

APPENDIX I

DESIGN CALCULATIONS



9/23/14

OAK LAKE DAIRY AWMS
DAIRY WASTE VOLUME CALCULATIONS SUMMARY

Dairy Waste - Milking Herd

Number	Weight	Manure, cf/day/cow	Manure, total cf/day	Storage Period, days	Manure Volume over Storage Period
3,900	1,000	2.4	9,360	365	3,416,400

Dairy Washwater & Flushwater - Milking Herd

Number	Weight	Wash water, cf/day/1000#	Wash water, total cf/day	Storage Period, days	Wash water Volume over Storage Period
3,900	1,000	0.6	2,340	365	854,100

Annual Precipitation on Contributing Areas

Annual precipitation runoff from solids stockpiling area, cf: **6,922**

Total Volume of Manure, Wastewater, and Precipitation to Ponds, cubic feet **4,277,422**

Total Storage Pond Volume Available, cubic feet: **6,775,202**

9/23/14

**OAK LAKE DAIRY AWMS
SOLIDS STORAGE AREA
VOLUME CALCULATIONS**

SOLIDS STORAGE PAD RUNOFF VOLUME	
Length of stockpile area, ft	80
Width of stockpile area, ft	80
25 year 24 hour storm depth, ft	0.38
25 year 24 hour volume, cubic ft	2,451
Annual precipitation, ft	2.23
Runoff - percent of mean annual precipitation, % @ CN 97	48.5%
Annual precipitation volume, cubic ft	6,922

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OAK LAKE DAIRY AWMS
REQUIRED POND CAPACITY CALCULATIONS

Storage Pond Capacity Balance

25 year / 24 hour storm volumes reporting to Pond 1	Volume, cf
Solids storage pad and drainage area	2,451
Volumes reporting to ponds for storage	Volume, cf
Manure, washwater, and bedding volume from herd	4,277,422
Annual precipitation from solids storage pad and drainage area	<u>6,922</u>
Total, cubic feet	4,284,344

Storage Volumes Available	Volume, cf
Storage Pond 1	2,241,274
Storage Pond 2	2,241,274
Storage Pond 3	2,292,655
Total pond storage volume provided, cubic feet	6,775,202

Balance 2,490,858

**OAK LAKE DAIRY AWMS
POND 1 VOLUME CALCULATIONS**

POND DESIGN VOLUME AND ELEVATION SUMMARY

DESCRIPTION	EQN.		DEPTH (FT)	ELEV.	ACTUAL DESIGN USED
Existing Grade	G			1945.00	
Inside Top of Berm Width (ft)	W	405			
Inside Width Slope, horizontal feet per foot drop	SW	3			
Inside Top of Berm Length (ft)	L	405			
Inside Length Slope, horizontal feet per foot drop	SL	3			
Constructed Top of Berm, including settlement	E+S			1950.00	1850.0
Settlement, % of embankment height	S=%(E-G)	0%	0.00		
Reference Elevation, operational top of berm (acres & elev. - ft.)	E	3.77		1950.00	
Freeboard (in)	F	24	2.00		
Surface Area at Top of 24hr/25yr storm (acres/elev)	AS=E-F	3.55		1948.00	
25yr/24hr Rainfall (in)	R	4.6			
Surface Area at Inside Top of Berm, incl. Contributing area (ac)	OB	3.77			
Volume of 25yr/24hr Rainfall (cf)	VR=R*OB	65,327			
Volume Provided for 25yr/24hr Rainfall (cf)	avg(AS,O)*(AS-O)	69,026	0.45		
Maximum Surface Area and Operating Level (acres/elev)	O=E-F-R	3.50		1947.55	1947.55
Mean Annual Rainfall (in)	MAR	26.74			
Direct Mean Annual Rainfall within berms (cf)	DM=OB*MAR	365,502			
Mean Annual Lake Evaporation (in)	ME	33			
Evaporation Midpoint (elev)				1936.78	
Surface Area at Evaporation Midpoint (ac)	ESA	2.43			
Net Evaporation at Midpoint (cf)	NE=ME*ESA	291,632			
Net Moisture used for design (evap[-] or rain[+]) (cf)	M	73,871	0.49		
Apparent Operation Level considering Net Moisture adj.	A=O-M	3.44		1947.06	
Volume Provided for Net Moisture (cf)	avg(O,A)*(O-A)	74,084			
Waste Storage Depth (ft) excluding residual depth	D	21.55			
Surface area at top of residual layer (acres/elev)	SS=O-D	1.56		1926.00	
Net Storage Depth provided	D-M	21.1	21.1		
Total Storage Volume from Net Storage Depth (cf)		2,241,274			
Residual Layer Depth (in)	SD	12	1.00		
Top of Liner, surface area, acres	SS-SD	1.49		1925.00	1925.0

