult to achieve a target application rate using the pond drop method because of the large amount of acreage that must be irrigated before the rate of drop can be established and adjusted. Constructing a chart which gives the estimated pump output (in gpm) from the pond at different pond levels can be helpful in proactively estimating if a planned application will result in an appropriate application rate.



Measuring Lagoon Flow Rate using Dilution

If only the freshwater flow rate can be measured, it is possible to estimate the flow rate of lagoon water by sampling the combined lagoon and fresh water and the undiluted lagoon water, and then analyzing both samples for a constituent that is not present in the fresh water. Potassium is a good constituent to use for this purpose since it occurs in only one form in water and is not commonly present in greater than trace amounts in freshwater. Some "fresh" water sources that do contain significant amounts of potassium or sodium include manured tailwater, some tile drain water, canal water that receives tile drain water, and most municipal or food processing wastewaters. In these situations, the fresh water source will need to be analyzed in addition to the lagoon and blended water. Ammonium is another constituent that can be

Calculating lagoon flow rate from dilution
 Example:
 The measured freshwater flow rate is 1300 gpm. The concentration of soluble K in the freshwater is negligible.
 The concentration of soluble K (potassium) in the lagoon water is 490 mg/L and 160 mg/L in the blended water.
 $160 \div 490 = .33$ or 33% of the total flow came from the lagoon.
 If 33% came from the lagoon, then 67% came from the freshwater.
 $1300 \text{ gpm} \div .67 = 1930 \text{ gpm}$ combined flow rate.
 $1930 \text{ gpm} - 1300 \text{ gpm} = 630 \text{ gpm}$ lagoon flow rate

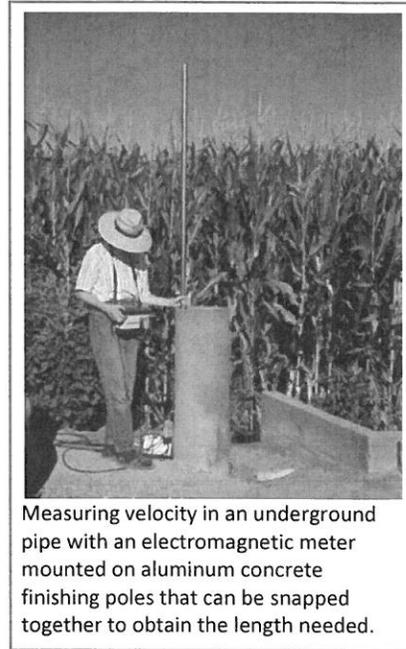
analyzed for dilution but it can volatilize or change form under some circumstances. Other constituents such as sodium would work as well as potassium but may require analyses that or otherwise not required.

Both lagoon and blended water samples should be taken at the same time and as close as possible to the time that the flow was measured to minimize the effect of fluctuations in flow rates or concentrations. Be sure that the flow from the lagoon has run long enough to have cleared out water from previous applications. Where pipeline runs are long, this can take a long time.

To calculate the flow rate of the lagoon water, divide the concentration of potassium in the mixed water by the concentration in the lagoon water to find what percent of the total flow came from the lagoon. The percent that came from the freshwater is 100% minus the lagoon flow percentage. Divide the measured freshwater flow rate by the freshwater percentage to calculate what the total flow rate must have been. Subtract the freshwater flow rate from the total flow rate to determine the lagoon flow rate.

The freshwater flow rate can be measured with a flow meter on the freshwater pump, a recent pump test, or by using a hand-held velocity meter inserted down a vent or standpipe. If an accurate measurement of the blended fresh and lagoon flow can be obtained, this method can be adapted to estimate both the fresh and lagoon flow rates. It can also be adapted for use in other difficult situations, such as measuring tailwater runoff.

The dilution method is somewhat cumbersome for most dairy operators to use regularly but is useful when it is not feasible to make permanent changes to the system. Also, any method such as this one that measures the flow rate at a single point in time assumes that the flow rate from the district and the pond is the same throughout an irrigation, which is often not true. Even if the district or pump flow rate is uniform, the flow rate for a particular field, or portion of a field, may vary due to differences in pipeline characteristics such as slope, pipe length and diameter, in addition to the number and degree of opening of valves. For this reason, this method can be considered only an estimate of actual flow rates.



