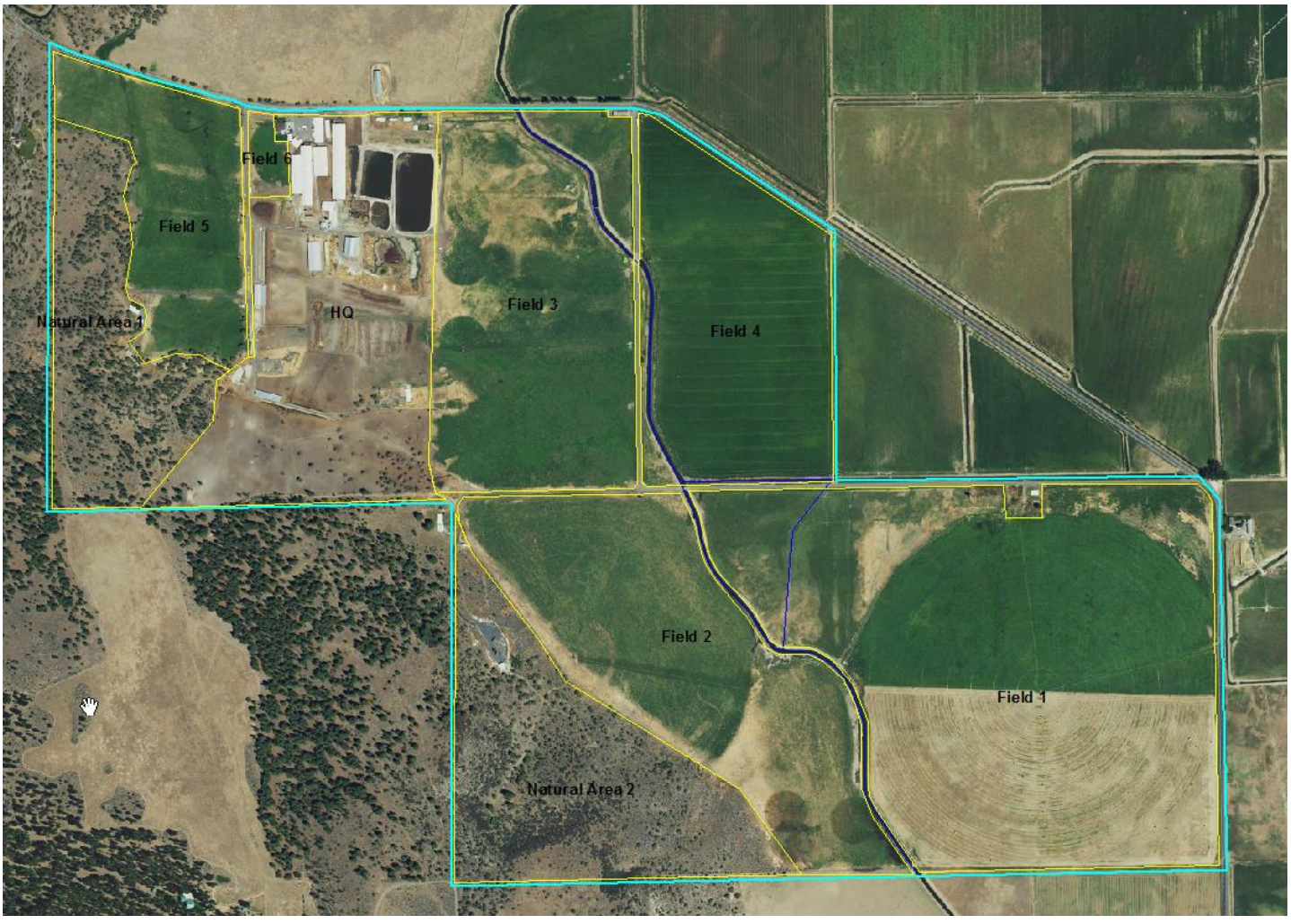
Animal Waste Management Plan
for
Holland's Dairy

c/o Bouke DeHoop
19000 South Poe Valley Road
Klamath Falls, OR 97603
(541) 882-9747



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Holland's Dairy

2016

Animal Waste Management Plan

Holland's Dairy

2016

Animal Waste Management Plan

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SECTION 5 – REFERENCES

GENERAL INFORMATION

Oregon Department of Agriculture **CAFO Division** **Animal Waste Management Plan** **Signature Sheet**	**ODA USE ONLY** MA#_____ AWMP#_____ Approved Date_____ Received Date_____

Facility Name: Holland's Dairy

Facility Address: 19000 South Poe Valley Road

Klamath Falls, OR 97603

Operated by: Bouke DeHoop

Mailing Address: 19000 South Poe Valley Road

Klamath Falls, OR 97603

Complete if different than the Operator

Owned by: Bouke DeHoop

Mailing Address: 19000 South Poe Valley Road

Klamath Falls, OR 97603

☐**As the Operator of** Holland's Dairy**, I agree to manage this facility in accordance with the existing Animal Waste Management Plan (AWMP) #_____ on file with ODA and maintain those practices as described in the plan. This signed AWMP is incorporated into the CAFO NPDES General Permit by reference (Permit Condition S3.A.2.).**

☐**If changes are made to the animal population, facilities and/or management of the CAFO, a new AWMP must be submitted to ODA for approval at least 45 days before the modification is implemented unless a different schedule is allowed by ODA in writing (Permit Condition S3.D.1 and 2).**

Operator's Signature	**Date**

Operator's Name (Please Print)

Bouke DeHoop

GENERAL INFORMATION

GENERAL INFORMATION

BACKGROUND AND SITE INFORMATION

Animal Feeding Operation: Large Concentrated CAFO

Type & Size: Dairy – 2,000 animals

Latitude/Longitude: N42.1593^0, W121.5586^0

Holland's Dairy is located approximately a 13.5 miles east of Klamath Falls, Oregon along South Poe Valley Road in a rural area of Klamath County. It is located in the southeast region in Oregon at an elevation of approximately 4,150 feet. The annual precipitation varies from 12 to 15 inches of which 70% falls within a 6 month period from November through April and less than 10% falls from June through August. Total average annual snowfall is 15 to 45 inches. Winds are generally moderate from the west with an average annual wind speed of 9 mph. There is approximately 90 to 120 frost free days and the average annual mean temperature is 48 degrees Fahrenheit. Soils vary from deep to moderately deep loam, loamy fine sand, fine sandy loam, and very fine sandy loam that are well to excessively drained.

Holland's Dairy is currently permitted to house 2,000 dairy livestock which are confined from November through April in freestall barns, loafing barns and open lot areas and are out on pasture a percentage of time from May through October.

Any livestock mortality that occurs during the year on the farm are disposed of by burial or composting.

Holland's Dairy owns 629.1 acres consisting of the operation area totaling 83.0 acres that contain the dairy and livestock housing facilities, 439.7 acres of hay and pasture land and 106.4 acres of range land. The fields are shown on the Fields Map on page 3-2.

Manure Handling

Wash water from the dairy operations is directed to a central below ground reinforced concrete collection tank. Manure, wasted feed and bedding in the freestall barns is collected in the alleyways and flushed to the central collection tank using recycled flush water from the waste storage ponds. When the flush water system freezes up in the winter time the alleyways are scraped using a front end loader and place in the solids storage areas. Wastewater and rainfall runoff collected in the collection tank is pumped to a gravity inclined screen where a solids are removed from the wastewater stream. Wastewater from the gravity inclined screen is directed to two settling basins. Solids cleaned from the settling basins and manure, bedding and wasted feed cleaned from the loafing barns and lot areas are place in piles and composted to be used for bedding. Wastewater from the earthen settling basins drains to two waste storage ponds where it is stored until it is used for flushwater or applied to the hay and pasture land fields as a source of nutrients. Composted solids not used for bedding and solids that are not composted are applied to the hay and pasture land fields or exported off farm and utilized as a source of nutrients and organics. The Production Area Map shown on page 2-11 provides an overview of the dairy facilities and manure management system.

Forage

GENERAL INFORMATION

Holland's Dairy farms 439.7 acres of irrigated hay and pasture land to raise feed for the dairy livestock. The hay and pasture land fields are planted to grass and are harvested as hay and by grazing livestock. The cropping system consists of continuous grass hay and pasture in fields which are replanted as needed to maintain production.

Nutrient Management

Performance based nutrient management will be employed to insure nutrient balance on all fields. Forage yield will be tracked annually and used to determine the rate of manure application on a per field basis. Manure will be tested annually and tested values will guide application rates. Actual yield varies from year to year depending upon weather conditions and specific field management. Pastures are well managed and in good condition.

Applications of wastewater and solids containing manure are planned on a nitrogen basis on all fields based on the low to medium phosphorus index rating. The soil phosphorus concentrations will be monitored using soil tests on all of the hay and pasture land fields. It is estimated that the dairy produces enough manure to meet the nutrient demand for the hay and pasture land fields. Supplemental nutrient applications to the hay and pasture land fields should be based on soil tests and fertilizer guides to prevent excess soil nutrient concentrations.

GENERAL INFORMATION

MANURE STORAGE AND NUTRIENT BALANCE SUMMARY

Manure Storage-

Storage Type:	Capacity	Estimated Storage Period
Settling Basins-	5.91 AF	0 Days
Wastewater Storage Ponds-	63.01 AF	>365 Days
Solids Storage-	642,074 CF	>365 Days

Nutrient Balance-

Nutrients Generated:	N Generated (lbs) after Losses	P_2O_5 Generated (lbs) after Losses
Solid Manure-	59,504 lbs	37,043 lbs
Liquid Manure-	36,217 lbs	23,250 lbs
Pasture Manure-	54,516 lbs	25,535 lbs
Total-	**150,238 lbs**	**85,828 lbs**

Exported Nutrients:	N Exported (lbs) after Losses	P_2O_5 Exported (lbs) after Losses
Solid Manure-	35,889 lbs	18,522 lbs
Liquid Manure-	0 lbs	0 lbs
Total-	**35,889 lbs**	**18,522 lbs**

Crop Nutrient Removal:	N Utilized (lbs)	P_2O_5 Utilized (lbs)
Total-	**125,251 lbs**	**39,579 lbs**

Net Nutrients:	Nutrients Generated after Losses(lbs.)	Nutrients Removed by Crop and Exported after Losses (lbs)	Net Nutrient Balance after Losses (lbs)
Nitrogen (N)-	150,238 lbs	161,140 lbs	-10,902 lbs
Phosphate (P_2O_5)-	85,828 lbs	58,101 lbs	27,727 lbs

System Losses:	Nutrients Generated (lbs)	Nutrients Remaining after Losses (lbs)	Nutrients Lost in System (lbs)
Nitrogen (N)-	242,969 lbs	150,238 lbs	92,731 lbs
Phosphate (P_2O_5)-	91,168 lbs	85,828 lbs	5,340 lbs

GENERAL INFORMATION

EMERGENCY RESPONSE PLAN

In Case of an Emergency Storage Facility Spill, Leak or Failure

Implement the following first containment steps:

a. Stop all other activities to address the spill.
b. Stop the flow. For example, use skid loader or tractor with blade to contain or divert spill or leak.
c. Call for help and excavator if needed.
d. Complete the clean-up and repair the necessary components.
e. Assess the extent of the emergency and request additional help if needed.

In Case of an Emergency Spill, Leak or Failure during Transport or Land Application

Implement the following first containment steps:

a. Stop all other activities to address the spill and stop the flow.
b. Call for help if needed.
c. If the spill posed a hazard to local traffic, call for local traffic control assistance and clear the road and roadside of spilled material.
d. Contain the spill or runoff from entering surface waters using straw bales, saw dust, soil or other appropriate materials.
e. If flow is coming from a tile, plug the tile with a tile plug immediately.
f. Assess the extent of the emergency and request additional help if needed.

Contacts to be made by the owner or operator within 24 hours

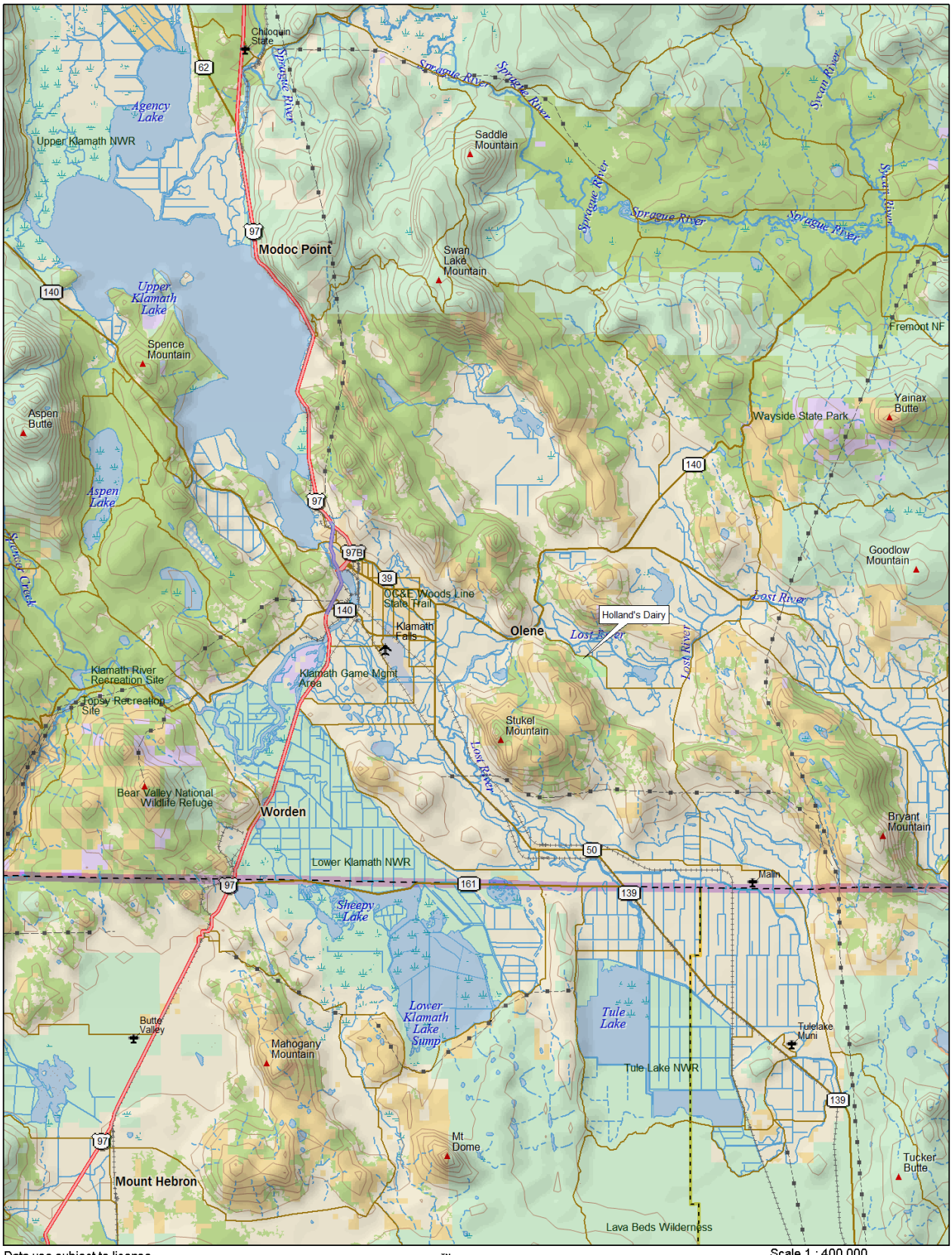
Organization	Phone Number
Oregon Dept. of Agriculture Natural Resources Division 635 Capitol St., N.E. Salem, OR 97301-2532	(503) 986-4700 TTD (503) 986-4762
Oregon Emergency Response (System OERS)	(800) 452-0311
County Environmental Health Department	(541) 883-1122
County Roads Department	(541) 883-4585

Be prepared to provide the following information:

a. Your name and contact information.
b. Farm location (driving directions) and other pertinent information.
c. Description of emergency.
d. Estimate of the amounts, area covered, and distance traveled.
e. Whether manure has reached surface waters or major field drains.
f. Whether there is any obvious damage: employee injury, fish kill, or property damage.
g. Current status of containment efforts.