Measuring velocity in an underground pipe with an electromagnetic meter mounted on aluminum concrete finishing poles that can be snapped together to obtain the length needed.

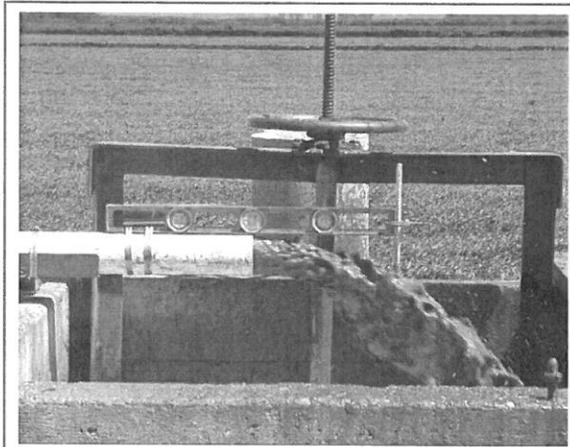
Measuring Lagoon Water Flow Rate by Difference

If it is not possible to directly measure the flow rate of the lagoon water but it is possible to measure the flow rates of both the fresh water and the combined fresh and lagoon water, the flow rate of the lagoon water can be calculated by subtracting the freshwater flow rate from the combined water flow rate.

For example, if the blended water flow rate is 1500 gpm and the freshwater flow rate is 500 gpm, then the lagoon water flow rate is $1500 \text{ gpm} - 500 \text{ gpm} = 1000 \text{ gpm}$.

If only the blended water flow rate can be measured, turning off the pond pump and comparing the blended flow rate to the freshwater only flow rate will not usually provide an accurate measure of the lagoon flow rate unless the blended water is measured in an open channel or in a pipeline that is not

full. Both the velocity and level of the water must be measured. If When the blended water to be measured is in a full pipeline and the pond water pump is turned off, part of the original mixed flow may be taken up by additional fresh water, giving an erroneously low estimation of the difference between the total flow and the fresh water flow.



The trajectory of water being discharged from an open pipe may be used to estimate flow rate.

This method may be useful as a temporary estimate, however it may be awkward to do in the dark and is less convenient for throttling purposes. For charts and additional information on this method, see “Hanson and Schwankl, Measuring Irrigation Water Flow Rates.”

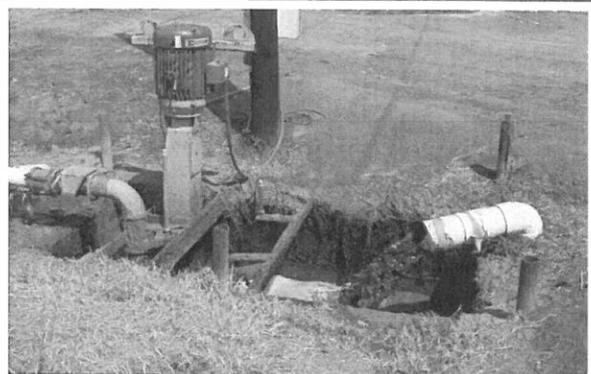
Another option is simply to record the amount of time it takes for the discharge to fill a container of known volume, such as 5 gallon bucket, and calculate the gallons per minute (gpm). This method works best when the expected flow rate is less than about 30 gpm.

Measuring Freshwater and Blended Fresh and Lagoon Water with Flow Meters

Accurate measurement of fresh water applied is important for many reasons in addition to being required. Inexpensive mechanical meters such as propeller type meters are often used when pumping groundwater. If the meter must be located near an elbow or valve, propeller meters that measure the entire cross section of the pipe are more accurate than those that measure only a portion of the flow. Accuracy can also be improved by placing the meter in a standard metering run. Other types of meters, such as electromagnetic flow meters, can be used to measure fresh or blended water but are considerably more expensive.

Measuring Lagoon Flow Rate from a Pipe Discharge

If there is a location where the liquid manure discharges from an accessible pipe, and the flow rate is not high, there are a couple of inexpensive options for measuring the flow rate. If the pipe is horizontal, the output can be estimated by measuring the distance from the pipe at the point where the output stream has dropped 4 inches from horizontal. The flow rate is estimated from this distance and the pipe diameter using a table. Similar charts exist for pipes that are not horizontal.



The flow rate of this liquid manure discharge could be estimated by timing how many seconds it takes to fill a 5 gallon bucket. If it takes 10 seconds, or $10 \div 5 = 2$ seconds per gallon, then in 60 seconds (1 minute), $60 \div 2 = 30$ gallons or 30 gpm would be pumped. Or, calculate gpm by dividing 300 by the number of seconds it takes to fill 5 gallons.

On freshwater pumps with minimal variation in pumping levels, the pump output, verified by an accurate pump test, can be used along with pump run time to calculate the volume applied with sufficient accuracy for most purposes.

When measuring water pumped from a canal or river, however, propeller type meters may not be the best choice because water weeds or other stringy debris can interfere with any sort of meter which is installed inside or protrudes far into the pipe. Screened intakes can help but may need to be frequently cleaned. Electromagnetic or Doppler meters with minimal protrusions are preferred for these situations but are more expensive.

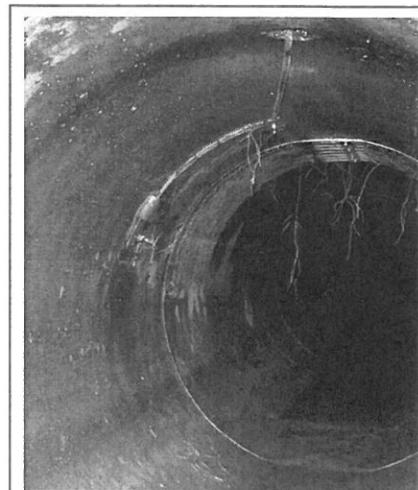
Water received from a district is usually delivered in open canals. Travel from the district turnout to the fields may be in underground pipeline or it may be in an open channel.

The easiest way to measuring the flow of water in a large underground pipeline is with an electromagnetic or wetted Doppler meter with a debris shedding sensor mounted to the inside wall of the pipe. On pipes less than about 30 inches in diameter, the sensor is often mounted to a band that fits snugly inside the pipe. On larger pipes where access to the inside of pipe is possible, affixing a bracket to the inside wall of the pipe to hold the sensor may be preferable. In either case, it is critical that the sensor, bracket and interior cable be configured tight to the wall in such a way that water weeds and debris cannot be trapped and interfere with the reading.

Pipes that do not run full and open channels will require that both the velocity of the water, as measured by the flow meter velocity sensor, and the depth of water in the pipe or canal, be simultaneously measured. Flow meters measure the velocity of the water but the flow rate is determined by both the velocity (the number of feet a water particle travels per second) of the water and the cross sectional area (square feet) that the water travels through. Combined, these two pieces of information give the volume (cubic feet) passing through that cross sectional area per second (cubic feet per second, or cfs).

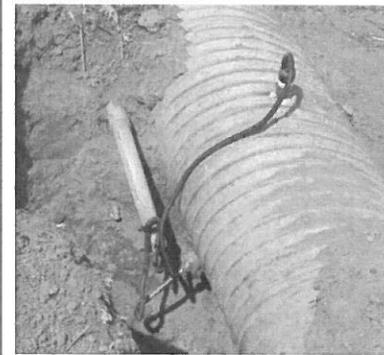
Open air space in the top of the pipe, and silt or debris in the bottom of the pipe change the area of the pipe. The depth of the silt layer may change even during the irrigation of an individual field depending on the velocity of the water in the pipe, which can be affected by a variety of factors including the number of valves open or the elevation of the irrigation valves in comparison to the height of the canal.

Both an estimate of depth of the silt in the pipe and the depth of water in the pipe are necessary to calculate the volume of water flowing through the pipe in a non-pressurized system This can be done by



The flow meter sensor above is mounted to the inside wall of a large diameter pipeline. If the pipe does not always run full, another sensor to detect the water level in the pipe will be needed in addition to the velocity sensor. The level and velocity sensor may be integrated on the same mount, or they may be separate devices. The installation in the photo below has a ultrasonic level sensor mounted at the top of the pipe and a velocity sensor through the side, with no wires inside the pipe.