GENERAL INFORMATION

LOCATION MAP FOR HOLLAND'S DAIRY



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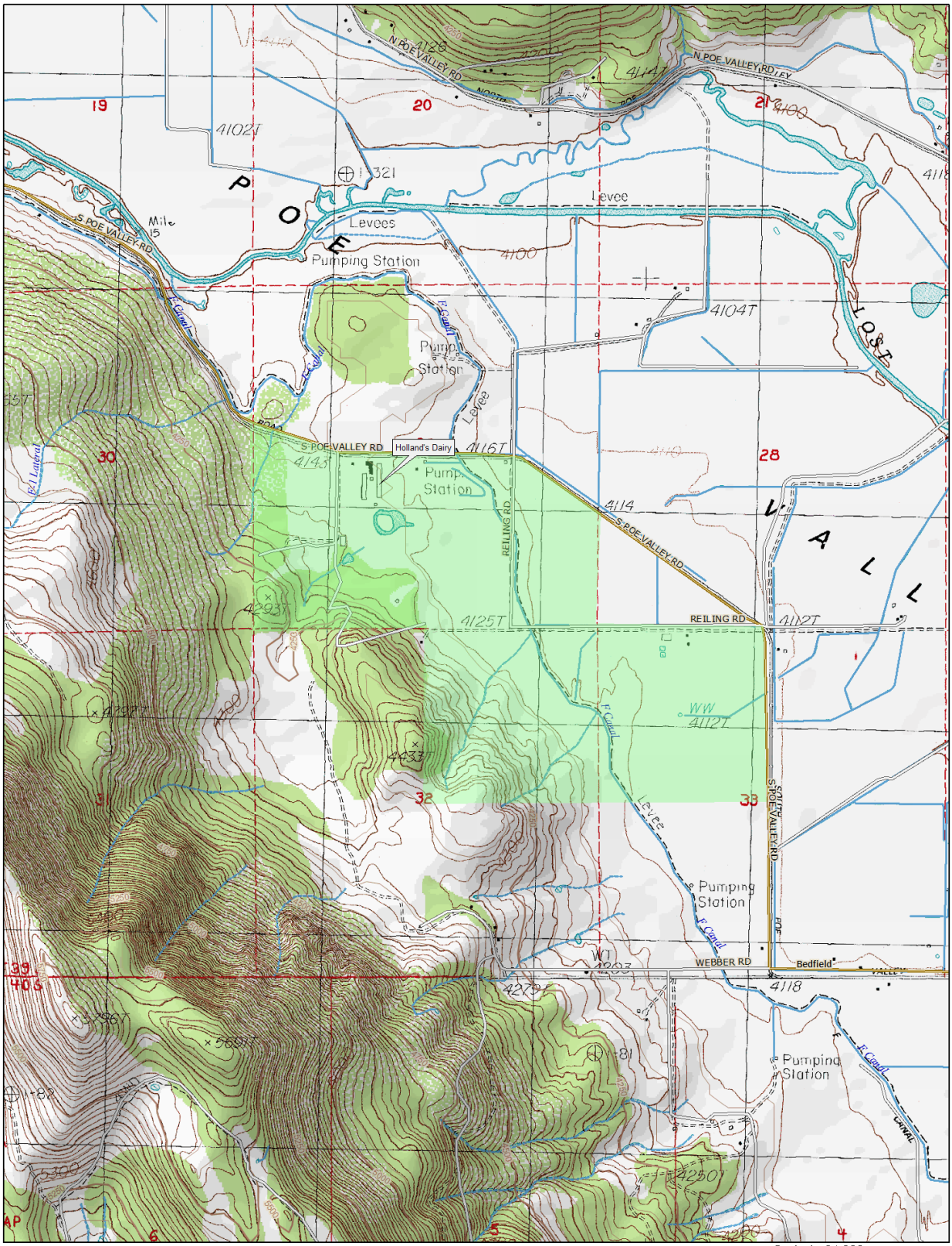
www.delorme.com

TN
MN (14.5°E)

Scale 1 : 400,000
1" = 6.31 mi
Data Zoom 9-0

GENERAL INFORMATION

TOPOGRAPHY MAP FOR HOLLAND'S DAIRY



PRODUCTION AREA

ANIMAL NUMBERS

Holland's Dairy is currently permitted for 2,000 animals which is the maximum planned for this facility. The planned number of animals for Holland's Dairy consists of 900 milk cows, 140 dry cows, 545 heifers and 415 calves.

This plan was written based on 2,000 livestock and land base described herein.

ANIMAL MORTALITY MANAGEMENT

Currently animal mortalities for the Holland's Dairy are being disposed of by Composting or Burial. Other approved methods of dealing with mortalities may be employed by Holland's Dairy as needed.

Having dead animals sent to an acceptable disposal site is the best method to deal with animal mortalities. A list of landfills and phone numbers can be found on the internet at http://www.deq.state.or.us/lq/sw/disposal/permittedfacilities.html. If a local landfill is not permitted to accept animal carcasses, the Oregon Department of Environmental Quality (DEQ) may grant an exception. Phone numbers to local DEQ offices can be found in most phone books or on the internet at http://www.deq.state.or.us/about/locations.html.

Under no circumstances are animal mortalities to be disposed of in any type of liquid manure storage facility.

COLLECTION OF MANURE, PROCESS WATER AND RUNOFF

Manure, bedding and wasted feed is collected in the barns. The estimated volume of Manure bedding and wasted feed that will be collected annually was generated using the ORAWM workbook located in Section 5.

Flushwater used to clean the alleyways in the barns is directed to catch basins that drain to the wastewater collection tank via underground pipelines. Flushwater is recycled from the wastewater storage ponds. There is no additional fresh water added unless the wastewater in the wastewater storage ponds is not suitable for flushing.

Leachate and rainfall runoff from the solids storage areas is directed to catch basins that drain to wastewater collection tank via underground pipelines. The estimated volumes of leachate and rainfall runoff from the solid storage areas that will be collected annually were generated using the ORAWM workbook located in Section 5.

Rainfall runoff from paved and unpaved areas that comes into contact with animal manure is directed to catch basins that drain to the wastewater collection tank. The estimated volume of rainfall runoff that will be collected annually was generated using the ORAWM workbook located in in Section 5. All rainfall runoff from roofs that may come into contact with animal manure is collected using gutters and downspouts and directed to drainage ditches. Rainfall runoff from roofs that will not come into contact with animal manure is diverted to drainage ditches.

All process water from the dairy operation is directed to catch basins that drain to wastewater collection tank. The estimated volume of process water that will be collected annually was generated using the ORAWM workbook located in Section 5.

PRODUCTION AREA

TREATMENT FACILITIES

A solid/liquid separation facility separates solids from the wastewater. The separated solids are composted and recycled for bedding or stored and applied to the hay and pasture land fields or exported off farm.

STORAGE FACILITIES

The wastewater collection and storage facilities are shown on the Production Area Map on page 2-11. Capacities and estimate volumes to store for the waste storage facilities can be found on the Manure Storage and Nutrient Balance Summary on page 1-5.

TRANSFER OF MANURE, PROCESS WATER AND RUNOFF

Wastewater containing manure, bedding and wasted feed from the livestock barns are directed to the collection tank where it is pumped to the solid/liquid separation facility to separate solids from the wastewater. Wastewater from the separation facility is directed to settling basins where additional solids are removed. Separated solids and solids removed from the settling basins are transferred to solids storage areas shown on the Production Area Map on page 2-11.

Wastewater stored in the wastewater storage ponds is pumped to the hay and pasture land fields using underground pipelines to be utilized as a source of nutrients. Traveling big gun irrigation systems are used to apply the wastewater to the hay and pasture land fields.

Solids stored in the solids storage areas are composted and recycled for bedding or hauled to the hay and pasture land fields and applied at agronomic rates using a solids spreader or exported off farm.

PRODUCTION AREA

OPERATION AND MAINTENANCE CONSIDERATIONS

WASTEWATER COLLECTION TANK-

The wastewater collection tank shown on the Production Area Map on page 2-11 is used to collect and temporarily store wastewater containing manure generated by Holland's Dairy. Any annual buildup of solids in the wastewater collection tank must be removed to maintain design capacity and applied to land application areas in accordance with guidance given in Section 3, Utilization Area.

Inspect all tanks weekly to insure structural integrity. If the structural integrity of a tank is compromised, immediately empty the tank to determine the cause and make necessary repairs before putting the tank back into service. Do not allow equipment that exceeds the design limit of the tanks on or within 20 feet of the structure.

Keep pumps, agitators, piping, valves and all other electrical and mechanical equipment in good condition by following the manufacturer's recommendations. Maintain grounding rods and wiring for all electrical equipment in good condition. Immediately remove all foreign debris within the structure that may cause damage to pumps or agitators.

Pump the wastewater collection tank completely empty during the summer months and cleanout any debris and other solid materials that may have accumulated in the tank. Inspect the tank for structural damage and if structural damage to a tank is discovered seek the services of a qualified engineer to assess the damage and recommend necessary repairs before putting the tank back into service. Follow the guidance given in Section 3, Utilization Area, when applying wastewater to fields.

Do not dispose of animal carcasses in any wastewater collection tank. It is against the law to do so.

Maintain all fences, railings, and/or warning signs to provide warning and/or prevent unauthorized human or livestock entry. Immediately repair vandalism, vehicular or livestock damage to the structure, earthen areas surrounding the structure, or any appurtenances. Maintain lids, grates and shields on openings.

Provide proper ventilation before entering the tank, for any reason what so ever. Provide and use self - contained breathing apparatus (scuba) equipment when entering a tank. No persons should enter the tank unless safety ropes are used and someone else capable of providing rescue assistance is outside the tank.

Do not assume any tank, including open top tanks, are well ventilated.

PRODUCTION AREA

WASTEWATER STORAGE PONDS AND SETTLING BASINS-

The wastewater storage ponds and settling basins shown on the Production Area Map on page 2-11 are used to store wastewater containing manure generated by the Holland's Dairy. The storage capacity and estimated storage period for the settling basins and wastewater storage ponds are shown on the Manure Storage and Nutrient Balance Summary worksheet located on page 1-5.

Emptying of the wastewater storage ponds should begin in the spring and continue through the spring and summer months as weather conditions permit applying wastewater in accordance with the guidance given in Section 3, Utilization Area. To function properly and have the greatest management flexibility, the wastewater storage ponds must be as empty as possible in the fall before the fall and winter rainy season begins. Any annual sludge buildup in the wastewater storage ponds and settling basins must be removed to maintain design capacity and applied to land application areas in accordance with guidance given in Section 3, Utilization Area.

Inspect the wastewater storage ponds and settling basins weekly to insure structural integrity of embankments and that at least 1 foot-6 inches of freeboard is being maintained to accommodate excess rainfall such as a 25 year-24hour storm and prevent overtopping embankment. If the structural integrity of a wastewater storage pond or settling basin embankment is found to be compromised, immediately draw the liquid level down below the damaged area to determine the cause. Seek the services of a qualified engineer to assess the damage and recommend necessary repairs before allowing wastewater levels above the damaged area.

Pump the wastewater storage ponds and settling basins to the lowest level possible during the summer months and inspect the embankments for structural damage. If structural damage to the embankment of a wastewater storage pond or settling basin is discovered, seek the services of a qualified engineer to assess the damage and recommend necessary repairs before allowing wastewater levels above the damaged area. Follow the guidance given in Section 3, Utilization Area, when applying wastewater to fields.

Do not permit livestock access to the ponds, settling basins or on embankments. Control undesirable vegetation growth by spraying or mowing. Control rodents as necessary. Check elevations of embankments periodically and restored to grade and shape as necessary. Fill and reseed eroded embankment areas or repair with well graded rock riprap. Safety features such as signs and fences should be kept in good repair.

Do not dispose of animal carcasses in any settling basin or wastewater storage pond. It is against the law to do so.

PRODUCTION AREA

SOLIDS STORAGE AREAS-

The solids storage areas shown on the Production Area Map on page 2-11 are used to store solids containing manure generated by Holland's Dairy. The storage capacity and estimated storage period for the solids storage areas are shown on the Manure Storage and Nutrient Balance Summary worksheet located on page 1-5. Emptying of the solids storage areas should begin in the spring and continue through the spring and summer months as weather conditions permit applying solids in accordance with the guidance given in Section 3, Utilization Area or composting the solids for bedding or exporting the solids off farm. To function properly and have the greatest management flexibility, the solids storage areas must be as empty as possible in the fall before the fall and winter rainy season begins.

Periodically inspect concrete and asphalt slabs, walls and curbs and repair or replace broken sections as needed. Cleanup any spillage of manure and organics from outside of the solids storage area and place them back in the solids storage areas.

Maintain all fences, railings, and/or warning signs to provide warning and/or prevent unauthorized human or livestock entry. Immediately repair vandalism, vehicular or livestock damage to the structure, earthen areas surrounding the structure, or any appurtenances.

BUILDING ROOFS-

Inspect building roofs annually as a minimum. Repair and/or replace all rusted sections and secure loose sections as needed. Immediately replace all broken trusses, rafters, beams, poles as needed. Immediately determining the cause and necessary modification(s) to prevent reoccurring structural failure is essential.

COMPOSTING AREAS-

The composting areas shown on the Production Area Map on page 2-11 is used for the composting process and to store compost until it can be recycled for bedding or applied to the hay and pasture land fields or exported off farm. Any composted solids applied to the hay and pasture land fields should be done in accordance with the guidance given in Section 3, Utilization Area. To function properly and have the greatest management flexibility, the composting area must be at their minimum capacity in the fall before the rainy season begins.

The cause for any excess leachate from the composting process during the seasonal composting process performed in farm fields will be determined the operator will determine the cause of the excess leachate and take immediate corrective action such as turning the windrow pile(s) and inspecting the feedstock and compost for the presence of excess leachate.

Guidance for the composting process-

Take a representative sample of the raw compost mixture and have a laboratory determine the moisture content, pH, and the carbon and nitrogen content.

The carbon to nitrogen ratio should range between 25 and 40 to 1. Make adjustments as needed to the ingredients of the raw compost mixture as necessary to achieve a carbon to nitrogen ratio within the acceptable range.

PRODUCTION AREA

The moisture content should be between 40 and 60 percent. Add water or drier material to adjust the moisture content. Care must be taken to see that the carbon to nitrogen ratio of the mix is still in the 25 – 40 to 1 range after adjusting the moisture content.

The pH preferably should range between 6.5 and 8 however composting may be achieved between a pH of 5.5 and 9.0.

Check pile temperature using thermometer probe on a daily basis. The pile temperature should be checked at a point one-third the distance from the outside of the pile to the center of the mass. Initially it will take approximately 2 to 3 days for the compost to get above 105 degrees F. Compost temperatures should peak between 130 and 140 degrees F in 5 to 7 days. When the temperature of the compost material falls below 110 degrees F the compost needs to be aerated by turning or other means. Failure to achieve the desired temperatures may result in the incomplete destruction of pathogens and weed seeds and can cause fly and odor problems.

Odors given off by the composting operation is a good indicator of how the compost operation is proceeding. Foul odors may mean that the process has turned from aerobic to anaerobic. Anaerobic conditions are the result of insufficient oxygen in the compost. This may be caused by excessive moisture in the compost or the need for turning or aerating of the compost material.

For a well managed windrow or static pile composting operation, the composting time during the summer months should range from 14 days to a month. To ensure a finished compost, observe that the composted material has little or no trace of the original raw material and has little odor. The material should be black to brown in color. Particle size should be consistent and soil-like in texture.

All materials that are not considered feedstocks for the composting process (i.e. plastic ear tags, plastic gloves, etc…) are to be collected and transported to a permitted landfill by a garbage collection service or other means. It is anticipated that there will be no other material that will require offsite disposal.

Periodically inspect concrete and asphalt slabs, walls and curbs and repair or replace broken sections as needed. Cleanup any spillage of composted material from outside of the composting area and place them back in the composting facility.

Maintain all fences, railings, and/or warning signs to provide warning and/or prevent unauthorized human or livestock entry. Immediately repair vandalism, vehicular or livestock damage to the structure, earthen areas surrounding the structure, or any appurtenances.

PRODUCTION AREA

FENCES-

Do not allow livestock access to open water courses and drainageways. Provide off stream watering facilities where possible and limit access to designated watering areas.

Inspect fences periodically and repair or replace broken or decayed posts and tighten sagging wire as needed. Broken wire can be spliced or replaced. Replace broken or missing insulators on electric fences as needed and repair or replace inoperative electric fence controllers.

Insure gates and other appurtenances are in good working order. Replace or repair components as needed.

IRRIGATION SYSTEMS-

Maintain sprinkler irrigation systems in accordance with the manufacturer's recommendations to help ensure trouble free operation. Prevent livestock access to equipment during operation.

Clean plugged nozzles and replace if worn or defective.

Promptly repair all leaks by replacing valves, fittings, gaskets, worn or damaged parts.

Prompt repair or replacement of damaged or worn components is necessary. Check to make sure all application components i.e. water control structures, gates, valves, ditches, etc. are functional and are in good operating condition.

Maintain screening and filtering facilities.

Maintain vigorous vegetative growth where applicable.

LIVESTOCK WATERING FACILITIES-

Check all above ground connections, valves, gates, rodent guards, inlets and outlets to make sure they are functioning properly. Check troughs and tanks for leaks or cracks and repair or replace immediately, if necessary.

Make certain the area adjacent to the trough is well protected with gravel, paving, or good cover. Be sure that the outlet pipe has a free outlet and is not causing any serious erosion problems. Check periodically to see if debris has fallen into the trough or tank which may restrict inflow or planned functions of the outflow system.

Clean the entire system periodically and remove moss, algae growth, and/or sludge. Chemicals such as copper sulfate and chlorine can be used to prevent moss and algae growth. Local rules and regulations are to be followed when using chemicals to make sure they are safe for animals.

Where necessary maintain coverings and insulation to prevent damage by freezing.

Eradicate or otherwise remove all rodents or burrowing animals. Immediately repair any damage caused by their activity.

Immediately repair any vandalism, vehicular or livestock damage.

PRODUCTION AREA

PIPELINES-

Flush pipelines used for liquid waste applications with clean water following waste application, or as needed, to prevent particle buildup.

Drain the pipeline and components in areas that are subject to freezing. If parts of the pipeline cannot be drained, a non-toxic antifreeze solution may be added.

Check to make sure all valves and air vents are set at the proper operating condition so they can provide protection to the pipeline.

Inspect pipelines for signs of failure. Inspect risers and valves periodically for leaks or worn gaskets. Repair or replace pipeline, risers and valves as needed.

Eradicate or otherwise remove all rodents or burrowing animals. Immediately repair any damage caused by their activity.

PUMPS-

Operate and maintain pumps in accordance with good judgment and manufacture's manuals and recommendations.

Drain liquid manure from pumps during cold weather to prevent freezing. If parts of the system cannot be drained, a non-toxic antifreeze solution may be added.

Inspect pumps periodically and remove debris wrapped around shafts and impellers. Maintain foot valves and check valves for proper operation.

For proper operation of electric motors and controls, maintain lubrication for all bearings, keep electric panel free from obstructions and debris. Maintain electrical safety devices, assure all electrical contacts are tight, and lock main electrical switch to "OFF" position during non-use season. Maintain adequate shade and ventilation for pump motors.

For proper operation of pumps, maintain lubrication for all bearings and pump shafts, assure belts are adjusted properly, maintain safety covering devices on open shafts and belt drives, check to make sure all safety valves and devices are set at proper operating conditions so they may provide protection to the pump and power unit. For centrifugal pumps, periodically measure tolerance between pump impeller and pump casing (i.e. wearing) and replace wear ring as needed to help restore new pump operating characteristics.

Use portable pressure gauge (preferably a liquid filled gauge) to monitor pump performance.

Operate and maintain agitators in accordance with the manufacture's manual and recommendations. Inspect all plumbing annually as a minimum.

Replace, tighten, or repair broken or loose connections and lines as needed.

PRODUCTION AREA

SOLID/LIQUID SEPARATION FACILITY-

Inspect the solid/liquid separation facility daily to ensure the facility is operating properly and there has been no damage to structural components. Clean screens and outlets if they have become clogged or their capacity is not adequate for proper operation of the facility.

Prevent any spillage or leakage onto roadways when transferring solids from the solid/liquid separation facility to the solids storage area and to utilization areas.

WELL(S)-

Protect the area immediately surrounding the well from being damaged by agriculture machinery, vehicles, or livestock.

All fences, railings, and/or warning signs shall be maintained to provide warning and/or prevent unauthorized human or livestock entry.

Do not allow any foreign debris to accumulate and maintain soil and vegetative covering in the immediate vicinity of the well.

Eradicate or otherwise remove all rodents or burrowing animals. Immediately repair any damage caused by their activity.

Check metal surfaces for rust and other damage especially sections in contact with earthfill and with other materials. Repair or replace damaged section and apply paint as a protective covering.

Keep all surface water from entering or accumulating at the immediate vicinity of the well site.

Immediately repair any vandalism, vehicular, or livestock damage.

PRODUCTION AREA

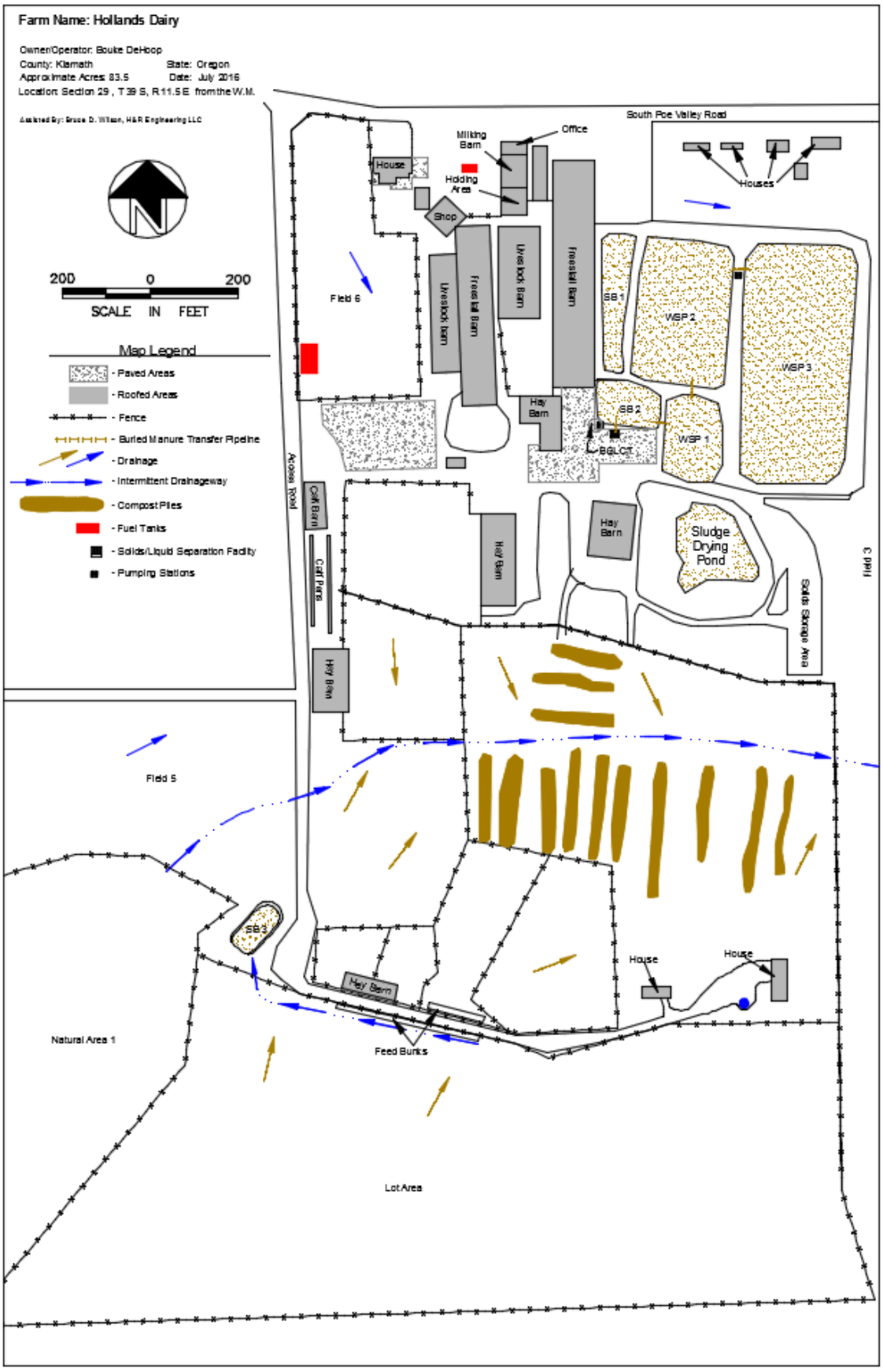
CHEMICAL HANDLING CHECKLIST-

The following measures shall be taken to prevent chemicals from contaminating process water or storm water storage and treatment systems:

1. Make sure all chemicals are stored in proper containers. Expired chemicals and empty containers are to be properly disposed of in accordance with state and federal regulations. Pesticides and associate refuse are to be disposed of in accordance with the FIFRA label.
2. Chemical storage areas are to be self-contained with no drains or other pathways that will allow spilled chemicals to exit the storage area.
3. Chemical storage areas are to be covered to prevent chemical contact with rain or snow.
4. Emergency procedures and equipment are to be in place to contain and clean up chemical spills.
5. Chemical handling and equipment wash areas are to be designed and constructed to prevent contamination of surface waters, waste water, and storm water storage and treatment systems.

PRODUCTION AREA

PRODUCTION AREA MAP FOR HOLLAND'S DAIRY



PRODUCTION AREA

UTILIZATION AREA

CROPPING SYSTEM

The acres of crop land area available for utilization of the nutrients and organics contained in the wastewater and solids produced from the Holland's Dairy is shown on the utilization worksheet in ORAWM located in Section 5. Yield data and nutrient utilization rates for the crops grown are also shown on the inventory worksheet in ORAWM located in Section 5.

Irrigated and nonirrigated crop yield data from the Natural Resources Conservation Service Soil Survey referenced in Section 5 indicates the yield data used in developing this plan is within the range of the given crop yields for the Holland's Dairy.

Traveling big gun irrigation systems are used to irrigate and apply wastewater containing manure and other organics produced from the Holland's Dairy. These systems use single large sprinkler nozzles usually mounted on a cart with wheels that is attached to a high density polyethylene pipeline that is rolled up on a large reel that provides a constant travel speed for the sprinkler. These systems apply water depending on the nozzle size, operating pressure and travel used and have an efficiency of 65 to 75 percent. Traveling big gun sprinkler systems must be well managed to prevent excess percolation, surface runoff, wind drift and evaporation losses.

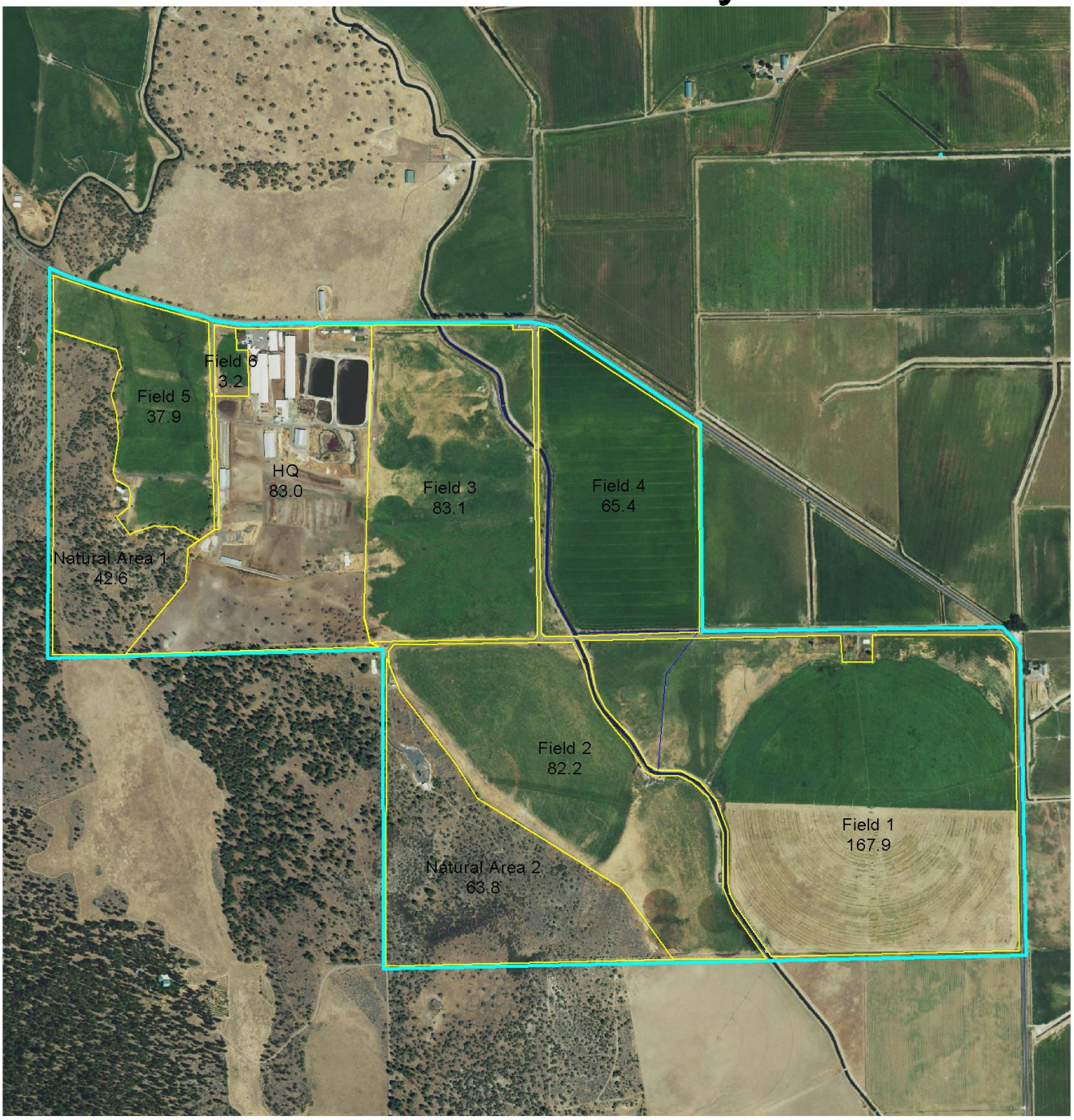
Other types of irrigation systems that will be used to irrigate the crops must be well managed to prevent excess percolation, surface runoff and erosion, wind drift and evaporation losses.

The amount of irrigation water to apply based on the net irrigation requirements for the crop being grown can be found in the tables starting on page 3-28.

UTILIZATION AREA

FIELD MAP(S)

Holland's Dairy



UTILIZATION AREA

APPLICATION

The manure and irrigation application systems will be calibrated in accordance with guidance starting on page 3-3 to insure the applications of manure, bedding and runoff from the waste storage facilities are in accordance with agronomic rates.

No application of wastewater or solids containing manure is to be made to the field buffer areas shown on the Setback Map on page 3-5. Applications of wastewater and solids containing manure should be made in accordance with guidance starting on page 3-3 to reduce the risk of contaminated runoff to surface water sources and leaching of contaminants to ground water sources.

The phosphorus runoff rating for each of the farm fields is based on the Eastern Oregon Phosphorus Index and is shown in the table on page 4-23. Wastewater, solids and commercial fertilizer for any field with a high runoff rating must be applied on a phosphorus basis. Wastewater, solids and commercial fertilizer for any field with a low or medium runoff rating can be applied on a nitrogen basis. No applications of manure or commercial fertilizer containing phosphorus are to be made on a field with a very high phosphorus runoff rating.

GENERAL CONSIDERATIONS FOR MAKING MANURE APPLICATIONS

Manure applications may be made at any time of the year provided certain factors have been considered. However, the overriding factor one should use in considering whether or not to apply nutrients to a crop, irrespective of the nutrient source, is the agronomic need of the crop at the time of application. The following guidelines are to be considered once the decision has been made to make a manure application.

- **Manure applications may be done** as long as you can comply with all permit conditions and can meet the conditions outlined is this section. Based on crop nutrient uptake patterns, manure applications should stop when the crop is done growing for the year and before the first significant rainfall event that is expected to result in saturated soils or surface runoff.
- **Fields that are subsurface (TILE) drained require additional precautions** when manure is applied. Any pre-application tillage should leave as much residue as possible on the soil surface. Water control structures installed in subsurface drainage systems should be managed to prevent discharge of manure and wastewater during periods of application.
- **Be aware of the location of sensitive areas, concerns of neighbors or concerns of the public**, which require special application procedures. To reduce odor problems, apply wastewater and solids containing manure in mid-morning when temperatures are warming and air is rising rather than in the afternoon or evening when air is cooling and settling. Avoid applications during periods of fog.
- **Calibrate application equipment** to insure uniform distribution and accurate application rates in accordance with guidance given in the Considerations for Manure Applications starting on page 3-4. Refer to page 3-15 for guidance on the calibration of application equipment.

UTILIZATION AREA

- **Maintain setbacks for manure application from any surface waters.** The management goal is to allow no manure to enter surface waters at any time. The following table shows minimum setback requirements for manure applications:

Manure type	Application Equipment	Season	
		Wet	Dry
Liquid	Big gun	100 feet	35 feet
Solid	Spreader	100 feet	35 feet

Note:

a. Setbacks are the distance between open waterways and manure application area.

b. Setback requirements will generally increase for manures which are applied aerially (such as a traveling big gun) versus manures applied lower to the ground (such as a splash bar) due to potential for drift from wind or splashing.

- **Record applications, transfers or exports of nutrients (manure and fertilizer)** and maintain them for at least 5 years. The CAFO Recordkeeping Calendar or the tools and forms referenced in Section 5 may be used to record this information.

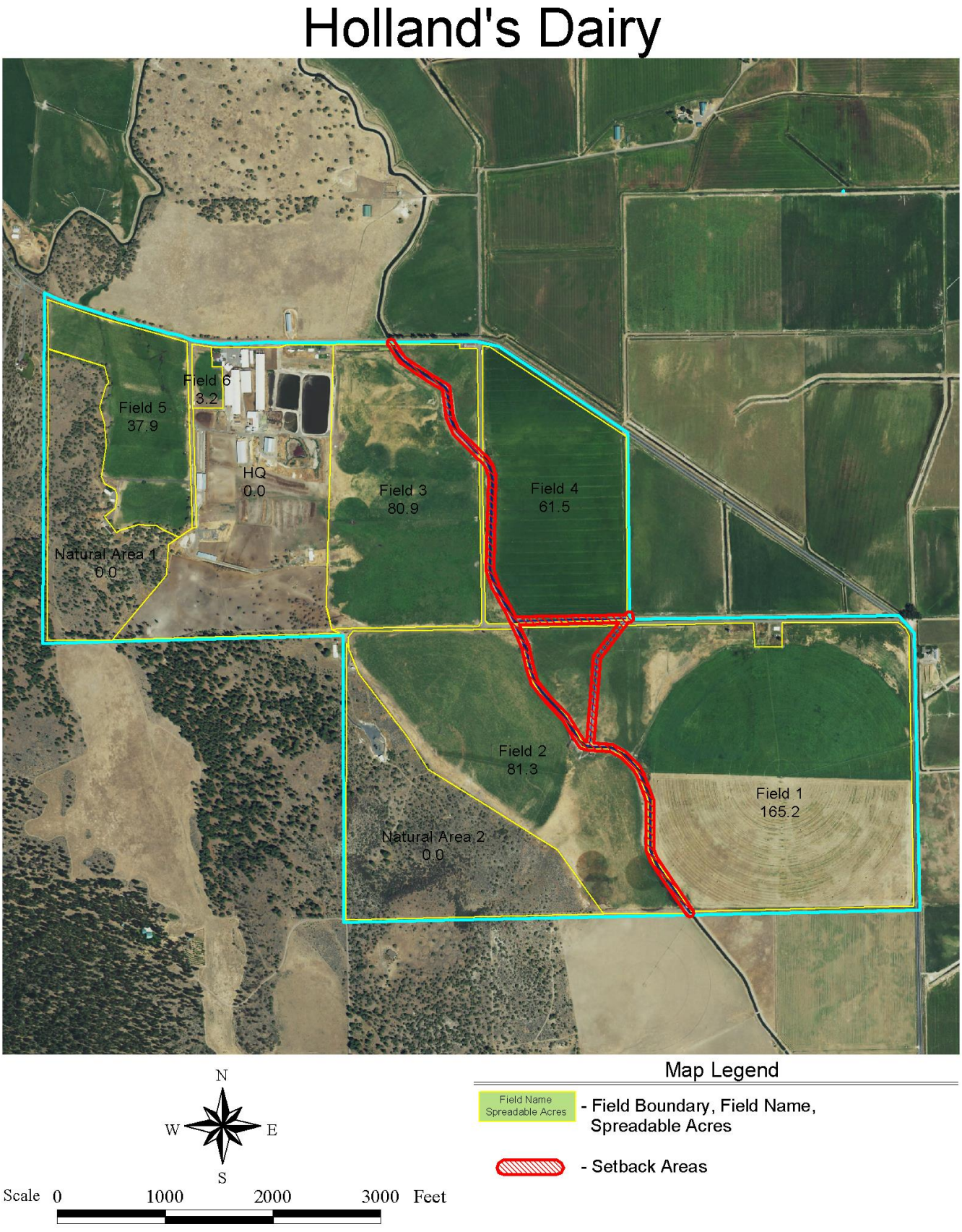
CONSIDERATIONS FOR DRY SEASON MANURE APPLICATIONS:

Apply wastewater and solids containing manure at **agronomic rates** shown on the table on page 3-19 using the following guidelines:

- Apply to land being prepared for crops and till manure into soil within 3 days of application if possible or apply to actively growing crops such as grass, clover or alfalfa.
- ***Do not apply*** during rainfall events that are expected to result in saturated soils or surface runoff.
- ***Maintain the setback buffer distances*** described on page 3-4 and shown on the Setback Map on page 3-5 when making applications of liquids or solids containing manure.
- ***Record applications, transfers or exports*** of nutrients (manure and fertilizer) and maintain them for at least 5 years. The CAFO Recordkeeping Calendar or the tools and forms referenced in Section 5 may be used to record this information.