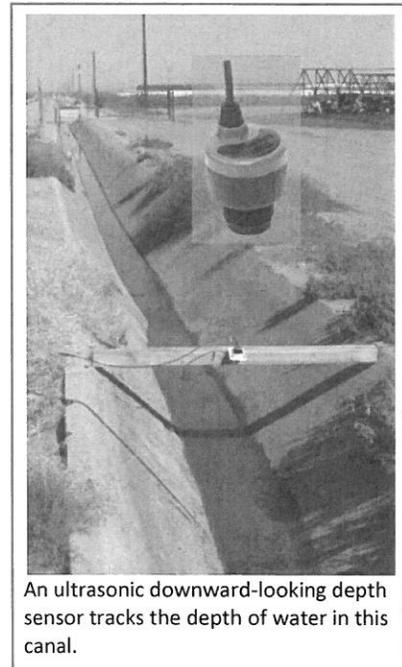
Photos: Mace USA LLC



using a sensor mount that has a capacitive pressure diaphragm which measures the weight of the water above it, or with a separate downward looking ultrasonic depth sensor mounted at the top of the pipe. The pressure diaphragm method is suitable in situations where the sensor will be wet. The downward looking depth sensor is mounted above the fluid and does not come in direct contact with it, making it ideal for very dirty or debris laden water. Both methods of measuring and recording water levels are useful for a variety of other purposes, such as turning on a sump pump or recording the depth of water in lagoons, open channels or weirs.

Computer software that will calculate the flow rate from the velocity and cross sectional area is essential and is generally supplied by the meter manufacturer. When selecting a meter and depth sensor, be sure that that you will be able to understand and use whatever additional software is needed to determine flow rate.

The same meters and level sensors that are used to measure flow rate in partially full pipes can also be used for the same purpose in open channels such as canals. If a temporary metering solution is needed, an electromagnetic meter on a lightweight pole can be used to obtain a velocity reading at a single point in time. Access to straight stretch of pipeline through a vent is necessary. Either an electromagnetic velocity meter or wetted Doppler insertion meter can be used as a temporary meter for blended liquid manure in open channel canals and irrigation ditches.



An ultrasonic downward-looking depth sensor tracks the depth of water in this canal.

Measuring Freshwater and Blended Fresh and Lagoon Water without using a flow meter

There are a variety of ways to measure irrigation water being applied to or running off of fields without using a flow meter. These involve portable flumes, various constructed weirs or the size and number of siphon pipes being used. All of these methods measure the depth of water in or difference in depth of water on either side of a constriction of specific shape and size. The flow rate is usually read off a chart for that device. These methods do not usually require expensive devices and are especially useful when exact volumes are not essential. They are most appropriate in situations where the flow rates are fairly constant, unless multiple readings are taken. A data logging depth sensor can provide a log of the height of the water passing through a flume or weir. This may be a cost effective solution if the depth sensor can be accommodated by an existing data logging controller box. An excellent reference for these and other method is Detailed information on these methods is "Hanson and Schwankl, 2010. [Measuring Irrigation Water Flow Rates](#)"



The depth of the water passing through a flume or weir can be used to estimate flow rates.

Measuring Tailwater Runoff

A method to measure or estimate the amount of tailwater runoff from fields is essential to avoid over estimating the amount of nutrients applied to the field and to avoid over reporting of nutrients and salts when calculating application amounts in relation to crop removal.

Allowing some of the water applied to run off the field as tailwater is often necessary on fields where infiltration is slow. On these fields, 15 to 25% of the total water applied is allowed to run off in order for the water to remain on the surface long enough to wet through the root zone. This runoff water is collected and either pumped back on to the same field, to a different field or to the retention pond. If this runoff is not reapplied back to the same field, that portion of water and nutrients that ran off needs to be subtracted from the application amount.

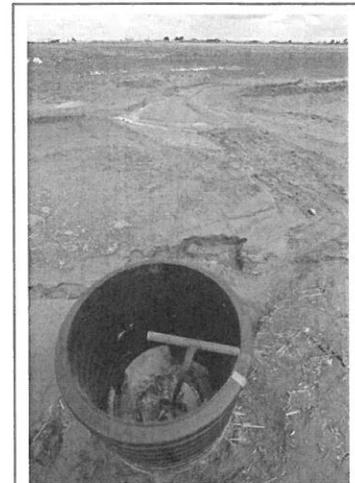
If the runoff is applied to the same field and the re-applied water contains significant concentrations of nutrients, the portions of the field that received the additional tailwater may receive more nutrients than portions that did not unless adjustments are made.