UTILIZATION AREA

SETBACK MAP(S) FOR HOLLAND'S DAIRY



UTILIZATION AREA

CONSIDERATIONS FOR WET SEASON MANURE APPLICATIONS:

Only apply manure during this time period if the following guidelines CAN be met. Call the ODA CAFO Program at (503) 986-4700 for guidance if a manure application is needed and the following guidelines CAN NOT be met:

- Apply manure only to actively growing crops such as grass, clover or alfalfa.
- Minimize application rates by using the maximum travel rates for the application equipment.
- ***Maintain the setback buffer distances*** described in the table on page 3-4 and shown on the Setback Map on page 3-5 when making applications of liquids or solids containing manure.
- ***Do not apply*** during rainfall events that are expected to result in saturated soils or surface runoff.
- ***Do not apply*** to saturated or flooded soils. It is recommended that application(s) be limited to soils (areas) where the flooding frequency class rating is None, Very Rare or Rare.
- ***Do not apply*** to slopes greater than 5%. See the Soil Map in Section 4 for the location of soil map units with slopes greater than 5%.
- ***Applications of wastewater or solids containing manure to frozen soils should be avoided***. Do the following if an application of wastewater or solids containing manure is to be made to frozen soils:
  - Apply only enough wastewater or solids containing manure to address storage limitations until suitable soil conditions for application are available.
  - Minimize applications to 5 wet tons per acre or less of solids containing manure and 6,788 gallons (0.25 inches) per acre or less of wastewater.
  - Apply to alternating strips to reduce the risk of contaminated runoff reaching surface water sources.
  - Apply to fields of established hay, pasture or fields containing at least 90% cover and are the furthest from open water sources.
  - Do not apply wastewater or solids containing manure within 200 feet of surface water sources, drainageways, wells, or inlets to subsurface drainage systems.
  - Runoff control systems such as earthen dikes must be in place where applications will be made to fields with slopes greater than 5%.
- ***Record applications, transfers or exports*** of nutrients (manure and fertilizer) and maintain them for at least 5 years. The CAFO Recordkeeping Calendar or the tools and forms referenced in Section 5 may be used to record this information.
- ***Do not apply*** manure or commercial fertilizer to fields receiving applications unless the nutrients applied in the manure are less than the annual application of nutrients planned in the nutrient budget for the fields.

UTILIZATION AREA

MANURE AND SOIL SAMPLING FREQUENCY

Sample liquids and solids containing manure during applications in early spring **annually** and have each sample analyzed for Total Nitrogen (TKN), Ammonium Nitrogen (NH_4-N), Phosphorus (P) and Potassium (K) plus percent moisture. Ask the lab to report results in pounds per ton for the solids containing manure and in pounds per thousand gallons for liquids containing manure. Analyses of solids and liquids containing manure should be performed by a laboratory that meets the requirements and performance standards of the Manure Testing Laboratory Certification Program (MTLCP), http://www.mda.state.mn.us/licensing/pestfert/manurelabs.htm.

Collect soil samples from all fields receiving solids or liquids containing manure **within a 5 year period** in the fall (September 15-October 15) in accordance with **Pacific Northwest (PNW) Extension publication 570-E, "Monitoring Soil Nutrients Using a Management Unit Approach"** referenced in Section 5. Have the soil samples analyzed for Total Nitrogen (TKN) and Phosphorus (P) and ask the lab to report results in parts per million (ppm). Soil test analyses should be performed by laboratories that meet the requirements and performance standards of the North American Proficiency Testing Program (NAPT) Proficiency Assessment Program (PAP); http://www.naptprogram.org/pap/.

HOW TO SAMPLE LIQUID MANURE

Obtain a composite following one of the procedures listed below and thoroughly mix. Using a plunger, an up-and-down action works well for mixing liquid manure in a five-gallon bucket. Fill a one-quart plastic bottle not more than three-quarters full with the composite sample. Store sample in freezer if not delivered to the lab immediately.

Procedure 1. Sampling from storage- Agitate storage facility thoroughly before sampling. Collect at least five samples from the storage facility or during loading using a five-gallon bucket. Place a sub sample of the composite sample in a one-quart plastic container. Sampling a liquid manure storage facility without proper agitation (2-4 hrs. minimum) is not recommended due to nutrient stratification, which occurs in liquid systems. If manure is sampled from a lagoon that was not properly agitated, typically the nitrogen and potassium will be more concentrated in the top liquid, while the phosphorus will be more concentrated in the bottom solids.

Procedure 2. Sampling during application- Place buckets around field to catch manure from spreader or irrigation equipment. Combine and mix samples into one composite sub sample in a one-quart plastic container.

HOW TO SAMPLE SOLID MANURE

Collect a composite sample by following one of the procedures listed below. A method for mixing a composite sample is to pile the manure and then shovel from the outside to the inside of the pile until well mixed. Fill a one-gallon plastic heavy-duty zip lock bag approximately one-half full with the composite sample, squeeze out excess air, close and seal. Store sample in freezer if not delivered to the laboratory immediately.

Procedure 1. Sampling while loading - Recommended method for sampling from a stack or bedded pack. Take at least ten samples while loading several spreader loads

and combine to form one composite sample. Thoroughly mix the composite sample and take an approximately one pound sub sample using a one-gallon plastic bag. Sampling directly from a stack or bedded pack is not recommended.

Procedure 2. Sampling during spreading - Spread a tarp in field and catch the manure from one pass. Sample from several locations and create a composite sample. Thoroughly mix the composite sample together and take a one-pound sub sample using a one-gallon plastic bag.

Procedure 3. Sampling daily haul - Place a five-gallon bucket under the barn cleaner 4-5 times while loading a spreader. Thoroughly mix the composite sample together and take a one-pound sub sample using a one-gallon plastic bag. Repeat sampling 2-3 times over a period of time and test separately to determine variability.

Procedure 4. Sampling poultry in-house - Collect 8-10 samples from throughout the house to the depth the litter will be removed. Samples near feeders and waterers may not be indicative of the entire house and sub samples taken near here should be proportionate to their space occupied in the whole house. Mix the samples well in a five-gallon pail and take a one-pound sub sample, place it in a one-gallon zip lock bag.

Procedure 5. Sampling stockpiled litter - Take ten sub samples from different locations around the pile at least 18 inches below the surface. Mix in a five-gallon pail and place a one-pound composite sample in a gallon zip lock bag.

Sample Identification and Delivery

Identify the sample container with information regarding the farm, animal species and date. This information should also be included on the sample information sheet along with application method, which is important in determining first year availability of nitrogen.

Keep all manure samples frozen until shipped or delivered to a laboratory. Ship early in the week (Mon.-Wed.) and avoid holidays and weekends.

UTILIZATION AREA

MANURE TESTS

Holland's Dairy **LIQUID MANURE ANALYSIS**

Testing performed by AgSource Laboratories, Umatilla, Oregon

Year Report	Date	Sample I.D.	Lbs/1,000 gallons				%	%
			Total N	P_2O_5	K_2O	NH_4-N	Moisture	Solids
2015								
M5567	02/24/2015	Wastewater Storage Ponds	13.33	6.03	11.84	6.67	97.04	2.96

Holland's Dairy **SOLID MANURE ANALYSIS**

Testing performed by A&L Western Agricultural Laboratories, Modesto, California

Year Report	Date	Sample I.D.	Lbs/Ton				%	%
			Total N	P_2O_5	K_2O	NH_4-N	Moisture	Solids
2015								
15-077-089	03/23/2015	Solids Stack	17.73	9.15	11.44	3.55	57.20	42.80

Manure analyses should be performed by a laboratory that meets the requirements and performance standards of the Manure Testing Laboratory Certification Program (MTLCP), http://www.mda.state.mn.us/licensing/pestfert/manurelabs.htm.

Manure should be analyzed annually for a minimum of three (3) consecutive years to develop a cumulative manure analysis history as a basis for nutrient allocation to the fields.

UTILIZATION AREA

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HOW TO SAMPLE SOILS

Current soil tests must be used in the development and editing of nutrient management plans. A current soil test is one that is no older than 5 years that is used to represent the nutrient status of the entire field. Soil analysis must be performed by laboratories successfully meeting the requirements and performance standards of the North American Proficiency Testing Program-Performance Assessment Program (NAPT-PAP). Results of these analysis will be used to determine application rates for manure, litter, and process wastewater. Guidance for soil sampling can be found in the Pacific Northwest (PNW) Extension publication 570-E, “Monitoring Soil Nutrients Using a Management Unit Approach”. Oregon State University Extension Publication EC1478, “Soil Test Interpretation Guide” provides guidance on how to determine soil nutrient concentrations and how to adjust soil pH to improve nutrient availability.

Field Area. A composite soil sample should represent a uniform field area. Each area should have similar crop and fertility history. Soil characteristics (color, slope, texture, drainage) should be similar. Exclude small areas within a field that are obviously different. The field area represented by a single composite sample should represent no more than 40 irrigated acres or 100 dry land acres.

Sampling Depth. Laboratory tests are calibrated to specific depths. It is vital to collect samples from appropriate depths. Sampling depth for most soils is the rooting depth in 6-inch intervals. In Oregon, as a minimum, soil samples should be collected from the 0-12” depth and from the 12-24” depth. The 0-6” surface soil samples are normally used for conventional tests of organic matter, nitrogen, phosphorus, potassium, pH and salt levels. Additionally, subsurface samples from the 6-24” depth are needed to estimate nitrogen availability for crops.

Post Harvest Soil Testing for Evaluating Nutrient Applications. Refer to Pacific Northwest (PNW) Extension Publication 570-E, “Monitoring Soil Nutrients Using a Management Unit Approach” in Section 5 for guidance on how to evaluate nutrient applications and crop uptake of nutrients.

UTILIZATION AREA

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SOIL TESTS

Holland's Dairy **SOIL TEST RESULTS**

Testing performed by A&L Western Agricultural Laboratories, Modesto, California

Year Lab Number	Test Date	Field	Depth	NO3-N ppm	P ppm	K ppm	Ca ppm	Mg ppm	TB meq	pH	SMP	OM %
2014												
51473	04/04/2014	Field 1	12"	14	64	1377	1728	487	NA	7.3	7.3	6.2
51474	04/04/2014	Field 2	12"	32	84	1361	1325	433	NA	6.6	7.1	5.8
51475	04/04/2014	Field 3	12"	22	91	1409	1467	512	NA	7.1	7.2	4.5
51476	04/04/2014	Field 4	12"	21	97	1413	1697	617	NA	7.2	7.3	5.3
51477	04/04/2014	Field 5	12"	10	119	1129	1574	617	NA	7.3	7.4	4.0
51477	04/04/2014	Field 6	12"	10	119	1129	1574	617	NA	7.3	7.4	4.0

Soil test analyses should be performed by laboratories that meet the requirements and performance standards of the North American Proficiency Testing Program (NAPT) Proficiency Assessment Program (PAP); http://www.naptprogram.org/pap/.

UTILIZATION AREA

UTILIZATION AREA

HOW TO CALIBRATE APPLICATION EQUIPMENT

Calibration of application equipment is a critical part of nutrient management. Calibration should be completed at least annually to insure manure and fertilizer will be uniformly applied. There are two basic approaches for calibrating a manure spreader – the load area and the weight area methods. The load area method is more accurate and can be used for both liquid and solid manure. The weight area method works only with solid or semi-solid manure.

Irrigation System Calibration

Place 3-5 buckets throughout the irrigation spray pattern and collect samples while operating the pump at a given rpm and pressure (for a traveling gun record the travel speed also). At the end of the planned sample period measure the amount of liquid collected in inches (average the samples). The following chart shows how many gallons per acre applied per inch of liquid applied:

Inches Liquid Manure Applied via Irrigation:	Gallons per Acre:
0.20	5,431
0.30	8,146
0.40	10,862
0.50	13,577
0.75	20,366
1.00	27,154
1.25	33,943
1.50	40,731

Soft Hose Injection System with Irrigation Hose:

Alternative 1. Use a flow meter mounted on the injector system and calculate the distance and width to determine amount applied over a measured area. Example the flow meter measures 1,000 gallons over a distance of 600 feet and 10 feet wide.

Formula:

Application Rate (7,260 gallons/acre) = (Gallons Applied (1,000 gal) X 43,560 sq. ft/acre) divided by (Distance traveled (600 ft) X Application width (10 ft))

Alternative 2. (Requires a 10-20 gallon graduated measuring container)

Step 1) In the field, measure the flow out of one injector for 5 seconds into the graduated measuring container and record gallons, repeat three (3) times and average the results.

Step 2) Multiply the average amount collected from one injector by the number of injectors (equals amount applied for the whole system for 5 seconds).

Step 3) Multiply the results of Step 2 times 12 to get gallons per minute.

Step 4) Place the injector in the soil at the planned depth and operating speed and record the distance traveled in 1 minute (average 3 different measurements).

Step 5) Determine the effective application width (number of injectors X injector spacing in feet).

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Step 6) Multiply the effective width times the distance traveled in 1 minute (this gives the square feet covered in 1 minute).

Step 7) Divide the result of Step 6 by 43,560 (this gives the acres covered in 1 minute).

Step 8) Divide the results of Step 3 (gallons per minute) by the results of Step 7 (acres covered in 1 minute) - (this gives the gallons applied per acre.

For example:
Step 1) Collect an average of 6 gallons from one injector for 5 seconds.

Step 2) Applicator has 8 injectors (8 injectors X 6 gallons per injector = 48 gallons for 5 seconds)

Step 3) 48 gallons in 5 seconds X 12 = 576 gallons/minute applied

Step 4) Average distance covered in 1 minute was 250 feet

Step 5) Average width of the applicator is 12 feet.

Step 6) 12 feet wide X 250 feet long = 3000 square feet

Step 7) 3000 square feet divided by 43,560 square feet/acre = .0688 acres covered in 1 minute

Step 8) 576 gallons/minute divided by .0688 acres/minute = 8,372 gallons/acre.

Manure Spreader/Tanker Calibration
There are several methods that can be used to calibrate the application rate of a manure spreader. The two best methods are the load-area method and the weight-area method. It is desirable to repeat the calibration procedure 2 to 3 times and average the results to establish a more accurate calibration.

Before calibrating a manure spreader, the spreader settings such as splash plates should be adjusted so that the spread is uniform. Most spreaders tend to deposit more manure near the middle than at the edge of the spread pattern. Overlapping can make the overall application more uniform. Calibrating application rates when overlapping is involved requires measuring the width of two spreads and dividing by two to get the effective spread width.

Calibration should take place annually or whenever manure is being applied from a different source or consistency.

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Load-Area Method:
The load-area method is the most accurate and can be used for both liquid and soild manure. The load area method is a 3-step process:

Step 1) Determine the amount of manure in the spreader. The most accurate way to determine the amount of manure in a spreader is weighting the spreader when it is empty and again when it is full. For a reliable estimate of spreader capacity, weigh several representative loads (at least five) to determine the average gross weight. Subtract the empty spreader weight. Then, calculate the average net loaded weight.

Step 2) Determine the area of spread using the method at the right. Width measurements near the beginning and end of the spread pattern should be avoided because the spreader may not be operating at full capacity.

Step 3) Calculate the application rate. The application rate is calculated using the formula for either liquid or solid manure.

> **Formula for Solid Manure Equals Tons/Acre**
> (Average Loaded Weight (lbs) x 21.81) divided by (Distance Traveled (ft) x Width of Spread (ft))
>
> **Formula for Liquid Manure Equals Gal/Acre**
> (Tank Volume (gal) x 43,560) divided by (Distance Traveled (ft) x Width of Spread (ft))

Weight-Area Method:
The weight-area method can only be used with solid or semi-solid manure. When a scale is not available, the application rate of a box spreader can be determined by collecting manure on a tarp or piece of heavy material. The weight area method is less accurate than the load area method.

This method consists of eight steps:
Step 1) Prepare/cut three 56-inch square tarps or pieces of heavy material (this size equals 1/2,000 of an acre). The pounds of manure collected on 56 inches square equals tons applied per acre.

Step 2) Weigh one of the clean tarps and a large bucket on a platform scale. Record the weight.

Step 3) Anchor the three tarps in the field ahead of the spreader near the beginning, middle, and end of the area that will be spread with one load.

Step 4) Drive over the three tarps at a normal speed to collect a representative manure sample.

Step 5) Fold and place the first tarp into the empty bucket without spilling the manure. Weigh the bucket, tarp, and manure. Subtract the weight of the clean tarp and bucket recorded in step 2.

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Step 6) Repeat the process for each of the two remaining tarps.
Calculate the average weight (pounds) of the manure collected. This value equals tons of manure applied per acre.

Factor for converting pounds to tons and square feet to acres (21.8 = 43,560 sq ft per acre divided by 2,000 lbs/ton).
The factor for converting square feet to acres = 43,560 sq ft per acre.

Step 7) Determining Area of Spread.
The “area of spread” is the length and width of the ground covered with one load of manure. The area of spread is affected by speed and equipment settings. Spreaders discharge manure at varying rates depending on travel and PTO speed, gear box settings, and discharge openings. It is important to adjust the spreader so the pattern is as uniform as possible. Accurately measuring the length and width of this area is essential. To determine width, measure two adjacent spreads and divide by two to find the “effective” spread width. This accounts for overlap, which is often needed for a more uniform application. The length of spread is determined using the following three values:

1. Desired manure application rate based on soil and manure tests,
2. Width of the manure spread, and
3. Manure spreader holding capacity (weight and/or volume).

From these values, calculate the distance or lengths of spread using these formulas:

Formula: Solid Manure Equals Feet/Load
(Average Load Weight (lbs) x 21.81) divided by (Spread Width (ft) x App. Rate (tons/ac))

Formula: Liquid Manure Equals Feet/Load
(Tank Volume (gal) x 43,560) divided by (Spread Width (ft) x Desired App. Rate (gal/ac))

Step 8) Spread a load. If the distance traveled does not equal the calculated distance, adjust the speed or equipment settings.

UTILIZATION AREA

AMOUNT OF MANURE TO APPLY FOR CROPS GROWN

The timing and frequency of applications of wastewater and solids containing manure for utilization by crops shown in the table below are based on information provided in Oregon State University Extension publications listed in Section 5.

The formulas for determining the total nutrient application rate per unit yield for each crop shown in the table below are as follows:

Total N to apply in pounds = N in pounds per yield unit from the table for the crop grown X percent (%) dry matter (DM) of harvested crop/100 X planned or measured yield per yield unit

Total P_2O_5 to apply in pounds = P in pounds per yield unit from the table for the crop grown X 2.291 P_2O_5/P X percent (%) dry matter (DM) of harvested crop/100 X planned or measured yield per yield unit

Total K_2O to apply in pounds = K in pounds per yield unit from the table for the crop grown X 1.205 K_2O/K X percent (%) dry matter (DM) of harvested crop/100 X planned or measured yield per yield unit

The following tables show the crops that may be grown on this farm:

				Nutrient Removal (lb/yield unit)		
FRUIT OR VEGETABLES	**Yield Unit**	**lb/Unit**	**% DM**	**N**	**P**	**K**
Beans, dry edible	cwt	100	100	3.13	0.45	0.85
Blueberries	ton	2000	100	2.14	0.20	3.54
Caneberries	ton	2000	100	11.43	7.42	11.43
Corn, Sweet	ton	2000	100	17.80	4.8	11.6
Mixed Vegetables & Fruit	ton	2000	100	8.33	2.08	10.20
Onions	cwt	100	100	0.30	0.06	0..22
Orchard, Fruit	ton	2000	100	13.00	2.00	16.00
Pea, edible	ton	2000	100	73.60	8.00	18.00
Potatoes	ton	2000	100	6.60	1.20	10.33
Squash	ton	2000	100	3.2	1.02	1.71

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				Nutrient Removal (lb/yield unit)		
GRAIN, SEED OR OIL CROPS	**Yield Unit**	**lb/Unit**	**% DM**	**N**	**P**	**K**
Barley	bushels	48	100	0.87	0.16	0.21
Beets, sugar	ton	2000	100	4.00	0.60	2.78
Bluegrass, Seed	cwt	100	100	2.88	0.43	1.98
Canola	ton	2000	100	70.00	12.00	18.00
Corn, grain shelled	bushels	56	100	0.90	0.16	0.22
Crimson Clover seed	lb	1	100	0.05	0.01	0.02
Fescue Seed, Straw Removed	cwt	100	100	10.03	1.08	8.33
Fescue, seed (Fine or Tall)	lb	1	100	0.02	0.00	0.00
Grass Seed	cwt	100	100	1.60	0.20	0.40
Grass Seed, Straw Removed	ton	2000	100	33.90	5.50	34.40
Oats, grain	bushels	32	100	0.62	0.11	0.16
Orchardgrass seed	lb	1	100	0.016	0.002	0.004
Peppermint for Oil	ton	2000	100	4.20	1.80	2.80
Peppermint for Oil, Leaves and Stems Removed	ton	2000	100	87.2	36.8	57.8
Pumpkins	ton	2000	100	4.00	1.40	6.60
Rapeseed	bushels	50	100	1.38	0.30	0.30
Red Clover seed	lb	1	100	0.05	0.01	0.02
Ryegrass Seed	cwt	100	100	1.60	0.20	0.40
Ryegrass, Perennial Seed	lb	1	100	0.02	0.002	0.004
Triticale, Haylage	ton	2000	100	14.7	2.04	3.42
Wheat, Soft White for grain	bushels	60	100	1.00	0.24	0.21
Wheat, Soft White Straw Removed	ton	2000	100	43.40	8.90	20.90
Wheat, Hard Red for grain	bushels	60	100	1.60	0.37	0.31
Wheat, Soft White Straw Removed	ton	2000	100	83.40	17.10	37.10

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HAY AND PASTURE CROPS	Yield Unit	lb/Unit	% DM	Nutrient Removal (lb/yield unit) N	P	K
Alfalfa, Hay	ton	2000	100	64.00	8.00	42.00
Alfalfa, Seed	cwt	100	100	6.12	0.70	2.34
Alta Fescue Hay/Pasture	ton	2000	100	33.00	6.90	37.60
Grass Legume Hay/Pasture	ton	2000	100	33.90	5.50	34.40
Meadow Fescue Hay/Pasture	ton	2000	100	41.60	8.80	47.40
Oats Hay/Pasture	ton	2000	100	60.00	10.20	14.80
Orchardgrass Hay/Pasture	ton	2000	100	53.20	8.60	18.60
Perennial Grass Hay/Pasture	ton	2000	100	58.00	8.00	40.00
Reed Canary Grass	ton	2000	100	37.03	3.57	41.57
Ryegrass Hay	ton	2000	100	33.40	5.40	28.40
Ryegrass, Perennial Pasture	ton	2000	100	58.00	8.00	48.00
Tall Fescue Hay/Pasture	ton	2000	100	39.40	4.00	40.00

SILAGE AND HAYLAGE CROPS	Yield Unit	lb/Unit	% DM	Nutrient Removal (lb/yield unit) N	P	K
Alfalfa/Grass Haylage	ton	2000	100	15.60	1.02	6.84
Corn for Silage	ton	2000	100	7.50	1.20	6.00
Crimson Clover forage	ton	2000	100	40.00	4.41	32.98
Field Pea, Forage	ton	2000	100	73.60	8.00	18.00
Oat haylage	ton	2000	100	60.00	10.20	14.80
Oats & Peas/ Green Beans	ton	2000	100	32.03	5.58	18.65
Perennial Grass Haylage	ton	2000	100	15.00	2.40	12.78
Red Clover forage	ton	2000	100	40.00	4.41	32.98
Ryegrass Haylage	ton	2000	100	50.00	8.00	42.67
Sorghum-Sudan Haylage	ton	2000	100	54.33	6.33	58.00
Triticale Haylage	ton	2000	100	49.00	6.80	11.40
Wheatgrass Hay/Pasture	ton	2000	100	28.40	5.40	53.60

UTILIZATION AREA

OTHER CROPS	Yield Unit	lb/Unit	% DM	Nutrient Removal (lb/yield unit)		
				N	P	K
Filberts	ton	2000	100	41.7	7.30	39.29
Hops, Cones	bale	200	100	9.00	0.96	5.00
Natural Area (Trees and Grass)	ton	2000	100	10.52	1.56	9.20
Nursery Stock	ton	2000	100	8.33	2.08	10.20
Poplars, Pulpwood	ton	2000	100	0.30	0.09	0.12

UTILIZATION AREA

Holland's Dairy

SOLID MANURE APPLICATION CHART

MANURE ANALYSIS (As received lb/ton)

	Total N	NH4-N	P_2O_5	K_2O
Test Date: 03/23/15	17.73	3.55	9.15	11.44
Type: Solids Stack				

Thickness to apply (in)	Manure Applied (T/A)	Manure Nutrient Content: Total N (lb/A)	Available N (lb/A)	P_2O_5 (lb/A)	K_2O (lb/A)
0.013	1.00	18	4	9	11
0.026	2.00	35	7	18	23
0.039	3.00	53	11	27	34
0.052	4.00	71	14	37	46
0.066	5.00	89	18	46	57
0.079	6.00	106	21	55	69
0.092	7.00	124	25	64	80
0.105	8.00	142	28	73	92
0.118	9.00	160	32	82	103
0.131	10.00	177	36	92	114
CUSTOM:					
Spreader 1	12.1	215	43	111	139
Spreader 2	18.2	323	65	167	208
Spreader 3	36.4	646	129	333	417

SOLID MANURE SPREADER 1 CALIBRATION

SPREADER VOLUME AND WEIGHT CALCULATIONS

Stack height above sideboard = 1 ft
Length = 15.3 ft
Depth = 2 ft
Width = 5.4 ft

Spreader Volume = 231 ft3
Weight of Manure = 12,543 lbs

MANURE DENSITY CALCULATIONS

BUCKET

Top Diam 11 ght 13.75 Volume 0.756 ft3

Weight 41 lbs **Manure Density = 54 lbs/ft3**

SPREAD AREA CALCULATIONS

Spread Width = 15 ft

Application Area

Spread Length = 1,500 ft

Area Spread = 22,500 ft2 or 0.52 acre

Manure Rate Spread = 0.56 lbs/ft2
24,283 lbs/acre
12.1 ton/acre

SOLID MANURE SPREADER 2 CALIBRATION

SPREADER VOLUME AND WEIGHT CALCULATIONS

Stack height above sideboard = 1 ft
Length = 15.3 ft
Depth = 2 ft
Width = 5.4 ft

Spreader Volume = 231 ft3
Weight of Manure = 12,543 lbs

MANURE DENSITY CALCULATIONS

BUCKET

Top Diam 11 Height 13.75 Volume 0.756 ft3

Weight 41 lbs **Manure Density = 54 lbs/ft3**

SPREAD AREA CALCULATIONS

Spread Width = 15 ft

Application Area

Spread Length = 1,000 ft

Area Spread = 15,000 ft2 or 0.34 acre

Manure Rate Spread = 0.84 lbs/ft2
36,424 lbs/acre
18.2 ton/acre

SOLID MANURE SPREADER 3 CALIBRATION

SPREADER VOLUME AND WEIGHT CALCULATIONS

Stack height above sideboard = 1 ft
Length = 15.3 ft
Depth = 2 ft
Width = 5.4 ft

Spreader Volume = 231 ft3
Weight of Manure = 12,543 lbs

MANURE DENSITY CALCULATIONS

BUCKET

Top Diam 11 Height 13.75 Volume 0.756 ft3

Weight 41 lbs **Manure Density = 54 lbs/ft3**

SPREAD AREA CALCULATIONS

Spread Width = 15 ft

Application Area

Spread Length = 500 ft

Area Spread = 7,500 ft2 or 0.17 acre

Manure Rate Spread = 1.67 lbs/ft2
72,848 lbs/acre
36.4 ton/acre

UTILIZATION AREA

Holland's Dairy

LIQUID MANURE APPLICATION CHART

MANURE ANALYSIS
(As received lb/1000 gal)

		Total N	NH4-N	P_2O_5	K_2O
Test Date:	02/24/15	13.33	6.67	6.03	11.84
Location:	WSP				

Manure Nutrient Content

Thickness to apply (inch)	Manure Applied (gallons)	Total N (lb/A)	Available N (lb/A)	P_2O_5 (lb/A)	K_2O (lb/A)
0.25	6,789	90	45	41	80
0.50	13,577	181	91	82	161
0.75	20,366	271	136	123	241
1.00	27,154	362	181	164	322
1.25	33,943	452	226	205	402
1.50	40,731	543	272	246	482
1.75	47,520	633	317	287	563
2.00	54,308	724	362	327	643
CUSTOM:					
Tank Wagon	3,630	48	24	22	43
Big Gun	12,144	162	81	73	144
Spreader Bar	20,364	271	136	123	241

EQUIPMENT CALIBRATION CALCULATIONS

TANK WAGON MANURE SPREADER CALIBRATION

Volume of Wagon = 3,000 gallons OR 401 ft3

Spread Length = 600 ft

Spread Width = 60 ft

Application Area

Area Spread = 36,000 ft2 OR 0.83 acre

NOTE: Area spread is the total area covered by the tank wagon application.

APPLICATION RATE = 3,630 gal/acre OR 0.13 in/acre

NOTE: Inch/acre should be close to amount collected in a rain gauge or pan

BIG GUN TRAVELOR APPLICATION RATE CALCULATIONS

Nozzle Diameter 1.00 inch Wetted Dia 330 feet

Pump Pressure 80 psi Flow Rate 230 gpm

Hose Speed = 24 sec/foot

= 2.5 feet/minute

= 150 feet/hour

Spread Width = 330 ft

Application Area

Length of Pull = 1,200 ft

Area Spread = 396,000 ft2 OR 9.09 acre

NOTE: Area spread is the total area covered by the big gun application.

APPLICATION RATE = 12,144 gal/acre OR = 0.45 inch/acre

NOTE: Inch/acre should be close to amount collected in a rain gauge or pan

SPREADER BAR APPLICATION RATE CALCULATIONS

Spreader Bar Width- 12 ft

Flowrate- 279 gpm

Time to Apply- 5 Hrs

Spread Width = 120 ft

Application Area

Spread Length= 1,492 ft

Area Spread = 179,040 ft2 OR 4.11 acre

NOTE: Area spread is the total area covered by the spreader bar application.

APPLICATION RATE = 20,364 gal/acre OR = 0.75 inch/acre

NOTE: Inch/acre should be close to amount collected in a rain gauge or pan

UTILIZATION AREA

IRRIGATION WATER MANAGEMENT

The application of Irrigation Water Management to the irrigated fields as shown on the Field Map will manage soil moisture to promote the desired crop response, optimize the available water supplies, minimize irrigation induced erosion, decrease non-point source pollution of surface and groundwater sources, manage salts in the crop root zone and manage the crop micro climate. Irrigation water is supplied by wells and surface water sources using pumps through pipelines to sprinkler irrigation systems. The average amount of irrigation water to be applied per application and total annual amount needed for irrigated crops with guidance on when and how much irrigation water to apply can be found starting on page 3-28.

Permits: Under Oregon law all water is publicly owned and anyone planning to store or divert surface or groundwater for the purpose of irrigation must obtain a permit or water right from the Oregon Water Resources Department. These permits or water rights must be obtained prior to the use of the water. It is the responsibility of the Farmer to file for the necessary permits or water rights.

Permits or water rights are not needed to apply wastewater as a nutrient source.

Irrigation Water Flows, Volumes, and Relationships

Equation 1-

$$Q \times T = D \times A$$

where:

Q = flow rate (acre-in/hr or cfs)
T = time (hr)
D = gross depth applied (in)
A = area (acres)

Equation 2-

$$Q = \frac{453 \times A \times D}{F \times H}$$

where:

Q = flow rate (gpm)
A = area (acres)
D = gross application depth (in)
F = irrigation period (days)
H = hours of operation per day

Water Flow Rates:

1 cubic foot per second (cfs)
= 448.8 gallons per minute
1 cfs for 1 hour = 0.99 acre-inch
1 cfs for 24 hr = 1.98 acre-ft
1,000 gpm = 2.23 cfs
1,000 gpm for 24 hr = 4.42 ac-ft
1 gpm/acre = 0.053 ac-in/ac/day
1 cfs = 40 miner's inches in OR, No CA
1 cfs = 50 miner's inches in ID, WA
1 miner's inch = 11.22 gpm in OR
1 miner's inch = 9 gpm in ID, WA
1 cfs = 28.32 liters/sec
1 cubic meter/sec = 35.3 cfs
1 liter/sec = 15.85 gpm

Q x **T = D** x **A** *where:*

Q = cfs, T = hr; D = inches depth; A = acres

Gpm for 5 ft/s velocity in PVC pipe:

6"	8"	10"	12"	14"
480	800	1250	1750	2150

NRCS *Natural Resources Conservation Service*

Water Volumes & Weights:

1 cubic foot = 7.48 gallons
= 62.4 lb = 28.3 liters
1 acre-foot = 43,560 cubic feet
(1 acre covered 1 ft deep)
12 acre-in = 1 acre-ft = 325,829 gal
1 million gallons = 3.07 acre-ft
1 acre-ft = 1,234 cubic meters
1 cu meter = 1,000 liters = 35.3 cu ft

Pressure and Pressure Head:

1 psi = 2.31 ft of pressure head
1 atmosphere (sea level)
= 14.7 psi = 33.9 ft of head

Lengths and Areas:

1 mile = 5,280 ft = 1.61 km
1 meter = 3.28 ft = 39.37 inches
1 acre = 43,560 square ft
1 hectare = 2.47 acres

Pump Power Requirement

$$Horsepower = \frac{Pump\ Head\ in\ ft \times gpm}{39.6 \times \%\ Pump\ Efficiency}$$

UTILIZATION AREA

SOILS-

Based on the Natural Resources Conservation Service National Engineering Handbook, Part 652, National Irrigation Guide, the irrigated soils on this farm have an average water holding capacity of 0.16 inches per inch of soil depth and a soil intake rate of 0.30 inches per hour.

CROPS-

CROP	MATURE ROOT DEPTH (INCHES)	MAXIMUM ALLOWED DEPLETION	CRITICAL PERIOD
Grass Hay/Pasture	**30**	**50%**	**July**

Above data are from EM8713, *Western Oregon Irrigation Guides*, June 1998, OSU: Corvallis, OR and NRCS *Irrigation Guide (National Engineering Handbook, Part 652)*.