There are several options for measuring the volume of tailwater runoff.

As with undiluted lagoon water, using a suitable flow meter is the easiest and most accurate method of measuring runoff. Solar or battery powered datalogging wetted Doppler or electromagnetic flow meters are ideal for this purpose if the water can be routed through a length of pipe that is configured so that it will always run full. If the water is in a pipeline or open channel that is not full, the flow meter velocity reading can be used in conjunction with a level sensor to calculate the flow. It may be possible to use a temporary meter to obtain percent runoff estimates that can be used at other times.

If the runoff drains into a sump out of which water is pumped, the volume pumped can be estimated by multiplying the length of time the pump ran by the pump output. The pump output in gpm can be determined by stopping the inflows to the sump and timing how long it takes for the pump to draw down a

known volume. At a minimum, the pump should have a run time meter and the hours of runoff for each field recorded. A totalizing flow meter on the pump discharge would be more accurate.



Water and nutrients that run off the field and are not re-applied to that same field should be measured and subtracted from what was applied so that the crop is not inadvertently shorted of nutrients and so that application amounts are not over—reported.

Calculating flow rate by sump fill time

Example:

A 5 foot deep tailwater sump is 8 feet wide and 10 feet long when it is halfway full.

8 ft x 10 ft is 800 square feet surface area, or $800 \div 43560 \text{ ft}^2/\text{ac} = .001837$ acres

The pond is 5 feet deep or $5 \times 12 \text{ in/ft} = 60$ inches deep

Measuring the pond surface area when the pond is half full, or 2.5 feet below full accounts for the side slope of the pond.

The pond capacity is $.001837 \text{ acres} \times 60 \text{ inches} = .110193 \text{ acre inches}$.

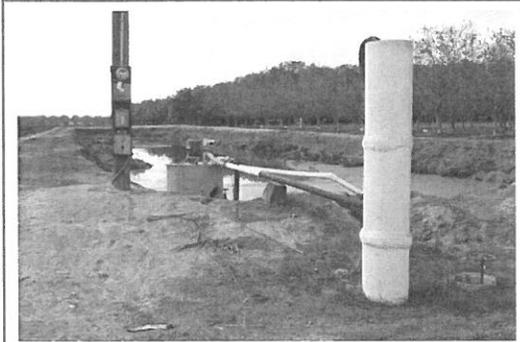
1 ac-in = 27,154.3 gallons

$.110193 \text{ acre inches} \times 27,154 \text{ gallons/ac-in} = 2,992 \text{ gallons in the pond}$.

If it takes 30 minutes to fill the pond, the inflow rate is

$2992 \text{ gallons} \div 30 \text{ minutes} = 100 \text{ gpm}$.

Another way to estimate the runoff flow rate is to record the length of time it takes to fill a sump of known volume and use this to calculate the flow rate. Ideally, this should be done several times over the course of the irrigation to confirm that the flow rate is constant. The flow rate is then multiplied by how long the entire flow ran to calculate the total volume of runoff for that field. The more variable the flow rate and uncertain the start and end times of the runoff, the less accurate this method will be for a particular irrigation and field.



Many of the same methods that are used to measure flows from wastewater lagoons can also be used to measuring the flow into and out of tailwater retention ponds like this one.

If there is a tailwater retention pond, measuring the volume of water in that pond is useful only if the entire runoff from a single field is captured in the pond, and if the pond is not being drawn down at the same time as it is being filled. If the runoff from only one field it may be possible to calculate the runoff rate.

Ideally, a tailwater pump sumps and tailwater retention ponds should be constructed in a way that facilitates a way to measure or estimate the amount of runoff that occurred, and to measure the amount of tailwater that was re-applied onto a different field.

References

Hanson, B. R. and L. J. Schwankl. 2010. Measuring Irrigation Water Flow Rates. University of California Agriculture and Natural Resources Publication 21644

Schwankl, L. and C. Frate. 2004. Alternative techniques improve irrigation and nutrient management on dairies. California Agriculture. Vol 50 NO. 3 pp 159-163