IRRIGATION WATER SUPPLY-

Description of Oregon Water Right:	Certificate 87917
Description of Irrigation Water Supply (Well, Stream, Irrigation District, etc.):	Wells and Irrigation District
Supply Flowrate (gpm or cfs):	4,934 gpm or 10.99 cfs
Annual Volume Available (Acre-ft.):	1,979 AF
Water Delivery Schedule:	On Demand
Method(s) of Water Measurement:	NA

IRRIGATION SYSTEM-

System	System Capacity (gpm)	Nozzle Size (in)	Pressure (psi)	Spacing (ft)	Application Rate (in/hr)	System Efficiency (%)
Side Roll (Wheel Line) Sprinkler	231	11/64 and 3/16	50 to 60	60	0.26 to 0.3	75
Traveling Big Gun Sprinkler	335	1.1	80 to 90	180 to 240	0.4 to 0.5	65
Center Pivot Sprinkler	800	1/4	50 to 60	NA	0.7 to 0.8	80

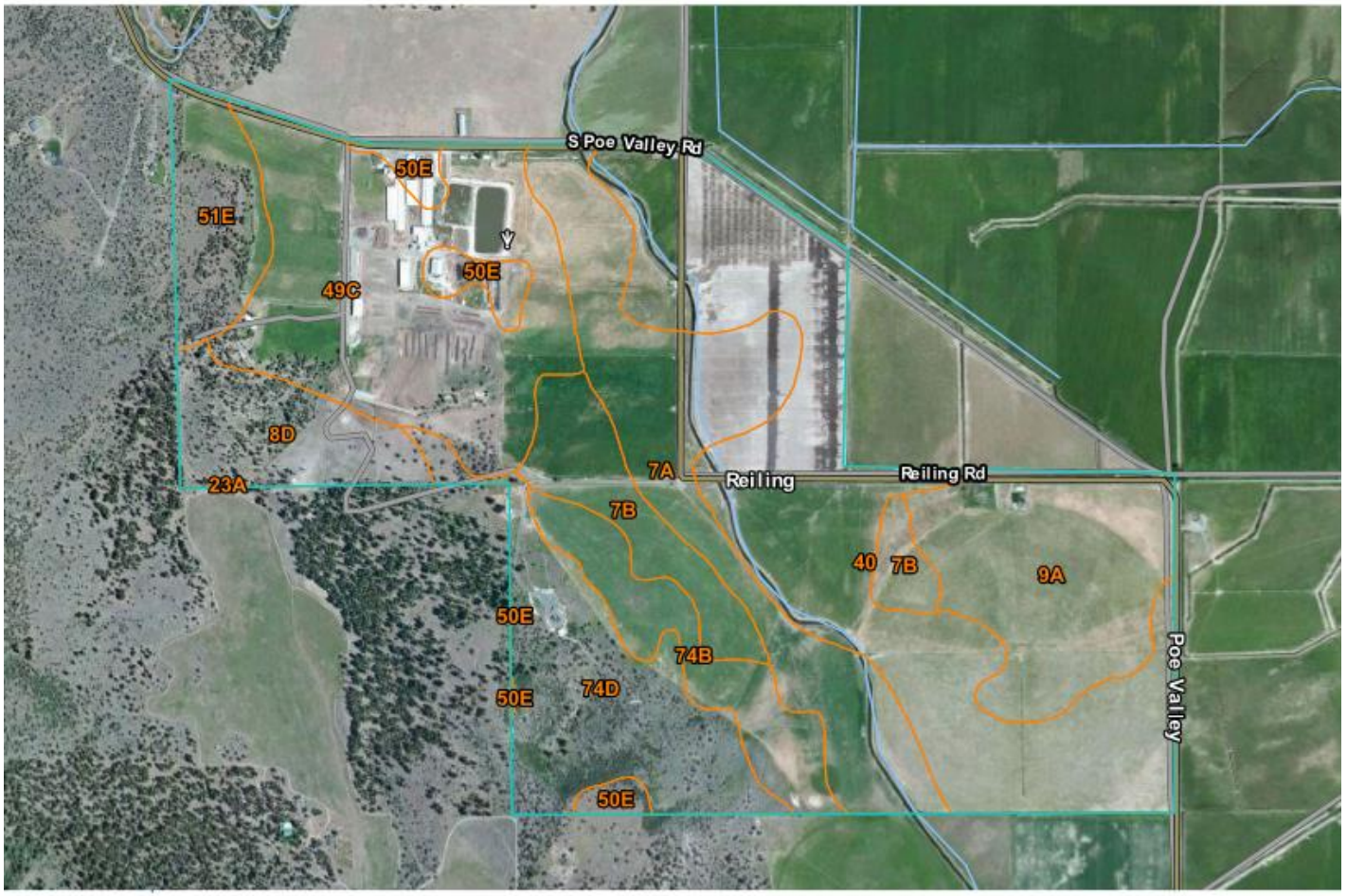
UTILIZATION AREA

Irrigation Water Management Worksheet						
Crop Name:	**Hay/Pasture Land**					
Managed Rooting Depth (inches):	**30**					
Management Allowed Depletion, MAD:	**50%**					
Irrigated Acres:	**440**					
Soil Name:	**Calimus, Laki, Lorella, Stukel**					
Soil Depth (inches):	**60**					
Available Water Capacity (in/in):	**0.16**					
Soil Intake Rate (in/hr) :	**0.30**					
IRRIGATION REQUIREMENT HOW MUCH water to apply?	**Month**					
	April	**May**	**June**	**July**	**August**	**Sept**
Total Plant Available Water Capacity (in): Soil or Root Depth * Available Water Capacity	4.8	4.8	4.8	4.8	4.8	4.8
Net Irrigation Application (in): Total Plant Available Water Capacity * MAD	2.4	2.4	2.4	2.4	2.4	2.4
Irrigation System Application Rate (in/hr): Determined based on the type of Irrigation System	0.38	0.38	0.38	0.38	0.38	0.38
IRRIGATION TIMING WHEN to apply water?						
Net Irrigation Water Requirement (in): (From OSU Extension Miscellaneous Pub 8530, 1992)	**3.03**	**4.41**	**5.63**	**7.56**	**6.10**	**4.45**
Average Daily Crop Water Use (in/day):	0.10	0.14	0.19	0.24	0.20	0.15
Irrigation Frequency (days): Net Irrigation Application / Daily Crop Water Use	24	17	13	10	12	16
Irrigation System Set Time (hours):	**12**	**12**	**12**	**12**	**12**	**12**
Actual Net Irrigation Application (in): Gross Application * System Application Efficiency	**3.19**	**3.19**	**3.19**	**3.19**	**3.19**	**3.19**
Actual Irrigation Frequency (days): Actual Net Irrigation Application / Daily Crop Water Use	**30**	**22**	**17**	**13**	**16**	**22**
IRRIGATION SYSTEM CAPACITY						
System Application Efficiency (%): Water Required / Water Applied	**70%**	**70%**	**70%**	**70%**	**70%**	**70%**
Gross Irrigation Application (in): System Application Rate * System Set Time	4.56	4.56	4.56	4.56	4.56	4.56
Volume of Water per Irrigation (acre-in): Gross Irrigation Application * Irrigated Acres	2006	2006	2006	2006	2006	2006
Irrigation System Operation (hours/day):	16	16	16	16	16	16
Required System Flow Rate (gpm): (Equation 2)	**1,894**	**2,532**	**3,340**	**4,340**	**3,502**	**2,640**
Compare **Required** system flow rate with **Measured** flow noted on **Irrigation Application Record**						

SOIL AND RISK ASSESSMENT

SOIL MAP(S)

Soil Map—Klamath County, Oregon, Southern Part
(Holland's Dairy)



Map Scale: 1:15,200 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0 200 400 800 1200
Feet
0 500 1000 2000 3000
Map projection: Web Mercator Corner coordinates: WGS84

Map Unit Legend

Klamath County, Oregon, Southern Part (OR640)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
7A	Calimus loam, 0 to 2 percent slopes	91.2	13.8%
7B	Calimus loam, 2 to 5 percent slopes	37.4	5.7%
8D	Calimus-Capona loams, 15 to 35 percent slopes	34.8	5.3%
9A	Capona loam, 0 to 2 percent slopes	71.2	10.8%
23A	Harriman loam, 0 to 2 percent slopes	0.2	0.0%
40	Laki-Henley loams	162.3	24.5%
49C	Lorella loam, 1 to 15 percent slopes	116.7	17.6%
50E	Lorella very stony loam, 2 to 35 percent south slopes	15.4	2.3%
51E	Lorella-Calimus association, steep north slopes	29.6	4.5%
74B	Stukel-Capona loams, 2 to 15 percent slopes	34.5	5.2%
74D	Stukel-Capona loams, 15 to 25 percent slopes	68.6	10.4%
Totals for Area of Interest		**661.8**	**100.0%**

SOIL AND RISK ASSESSMENT

SOIL REPORTS

Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately.

The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

Report—Map Unit Description

Klamath County, Oregon, Southern Part

7A—Calimus loam, 0 to 2 percent slopes

Map Unit Setting
National map unit symbol: jdnq
Elevation: 4,100 to 4,700 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition
Calimus and similar soils: 59 percent
Minor components: 1 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Calimus

Setting
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy sediment derived from tuff, basalt and diatomite

Typical profile
H1 - 0 to 11 inches: loam
H2 - 11 to 40 inches: loam
H3 - 40 to 60 inches: loam

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 9.3 inches)

Interpretive groups
Land capability classification (irrigated): 2c
Land capability classification (nonirrigated): 6c
Hydrologic Soil Group: B

Minor Components

Aquolls
Percent of map unit: 1 percent
Landform: Lake terraces

7B—Calimus loam, 2 to 5 percent slopes

Map Unit Setting
National map unit symbol: jdnr
Elevation: 4,100 to 4,700 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 90 to 110 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition
Calimus and similar soils: 67 percent
Minor components: 1 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Calimus

Setting
Landform: Terraces, alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear, convex
Parent material: Alluvium and lacustrine sediment derived from tuff, basalt and diatomite

Typical profile
H1 - 0 to 11 inches: loam
H2 - 11 to 40 inches: loam
H3 - 40 to 60 inches: loam

Properties and qualities
Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 9.3 inches)

Interpretive groups
Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B

Minor Components

Aquolls
Percent of map unit: 1 percent
Landform: Lake terraces

8D—Calimus-Capona loams, 15 to 35 percent slopes

Map Unit Setting
National map unit symbol: jdp6
Elevation: 4,100 to 4,700 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Calimus and similar soils: 55 percent
Capona and similar soils: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Calimus

Setting
Landform: Escarpments
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Alluvium and lacustrine sediment derived from tuff, basalt and diatomite

Typical profile
H1 - 0 to 14 inches: loam
H2 - 14 to 48 inches: loam
H3 - 48 to 60 inches: loam

Properties and qualities
Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 9.6 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: SOUTH SLOPES 14-18 PZ (R021XY308OR)

Description of Capona

Setting
Landform: Escarpments
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Alluvium and lacustrine deposits derived from diatomite, tuff and basalt

Typical profile
H1 - 0 to 11 inches: loam
H2 - 11 to 25 inches: gravelly sandy clay loam
H3 - 25 to 35 inches: unweathered bedrock

Properties and qualities
Slope: 15 to 35 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.6 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: SOUTH SLOPES 14-18 PZ (R021XY308OR)

9A—Capona loam, 0 to 2 percent slopes

Map Unit Setting
National map unit symbol: jdpb
Elevation: 4,100 to 4,700 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Prime farmland if irrigated

SOIL AND RISK ASSESSMENT

Map Unit Composition
Capona and similar soils: 57 percent
Minor components: 1 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Capona

Setting
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from diatomite, tuff and basalt

Typical profile
H1 - 0 to 11 inches: loam
H2 - 11 to 25 inches: gravelly sandy clay loam
H3 - 25 to 35 inches: unweathered bedrock

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.6 inches)

Interpretive groups
Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C

Minor Components

Aquolls
Percent of map unit: 1 percent
Landform: Lake terraces

23A—Harriman loam, 0 to 2 percent slopes

Map Unit Setting
National map unit symbol: jdl7
Elevation: 4,100 to 4,200 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition
Harriman and similar soils: 59 percent
Minor components: 1 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

SOIL AND RISK ASSESSMENT

Description of Harriman

Setting
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from diatomite, tuff and basalt

Typical profile
H1 - 0 to 18 inches: loam
H2 - 18 to 42 inches: clay loam
H3 - 42 to 48 inches: sandy clay loam
H4 - 48 to 58 inches: weathered bedrock

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.2 inches)

Interpretive groups
Land capability classification (irrigated): 3c
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: C
Ecological site: DEEP LOAMY 10-14 PZ (R021XY206OR)

Minor Components

Aquolls
Percent of map unit: 1 percent
Landform: Lake terraces

40—Laki-Henley loams

Map Unit Setting
National map unit symbol: jdly
Elevation: 4,050 to 4,150 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 80 to 110 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Laki and similar soils: 60 percent
Henley and similar soils: 38 percent
Minor components: 1 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

SOIL AND RISK ASSESSMENT

Description of Laki

Setting
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium and lacustrine deposits derived from basalt, diatomite, tuff and ash

Typical profile
H1 - 0 to 19 inches: loam
H2 - 19 to 32 inches: loam
H3 - 32 to 60 inches: loam

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 36 to 60 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to strongly saline (0.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Very high (about 13.5 inches)

Interpretive groups
Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B

Description of Henley

Setting
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium and lacustrine deposits derived from diatomite, tuff, basalt and ash

Typical profile
H1 - 0 to 11 inches: loam
H2 - 11 to 36 inches: sandy loam
H3 - 36 to 60 inches: cemented material

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: 20 to 40 inches to duripan
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 12 to 36 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 30.0
Available water storage in profile: Low (about 5.4 inches)

Interpretive groups
Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C

Minor Components

Aquolls
Percent of map unit: 1 percent
Landform: Lake terraces

49C—Lorella loam, 1 to 15 percent slopes

Map Unit Setting
National map unit symbol: jdmc
Elevation: 4,140 to 4,400 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Lorella and similar soils: 71 percent
Minor components: 1 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lorella

Setting
Landform: Structural benches
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Very cobbly and gravelly colluvium and residuum derived from basalt and tuff

Typical profile
H1 - 0 to 5 inches: loam
H2 - 5 to 10 inches: very cobbly clay loam
H3 - 10 to 19 inches: very gravelly clay
H4 - 19 to 29 inches: unweathered bedrock

Properties and qualities
Slope: 1 to 15 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.9 inches)

Interpretive groups
Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: LOAMY 10-14 PZ (R021XY200OR)

Minor Components

Aquolls
Percent of map unit: 1 percent
Landform: Mountains

50E—Lorella very stony loam, 2 to 35 percent south slopes

Map Unit Setting
National map unit symbol: jdmh
Elevation: 4,140 to 5,500 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition
Lorella, south, and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lorella, South

Setting
Landform: Escarpments
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Crest, nose slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Very cobbly and gravelly colluvium and residuum derived from basalt and tuff

Typical profile
H1 - 0 to 5 inches: very stony loam
H2 - 5 to 10 inches: very cobbly clay loam
H3 - 10 to 19 inches: very gravelly clay
H4 - 19 to 29 inches: unweathered bedrock

Properties and qualities
Slope: 2 to 35 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.6 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: LOAMY 10-14 PZ (R021XY200OR)

SOIL AND RISK ASSESSMENT

51E—Lorella-Calimus association, steep north slopes

Map Unit Setting
National map unit symbol: jdmj
Elevation: 4,140 to 4,700 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 80 to 100 days
Farmland classification: Not prime farmland

Map Unit Composition
Lorella, north, and similar soils: 60 percent
Calimus, north, and similar soils: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lorella, North

Setting
Landform: Escarpments
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Crest, nose slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Very cobbly and gravelly colluvium and residuum derived from basalt and tuff

Typical profile
H1 - 0 to 5 inches: very stony loam
H2 - 5 to 10 inches: very cobbly clay loam
H3 - 10 to 19 inches: very gravelly clay
H4 - 19 to 29 inches: unweathered bedrock

Properties and qualities
Slope: 15 to 35 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.6 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: NORTH SLOPES 14-18 PZ (R021XY312OR)

Description of Calimus, North

Setting
Landform: Escarpments
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy lacustrine sediment

Typical profile
H1 - 0 to 14 inches: loam
H2 - 14 to 48 inches: loam
H3 - 48 to 60 inches: loam

Properties and qualities
Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 9.6 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: NORTH SLOPES 14-18 PZ (R021XY312OR)

74B—Stukel-Capona loams, 2 to 15 percent slopes

Map Unit Setting
National map unit symbol: jdnh
Elevation: 4,100 to 4,700 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Stukel and similar soils: 55 percent
Capona and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Stukel

Setting
Landform: Structural benches
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from tuff and diatomite

Typical profile
H1 - 0 to 7 inches: loam
H2 - 7 to 17 inches: loam
H3 - 17 to 27 inches: unweathered bedrock

Properties and qualities
Slope: 2 to 15 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.7 inches)

Interpretive groups
Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: LOAMY 10-14 PZ (R021XY200OR)

Description of Capona

Setting
Landform: Structural benches
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium and residuum derived from tuff and diatomite

Typical profile
H1 - 0 to 11 inches: loam
H2 - 11 to 25 inches: gravelly sandy clay loam
H3 - 25 to 35 inches: unweathered bedrock

Properties and qualities
Slope: 2 to 15 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.6 inches)

Interpretive groups
Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: LOAMY 10-14 PZ (R021XY200OR)

74D—Stukel-Capona loams, 15 to 25 percent slopes

Map Unit Setting
National map unit symbol: jdnj
Elevation: 4,100 to 4,700 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Farmland of statewide importance

SOIL AND RISK ASSESSMENT

Map Unit Composition
Stukel and similar soils: 65 percent
Capona and similar soils: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Stukel

Setting
Landform: Structural benches
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from tuff and diatomite

Typical profile
H1 - 0 to 7 inches: loam
H2 - 7 to 17 inches: loam
H3 - 17 to 27 inches: unweathered bedrock

Properties and qualities
Slope: 15 to 25 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.7 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: LOAMY 10-14 PZ (R021XY200OR)

Description of Capona

Setting
Landform: Structural benches
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium and residuum derived from tuff and diatomite

Typical profile
H1 - 0 to 11 inches: loam
H2 - 11 to 25 inches: gravelly sandy clay loam
H3 - 25 to 35 inches: unweathered bedrock

SOIL AND RISK ASSESSMENT

Properties and qualities
Slope: 15 to 25 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.6 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: LOAMY 10-14 PZ (R021XY200OR)

Data Source Information

Soil Survey Area:	Klamath County, Oregon, Southern Part
Survey Area Data:	Version 12, Sep 30, 2015

SOIL AND RISK ASSESSMENT

SOIL AND RISK ASSESSMENT

PREDICTED SOIL EROSION

USDA NRCS Natural Resources Conservation Service

RUSLE2 Worksheet Erosion Calculation Record

Info:

Owner name	*Tract #*	*Field name*
Hollands Dairy	**1348, 1553, 2295**	**Field 1, 4**

Location	*Soil*	*T value, t/ac/yr*	*Slope length (horiz), ft*	*Avg. slope steepness, %*
Oregon\Klamath County\OR_Klamath_R13	40 LAKI-HENLEY LOAMS\LAKI loam 60%	5.0	900	2.0

Alternatives:

Description	*Management*	*Contouring*	*Strips / barriers*	*Diversion/terrace, sediment basin*	*Cons. plan. soil loss*	*Soil conditioning index (SCI)*	*STIR value*	*Wind & irrigation-induced erosion for SCI, t/ac/yr*	*Equiv. diesel use, gal/ac*	*Energy use, BTU/ac*	*Fuel cost, US$/ac*
Erosion on Grass Hay/Pasture	a.Single Year/Single Crop Templates\Pasture, yr1 fall plant; clean till, fall mb plow, Z32	a. rows up-and-down hill	(none)	(none)	0.0099	1.0	128	0	3.0	410000	8.88

The **SCI** is the **Soil Conditioning Index** rating. If the calculated index is a negative value, soil organic matter levels are predicted to decline under that production system. If the index is a positive value, soil organic matter levels are predicted to increase under that system.

The **STIR** value is the **Soil Tillage Intensity Rating**. It utilizes the speed, depth, surface disturbance percent and tillage type parameters to calculate a tillage intensity rating for the system used in growing a crop or a rotation. STIR ratings tend to show the differences in the degree of soil disturbance between systems. The kind, severity and number of ground disturbing passes are evaluated for the entire cropping rotation as shown in the management description.

SOIL AND RISK ASSESSMENT

RUSLE2 Worksheet Erosion Calculation Record

Info:

Owner name	*Tract #*	*Field name*
Hollands Dairy	**363**	**Field 2**

Location	*Soil*	*T value, t/ac/yr*	*Slope length (horiz), ft*	*Avg. slope steepness, %*
Oregon\Klamath County\OR_Klamath_R13	74B STUKEL-CAPONA LOAMS, 2 TO 15 PERCENT SLOPES\STUKEL loam 55%	1.0	600	8.0

Alternatives:

Description	*Management*	*Contouring*	*Strips / barriers*	*Diversion/terrace, sediment basin*	*Cons. plan. soil loss*	*Soil conditioning index (SCI)*	*STIR value*	*Wind & irrigation-induced erosion for SCI, t/ac/yr*	*Equiv. diesel use, gal/ac*	*Energy use, BTU/ac*	*Fuel cost, US$/ac*
Erosion on Grass Hay/Pasture	a.Single Year/Single Crop Templates\Pasture, yr1 fall plant; clean till, fall mb plow, Z32	a. rows up-and-down hill	(none)	(none)	0.044	1.0	128	0	3.0	410000	8.88

The **SCI** is the **Soil Conditioning Index** rating. If the calculated index is a negative value, soil organic matter levels are predicted to decline under that production system. If the index is a positive value, soil organic matter levels are predicted to increase under that system.

The **STIR** value is the **Soil Tillage Intensity Rating**. It utilizes the speed, depth, surface disturbance percent and tillage type parameters to calculate a tillage intensity rating for the system used in growing a crop or a rotation. STIR ratings tend to show the differences in the degree of soil disturbance between systems. The kind, severity and number of ground disturbing passes are evaluated for the entire cropping rotation as shown in the management description.

SOIL AND RISK ASSESSMENT

RUSLE2 Worksheet Erosion Calculation Record

Info:

Owner name	*Tract #*	*Field name*
Hollands Dairy	**363**	**Field 3**

Location	*Soil*	*T value, t/ac/yr*	*Slope length (horiz), ft*	*Avg. slope steepness, %*
Oregon\Klamath County\OR_Klamath_R13	7A CALIMUS LOAM, 0 TO 2 PERCENT SLOPES\CALIMUS loam 59%	5.0	900	2.0

Alternatives:

Description	*Management*	*Contouring*	*Strips / barriers*	*Diversion/terrace, sediment basin*	*Cons. plan. soil loss*	*Soil conditioning index (SCI)*	*STIR value*	*Wind & irrigation-induced erosion for SCI, t/ac/yr*	*Equiv. diesel use, gal/ac*	*Energy use, BTU/ac*	*Fuel cost, US$/ac*
Erosion on Grass Hay/Pasture	a.Single Year/Single Crop Templates\Pasture, yr1 fall plant; clean till, fall mb plow, Z32	a. rows up-and-down hill	(none)	(none)	0.0100	1.0	128	0	3.0	410000	8.88

The **SCI** is the **Soil Conditioning Index** rating. If the calculated index is a negative value, soil organic matter levels are predicted to decline under that production system. If the index is a positive value, soil organic matter levels are predicted to increase under that system.

The **STIR** value is the **Soil Tillage Intensity Rating**. It utilizes the speed, depth, surface disturbance percent and tillage type parameters to calculate a tillage intensity rating for the system used in growing a crop or a rotation. STIR ratings tend to show the differences in the degree of soil disturbance between systems. The kind, severity and number of ground disturbing passes are evaluated for the entire cropping rotation as shown in the management description.

SOIL AND RISK ASSESSMENT

RUSLE2 Worksheet Erosion Calculation Record

Info:

Owner name	*Tract #*	*Field name*
Hollands Dairy	**363, 2294**	**Field 5, 6**

Location	*Soil*	*T value, t/ac/yr*	*Slope length (horiz), ft*	*Avg. slope steepness, %*
Oregon\Klamath County\OR_Klamath_R13	49C LORELLA LOAM, 1 TO 15 PERCENT SLOPES\LORELLA loam 71%	1.0	600	8.0

Alternatives:

Description	*Management*	*Contouring*	*Strips / barriers*	*Diversion/terrace, sediment basin*	*Cons. plan. soil loss*	*Soil conditioning index (SCI)*	*STIR value*	*Wind & irrigation-induced erosion for SCI, t/ac/yr*	*Equiv. diesel use, gal/ac*	*Energy use, BTU/ac*	*Fuel cost, US$/ac*
Erosion on Grass Hay/Pasture	a.Single Year/Single Crop Templates\Pasture, yr1 fall plant; clean till, fall mb plow, Z32	a. rows up-and-down hill	(none)	(none)	0.050	1.0	128	0	3.0	410000	8.88

The **SCI** is the **Soil Conditioning Index** rating. If the calculated index is a negative value, soil organic matter levels are predicted to decline under that production system. If the index is a positive value, soil organic matter levels are predicted to increase under that system.

The **STIR** value is the **Soil Tillage Intensity Rating**. It utilizes the speed, depth, surface disturbance percent and tillage type parameters to calculate a tillage intensity rating for the system used in growing a crop or a rotation. STIR ratings tend to show the differences in the degree of soil disturbance between systems. The kind, severity and number of ground disturbing passes are evaluated for the entire cropping rotation as shown in the management description.

SOIL AND RISK ASSESSMENT

OREGON PHOSPHORUS INDEX

FIELD SUMMARY & EASTERN OREGON P INDEX

Enter data in gray cells and select best choice from drop down menus.
Cells with blue font are completed automatically.

Grower:	Holland's Dairy
Application Plan by:	Bruce D. Wilson, H&R Engineering LLC
Date:	July 8, 2016

Field	Field 1	Field 2	Field 3	Field 4	Field 5	Field 6		
Acres	167.9	82.2	83.1	65.4	37.9	3.2		
Soil	40, Laki	74B, Stukel	7A, Calimus	40, Laki	49C, Lorella	49C, Lorella	KLAMATH COUNTY S PAI	KLAMATH COUNTY S PAI
Soil test date	April 4, 2014	April 4, 2014	April 4, 2014	April 4, 2014	April 4, 2014	April 4, 2014		
Olsen P (ppm)	64	84	91	97	119	119		
Acetate K (ppm)	1377	1361	1409	1413	1129	1129		
pH	7.3	6.6	7.1	7.2	7.3	7.3		
SMP	7.3	7.1	7.2	7.3	7.4	7.4		
TRANSPORT FACTORS								
Sheet & rill erosion (tons/ac-yr)	<1	<1	<1	<1	<1	<1	<1	<1
Sprinkler Irr erosion (tons/ac-yr)	no irrig. runoff	no irrig. runoff	no irrig. runoff	no irrig. runoff	no irrig. runoff	no irrig. runoff	not irrigated	not irrigated
Surface Irr erosion (tons/ac-yr)	<1	<1	<1	<1	<1	<1	<1	<1
Runoff Class	low	high	low	low	high	high	none	none
Distance to stream (ft)	<100 ft	<100 ft	<100 ft	<100 ft	>500 ft	>500 ft	>500 ft	>500 ft
Buffers	> 30 ft or NRCS spec.	> 30 ft or NRCS spec.	> 30 ft or NRCS spec.	> 30 ft or NRCS spec.	> 30 ft or NRCS spec.	> 30 ft or NRCS spec.	> 30 ft or NRCS spec.	> 30 ft or NRCS spec.
Drainage	no tiles	no tiles	no tiles	no tiles	no tiles	no tiles	no tiles	no tiles
SOURCE FACTORS								
Commercial P2O5 rate (lbs/ac)	0	0	0	0	0	0	0	0
Commercial P2O5 method	None applied	None applied	None applied	None applied	None applied	None applied	None applied	None applied
Commercial P2O5 timing	None applied	None applied	None applied	None applied	None applied	None applied	None applied	None applied
Organic P2O5 rate (lbs/ac)	165	165	165	165	165	165	0	0
Organic P2O5 method	Surface App, no Incorp	Surface App, no Incorp	Surface App, no Incorp	Surface App, no Incorp	Surface App, no Incorp	Surface App, no Incorp	None applied	None applied
Organic P2O5 timing	All months possible	All months possible	All months possible	All months possible	All months possible	All months possible	None applied	None applied
SCORE	19.6	75.2	23.0	23.8	90.1	90.1	0.0	0.0
P RUNOFF RISK RATING	Low	Medium	Low	Low	Medium	Medium	Low	Low

COMMENTS

SOIL AND RISK ASSESSMENT

Oregon Phosphorus Index Risk Interpretation

P Index rating	Interpretation	Recommended Nutrient Limitation
West PI Score<13 East PI Score<30	Low potential for P movement from this site given current management practices and site characteristics. There is a low probability of an adverse impact to surface waters from P losses on this site. Soil test P and P losses are likely to increase in future due to N-based nutrient management from animal manure.	Nitrogen
West PI Score 13-25 East PI Score 30-100	Medium potential for P movement from this site given current management practices and site characteristics. Practices should be introduced to reduce P losses by surface runoff, subsurface flow, and erosion. Soil test P and P losses are likely to increase in future due to N-based nutrient management from animal manure.	Nitrogen
West PI Score >25-50 East PI Score >100-400	High potential for P movement from this site given current management practices and site characteristics. All practicable management practices to reduce P losses through surface runoff, subsurface flow, or erosion should be implemented.	Phosphorus
West PI Score >50 East PI Score >400	Very high potential for P movement from this site given current management practices and site characteristics. Active remediation techniques should be implemented in an effort to reduce the P loss potential from this site.	No manure

SOIL AND RISK ASSESSMENT

REFERENCES

PUBLICATIONS AND SOFTWARE

Crop Fertilizer Recommendations

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http://www.nap.edu/openbook.php?isbn=0309069971

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REFERENCES

ORAWM WORKBOOK

OREGON ANIMAL WASTE MANAGEMENT DESIGN AID (ORAWM)

Version 5.2

7/8/2016

CLIENT: Hollands Dairy

ASSISTED BY: Bruce D. Wilson, H&R Engineering LLC

ANIMAL WASTE MANAGEMENT SYSTEM INVENTORY

ANIMAL INVENTORY

Type of Animal	Number of Animals	Average Weight (lbs.)	Animal Units (1,000 lb.)	Milk Production in Pounds/Cow/Day= 45 — Nutrient Production (lbs./day/1000 lb. Animal Unit) N	P	K	Nutrient Production (lbs./day) N	P	K	Manure CF/D/AU	Annual Days Confined	Annual Days Grazed	Annual Days Off Farm
MILKER (Jersey)	900	900	810.0	0.72	0.12	0.42	581.99	95.82	340.32	1.62	304	61	0
MILKER (DRY)	140	1,000	140.0	0.30	0.04	0.10	42.00	5.88	14.00	0.92	136	229	0
HEIFERS (12-24 Months)	545	700	381.5	0.27	0.05	0.12	101.48	17.36	45.78	0.90	136	229	0
CALVES (1-12 Months)	415	175	72.6	0.42	0.05	0.11	30.50	3.92	7.99	1.34	365	0	0
Totals/Averages-	2,000	694	1,404.1	0.54	0.09	0.29	756.0	123.0	408.1	1.3			

GRAZING PERIOD

Type of Animal	Percent of Month and Number of Animals Grazing OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AU-YR.
MILKER (Jersey)	33%	0%	0%	0%	0%	0%	0%	33%	33%	33%	33%	33%	
	900	900	900	900	900	900	900	900	900	900	900	900	1,604
MILKER (DRY)	100%	25%	25%	25%	25%	25%	25%	100%	100%	100%	100%	100%	
	140	140	140	140	140	140	140	140	140	140	140	140	1,050
HEIFERS (12-24 Months)	100%	25%	25%	25%	25%	25%	25%	100%	100%	100%	100%	100%	
	545	545	545	545	545	545	545	545	545	545	545	545	2,861
CALVES (1-12 Months)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
	415	415	415	415	415	415	415	415	415	415	415	415	0
													0
													0
													0
													0
													0
													0
Total AUM's Available>	0	0	0	0	0	0	0	0	0	0	0	0	0
Total AUM's Needed>>>	789	130	130	130	130	130	130	789	789	789	789	789	5,515
Total AUM's>>>>>>>>>>	-789	-130	-130	-130	-130	-130	-130	-789	-789	-789	-789	-789	-5,515

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REFERENCES

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ANIMAL WASTE MANAGEMENT SYSTEM INVENTORY

WEATHER STATION

KLAMATH FALLS AG-STN

Month	Precipitation	Evaporation	Paved	Unpaved
	25Yr-24Hr	2.40	Lot Runoff Factors as a Percent of Monthly Precipitation	
	RCN=	90.00		
	Average Monthly Inches			
October	0.89	3.23	100%	10%
November	1.87	0.67	100%	10%
December	2.04	0.38	100%	10%
January	1.14	0.50	100%	15%
February	1.86	0.88	100%	10%
March	1.31	1.77	100%	10%
April	0.73	3.65	100%	10%
May	0.67	5.54	100%	5%
June	0.63	6.53	100%	5%
July	0.48	7.78	100%	0%
August	0.48	7.23	100%	5%
September	0.75	4.69	100%	10%
Annual	12.85	42.85		

AREAS CONTRIBUTING RUNOFF TO LIQUID STORAGE FACILITY

Description of Runoff Area	Area in SF
Paved Lot Area >>> Is paved lot scraped daily? (Y/N) YES	122,746
Unpaved Lot Area >>>	0
Roof Area >>>	0
Surface Area of Silage Storage Facility>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> Does Silage Seepage Drain to Storage Facility? (Y/N) NO	0
Total Runoff Area Contributing to Liquid Storage Facility>>>>>>>>>>>>>>>>	122,746

WATER USE THAT ENTERS LIQUID STORAGE FACILITY

Type of Water Use	Number of Animals	Number of Washes per Day	Gallons of Water Used per Wash-Day	Total Water Use per Day, Gallons	Total Water Use per Day, Cubic Feet
Animal Washwater	900	2	0.03	54	7.2
Equipment Wash		2	1365.00	2730	365.0
Flushwater		0	0.00	0	0.0
Miscellaneous		2	7225.00	14450	1931.8
Total>>				17234	2304.0

CROP DATA

Field Number	Acres	Crop	Percent Dry Matter (DM)	Yield Units	Target Yield	Nutrients Removed in Pounds per Acre: Nitrogen N	Phosphorous P_2O_5	Potassium K_2O
1-6	431.9	Grass Hay/Pasture	100%	Ton	5.00	290	92	241
Off Farm								
Total Acres-	431.9							

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ANIMAL WASTE MANAGEMENT SYSTEM INVENTORY

BEDDING VOLUME

Type of Animal	Type of Bedding Facility	Bedding Material	Unit Weight Lbs/CF	Amount Needed Lbs/Day/AU	Volume CF/Day/AU	Total Volume CF/Day	Total Weight Lbs/Day
MILKER (Jersey)	Free Stall	Composted Manure	36.00	0.00	0.00	0	0
MILKER (DRY)	Free Stall	Loose Straw	2.50	2.60	1.04	146	364
HEIFERS (12-24 Months)	Free Stall	Loose Straw	2.50	2.04	0.82	313	778
CALVES (1-12 Months)	Confined	Loose Straw	2.50	2.04	0.82	60	148

SOLIDS SEPARATION FACTOR

Type of Animal	Type of Separator	% Solids Separated	Volume of Solids Separated CF/Day	Volume of Solids in Liquids CF/Day	Volume of Manure in Liquids CF/Day	Volume of Manure in Solids CF/Day	Accumulated Sludge in Storage CF/Day	Density of Separated Solids Lbs/CF	Weight of Separated Solids Lbs/Day
MILKER (Jersey)	Static Inclined Screen(Side Hill Separator)	15%	197	1,117	1,117	197	906	36	7,093
MILKER (DRY)	Dry Scrape System	50%	137	137	64	64	19	36	4,939
HEIFERS (12-24 Months)	Dry Scrape System	100%	656	0	0	343	0	36	23,622
CALVES (1-12 Months)	Dry Scrape System	100%	157	0	0	97	0	36	5,647
Totals>>			1,147	1,254	1,181	702	925		41,302

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ANIMAL WASTE MANAGEMENT SYSTEM PRODUCTION

MONTHLY VOLUMES

Month	Runoff in Cubic Feet: Roof Area Square Feet 0	Runoff in Cubic Feet: Paved Slab Area Square Feet 122,746	Runoff in Cubic Feet: Unpaved Lot Area Square Feet 0	Runoff in Cubic Feet: Silage Pit Surface Area, SF 0	Facility Water Use Cubic Feet	Manure Solids Cubic Feet	Manure Liquids Cubic Feet	Bedding Cubic Feet	Bedding Pounds	Solids Separated Cubic Feet	Solids Separated Pounds	Solids in Liquids Cubic Feet	Solids in Liquids Pounds	Total Solids Cubic Feet	Total Liquids Cubic Feet
October	0	9,104	0	0	71,424	3,778	26,522	1,846	4,593	8,955	322,395	23,191	834,860	8,955	103,719
November	0	19,128	0	0	69,120	6,817	46,133	12,101	30,146	28,468	1,024,857	36,583	1,316,996	28,468	124,831
December	0	20,867	0	0	71,424	7,044	47,671	12,505	31,150	29,417	1,059,019	37,803	1,360,896	29,417	130,094
January	0	11,661	0	0	71,424	7,044	47,671	12,505	31,150	29,417	1,059,019	37,803	1,360,896	29,417	120,888
February	0	19,026	0	0	64,512	6,363	43,057	11,295	28,136	26,570	956,533	34,144	1,229,196	26,570	117,682
March	0	13,400	0	0	71,424	7,044	47,671	12,505	31,150	29,417	1,059,019	37,803	1,360,896	29,417	122,627
April	0	7,467	0	0	69,120	6,817	46,133	12,101	30,146	28,468	1,024,857	36,583	1,316,996	28,468	113,171
May	0	6,853	0	0	71,424	3,778	26,522	1,846	4,593	8,955	322,395	23,191	834,860	8,955	101,468
June	0	6,444	0	0	69,120	3,656	25,666	1,787	4,445	8,667	311,995	22,442	807,929	8,667	98,007
July	0	4,910	0	0	71,424	3,778	26,522	1,846	4,593	8,955	322,395	23,191	834,860	8,955	99,525
August	0	4,910	0	0	71,424	3,778	26,522	1,846	4,593	8,955	322,395	23,191	834,860	8,955	99,525
September	0	7,672	0	0	69,120	3,656	25,666	1,787	4,445	8,667	311,995	22,442	807,929	8,667	99,234
Annual	**0**	**131,441**	**0**	**0**	**840,964**	**63,556**	**435,754**	**83,969**	**209,138**	**224,913**	**8,096,874**	**358,366**	**12,901,170**	**224,913**	**1,330,770**
Annual Gallons	**0**	**983,175**	**0**	**0**	**6,290,410**	**475,401**	**3,259,441**	**628,085**		**1,682,350**		**2,680,576**		**1,682,350**	**9,954,161**

DAILY NUTRIENT PRODUCTION

Type of Animal	Pounds/Day of Nutrients from LIQUIDS: N	LIQUIDS: P_2O_5	LIQUIDS: K_2O	Pounds/Day of Nutrients from SOLIDS: N	SOLIDS: P_2O_5	SOLIDS: K_2O	Pounds/Day of Nutrients from GRAZING: N	GRAZING: P_2O_5	GRAZING: K_2O	Grazing Manure Gallons/Yr	Confined Manure Cubic Feet/Yr
MILKER (Jersey)	254.91	79.16	156.19	153.80	69.11	102.56	581.99	219.53	410.09	596,608	399,695
MILKER (DRY)	10.82	2.86	3.78	37.00	14.14	14.06	42.00	13.47	16.87	220,865	17,485
HEIFERS (12-24 Months)	0.00	0.00	0.00	178.78	83.46	91.98	101.48	39.77	55.16	588,773	46,610
CALVES (1-12 Months)	0.00	0.00	0.00	53.74	18.86	16.05	0.00	0.00	0.00	0	35,521
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
									Total-	**1,406,246**	**499,310**

REFERENCES

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ANIMAL WASTE MANAGEMENT SYSTEM PRODUCTION

MONTHLY NUTRIENT PRODUCTION

Month	Pounds of Nutrients from LIQUIDS			Pounds of Nutrients from SOLIDS			Pounds of Nutrients from GRAZING			Total Pounds of Nutrients from ALL SOURCES		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
October	5,295	1,644	3,244	4,860	2,020	2,628	10,402	3,896	6,428	20,556	7,560	12,300
November	7,891	2,439	4,771	11,081	4,835	5,944	1,076	399	540	20,048	7,673	11,255
December	8,154	2,520	4,930	11,451	4,996	6,142	1,112	413	558	20,716	7,929	11,630
January	8,154	2,520	4,930	11,451	4,996	6,142	1,112	413	558	20,716	7,929	11,630
February	7,365	2,276	4,453	10,342	4,512	5,548	1,004	373	504	18,712	7,162	10,505
March	8,154	2,520	4,930	11,451	4,996	6,142	1,112	413	558	20,716	7,929	11,630
April	7,891	2,439	4,771	11,081	4,835	5,944	1,076	399	540	20,048	7,673	11,255
May	5,295	1,644	3,244	4,860	2,020	2,628	10,402	3,896	6,428	20,556	7,560	12,300
June	5,124	1,591	3,139	4,704	1,955	2,543	10,066	3,771	6,221	19,893	7,316	11,903
July	5,295	1,644	3,244	4,860	2,020	2,628	10,402	3,896	6,428	20,556	7,560	12,300
August	5,295	1,644	3,244	4,860	2,020	2,628	10,402	3,896	6,428	20,556	7,560	12,300
September	5,124	1,591	3,139	4,704	1,955	2,543	10,066	3,771	6,221	19,893	7,316	11,903
Annual	**79,034**	**24,474**	**48,039**	**95,705**	**41,159**	**51,460**	**68,231**	**25,535**	**41,415**	**242,969**	**91,168**	**140,913**

MONTHLY IMPORTS INTO STORAGE FACILITIES

Month	Liquids		Solids	
	Cubic Feet	Gallons	Cubic Feet	Tons
October	0	0	0	0
November	0	0	0	0
December	0	0	0	0
January	0	0	0	0
February	0	0	0	0
March	0	0	0	0
April	0	0	0	0
May	0	0	0	0
June	0	0	0	0
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
Totals-	**0**	**0**	**0**	**0**

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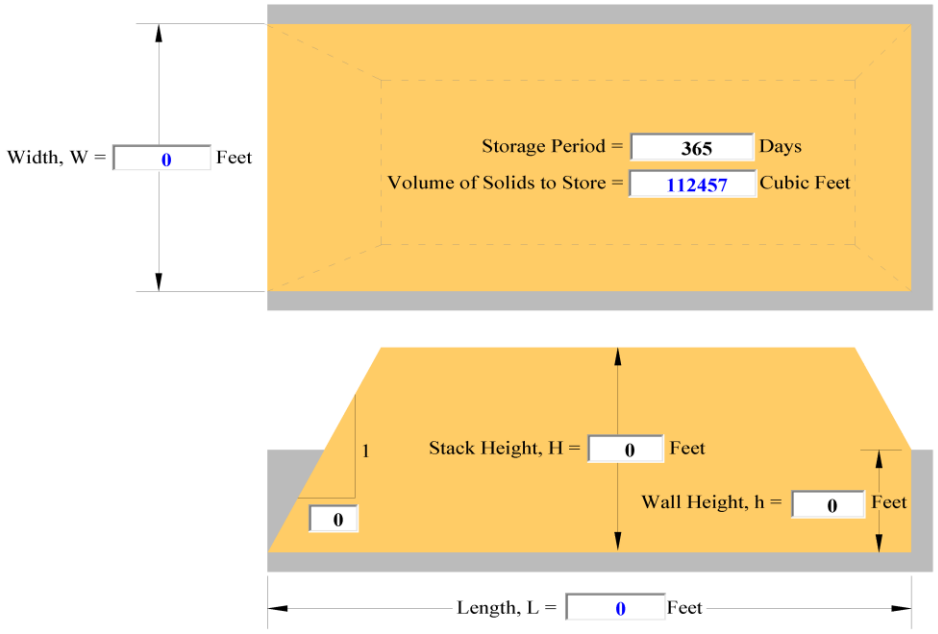
ANIMAL WASTE MANAGEMENT SYSTEM STORAGE

SOLIDS STACKING FACILITY

Solids Storage Facility Parameters	Value
Storage Period, Days=	365
Stacking Width, W in Feet=	0
Stacking Height, H in Feet=	0.00
Wall Height, h in Feet=	0.00
Stack Side Slope (X:1)=	0.00
Existing Storage, Cubic Feet=	642,074
Surface Area of Existing Storage, SF=	0
25 Year-24 Hour Storm Runoff, CF=	0
Volume Needed, Cubic Feet=	112,457
Design Volume, Cubic Feet=	0
Is Facility Covered?	NO
Volume Reduction Factor=	0.50

VOLUME OF MONTHLY SOLIDS STACKED IN FACILITY

Month	Number of Days	Manure CF	Bedding CF	Solids to Store CF	Solids to Store Tons	Normal Runoff CF
October	31	7,109	1,846	4,478	161	0
November	30	18,005	10,463	14,234	512	0
December	31	18,605	10,812	14,709	530	0
January	31	18,605	10,812	14,709	530	0
February	28	16,805	9,766	13,285	478	0
March	31	18,605	10,812	14,709	530	0
April	30	18,005	10,463	14,234	512	0
May	31	7,109	1,846	4,478	161	0
June	30	6,880	1,787	4,333	156	0
July	31	7,109	1,846	4,478	161	0
August	31	7,109	1,846	4,478	161	0
September	30	6,880	1,787	4,333	156	0
Annual	365	150,827	74,086	112,456	4,048	0



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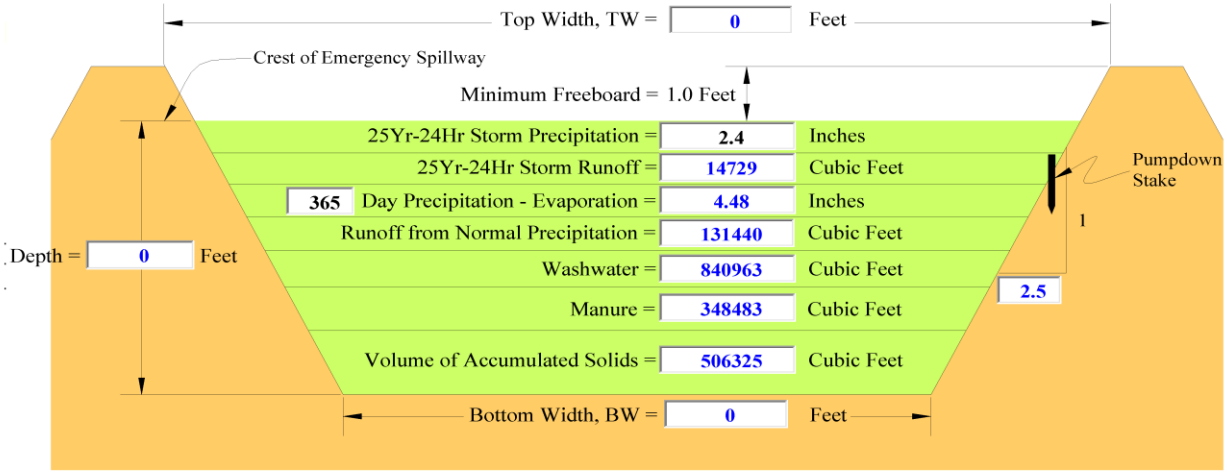
ANIMAL WASTE MANAGEMENT SYSTEM STORAGE

WASTEWATER STORAGE POND — **MONTHLY INFLOWS INTO WASTEWATER STORAGE POND**

Pond Parameters	Value	Month	Number of Days	Rain-Evap on Pond CF	Rain-Evap on Existing Storage, CF	Normal Runoff CF	Washwater CF	Solids CF	Waste to Store CF	Waste to Store Gallons
Storage Period, Days=	365	October	31	0	-63,609	9,104	71,424	23,191	63,300	473,515
Side Slope (X:1)=	2.50	November	30	0	32,620	19,128	69,120	36,583	192,397	1,439,229
Bottom Width, BW, Feet=	0	December	31	0	45,125	20,867	71,424	37,803	211,328	1,580,847
Bottom Length, BL, Feet=	0	January	31	0	17,397	11,661	71,424	37,803	174,395	1,304,568
Accumulated Solids Duration, Years=	2	February	28	0	26,640	19,026	64,512	34,144	176,938	1,323,585
Existing Storage, Acre Feet=	63.01	March	31	0	-12,504	13,400	71,424	37,803	146,232	1,093,894
Surface Area of Existing Storage, SF=	326,202	April	30	0	-79,376	7,467	69,120	36,583	68,740	514,211
Minimum Soil Liner Depth, Feet=	1.00	May	31	0	-132,384	6,853	71,424	23,191	-7,725	-57,786
25 Year-24 Hour Storm Runoff, CF=	14,729	June	30	0	-160,383	6,444	69,120	22,442	-39,933	-298,721
Top Width, TW, Feet=	0	July	31	0	-198,440	4,910	71,424	23,191	-75,724	-566,457
Top Length, TL, Feet=	0	August	31	0	-183,489	4,910	71,424	23,191	-60,773	-454,616
Volume Needed, Acre Feet=	46.81	September	30	0	-107,103	7,672	69,120	22,442	14,574	109,020
Design Volume, Acre Feet=	0.00	Annual	365	0	-815,505	131,441	840,964	358,366	515,265	3,854,452



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ANIMAL WASTE MANAGEMENT SYSTEM UTILIZATION

NUTRIENTS AVAILABLE AFTER STORAGE

Nutrient Source	Type of Operation / Type of Storage Facility	Pounds of Nutrients Available			Percent Nutrients Retained After Storage			Pounds of Nutrients Retained After Storage		
	Dairy	N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O
Liquids	Storage Pond Manure Analysis	79,034	24,474	48,039	65%	95%	95%	51,372	23,250	45,637
Solids	Solids Storage Manure Analysis	95,705	41,159	51,460	75%	90%	90%	71,778	37,043	46,314
Grazing	NONE	68,231	25,535	41,415	100%	100%	100%	68,231	25,535	41,415

NUTRIENTS AVAILABLE AFTER APPLICATION

Nutrient Source	Type of Application System	Pounds of Nutrients Available			Percent Nutrients Retained After Application			Pounds of Nutrients Retained After Application		
		N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O
Liquids	Sprinkling	51,372	23,250	45,637	75%	100%	100%	38,529	23,250	45,637
Solids	Broadcast (Incorporated 7 or more days after application)	71,778	37,043	46,314	70%	100%	100%	50,245	37,043	46,314
Grazing	Grazing	68,231	25,535	41,415	85%	100%	100%	57,996	25,535	41,415

NUTRIENTS AVAILABLE AFTER DENITRIFICATION

Nutrient Source	Location / Soil Drainage Class	Pounds of Nutrients Available			Percent Nutrients Retained After Denitrification			Pounds of Nutrients Retained After Denitrification		
	East of Cascade Mountains	N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O
Liquids	Well Drained	38,529	23,250	45,637	94%	100%	100%	36,217	23,250	45,637
Solids	Well Drained	50,245	37,043	46,314	94%	100%	100%	47,230	37,043	46,314
Grazing	Well Drained	57,996	25,535	41,415	94%	100%	100%	54,516	25,535	41,415
							TOTAL-	***137,964***	***85,828***	***133,365***

REFERENCES

OREGON ANIMAL WASTE MANAGEMENT DESIGN AID (ORAWM)
Version 5.2

7/8/2016

CLIENT: **Hollands Dairy**
ASSISTED BY: **Bruce D. Wilson, H&R Engineering LLC**

ANIMAL WASTE MANAGEMENT SYSTEM UTILIZATION

PERCENT OF MANURE TO BE APPLIED TO FIELD AND UTILIZATION ACRES NEEDED BASED ON NITROGEN, N

Field Number	Acres	Crop	LIQUIDS			SOLIDS			GRAZING		
			Percent to be Applied	Pounds of Nutrients to be Applied	Acres Needed for Utilization of Nutrients	Percent to be Applied	Pounds of Nutrients to be Applied	Acres Needed for Utilization of Nutrients	Percent to be Applied	Pounds of Nutrients to be Applied	Acres Needed for Utilization of Nutrients
1-6	431.9	Grass Hay/Pasture	100%	36,217	125	50%	23,615	81	100%	54,516	188
Off Farm			0%	0		50%	35,889		0%	0	
TOTALS-	431.9		100%	36,217	125	100%	59,504	81	100%	54,516	188

NUTRIENT BALANCE BASED ON AVAILABLE ACRES

Field Number	Acres	Crop	NUTRIENTS APPLIED			- NUTRIENTS REMOVED			= NUTRIENT BALANCE		
			Nitrogen, N Lbs/Acre	Phosphorous, P_2O_5 Lbs/Acre	Potassium, K_2O Lbs/Acre	Nitrogen, N Lbs/Acre	Phosphorous, P_2O_5 Lbs/Acre	Potassium, K_2O Lbs/Acre	Nitrogen, N Lbs/Acre	Phosphorous, P_2O_5 Lbs/Acre	Potassium, K_2O Lbs/Acre
1-6	431.9	Grass Hay/Pasture	265	156	255	290	92	241	-25	64	14
Off Farm											

REFERENCES