**OAK LAKE DAIRY AWMS
POND 2 VOLUME CALCULATIONS**

POND DESIGN VOLUME AND ELEVATION SUMMARY

DESCRIPTION	EQN.		DEPTH (FT)	ELEV.	ACTUAL DESIGN USED
Existing Grade	G			1945.00	
Inside Top of Berm Width (ft)	W	405			
Inside Width Slope, horizontal feet per foot drop	SW	3			
Inside Top of Berm Length (ft)	L	405			
Inside Length Slope, horizontal feet per foot drop	SL	3			
Constructed Top of Berm, including settlement	E+S			1950.00	1950.0
Settlement, % of embankment height	S=%(E-G)	0%	0.00		
Reference Elevation, operational top of berm (acres & elev. - ft.)	E	3.77		1950.00	
Freeboard (in)	F	24	2.00		
Surface Area at Top of 24hr/25yr storm (acres/elev)	AS=E-F	3.55		1948.00	
25yr/24hr Rainfall (in)	R	4.6			
Surface Area at Inside Top of Berm, incl. Contributing area (ac)	OB	3.77			
Volume of 25yr/24hr Rainfall (cf)	VR=R*OB	62,876			
Volume Provided for 25yr/24hr Rainfall (cf)	avg(AS,O)*(AS-O)	69,026	0.45		
Maximum Surface Area and Operating Level (acres/elev)	O=E-F-R	3.50		1947.55	1947.55
Mean Annual Rainfall (in)	MAR	26.74			
Direct Mean Annual Rainfall within berms (cf)	DM=OB*MAR	365,502			
Mean Annual Lake Evaporation (in)	ME	33			
Evaporation Midpoint (elev)				1936.78	
Surface Area at Evaporation Midpoint (ac)	ESA	2.43			
Net Evaporation at Midpoint (cf)	NE=ME*ESA	291,632			
Net Moisture used for design (evap[-] or rain[+]) (cf)	M	73,871	0.49		
Apparent Operation Level considering Net Moisture adj.	A=O-M	3.44		1947.06	
Volume Provided for Net Moisture (cf)	avg(O,A)*(O-A)	74,084			
Waste Storage Depth (ft) excluding residual depth	D	21.55			
Surface area at top of residual layer (acres/elev)	SS=O-D	1.56		1926.00	
Net Storage Depth provided	D-M	21.1	21.1		
Total Storage Volume from Net Storage Depth (cf)		2,241,274			
Residual Layer Depth (in)	SD	12	1.00		
Top of Liner, surface area, acres	SS-SD	1.49		1925.00	1925.0

**OAK LAKE DAIRY AWMS
POND 3 VOLUME CALCULATIONS**

POND DESIGN VOLUME AND ELEVATION SUMMARY

DESCRIPTION	EQN.		DEPTH (FT)	ELEV.	ACTUAL DESIGN USED
Existing Grade	G			1945.00	
Inside Top of Berm Width (ft)	W	300			
Inside Width Slope, horizontal feet per foot drop	SW	3			
Inside Top of Berm Length (ft)	L	575			
Inside Length Slope, horizontal feet per foot drop	SL	3			
Constructed Top of Berm, including settlement	E+S			1950.00	1893.0
Settlement, % of embankment height	S=%(E-G)	0%	0.00		
Reference Elevation, operational top of berm (acres & elev. - ft.)	E	3.96		1950.00	
Freeboard (in)	F	24	2.00		
Surface Area at Top of 24hr/25yr storm (acres/elev)	AS=E-F	3.72		1948.00	
25yr/24hr Rainfall (in)	R	4.6			
Surface Area at Inside Top of Berm, incl. Contributing area (ac)	OB	3.96			
Volume of 25yr/24hr Rainfall (cf)	VR=R*OB	66,125			
Volume Provided for 25yr/24hr Rainfall (cf)	avg(AS,O)*(AS-O)	72,449	0.45		
Maximum Surface Area and Operating Level (acres/elev)	O=E-F-R	3.67		1947.55	1947.55
Mean Annual Rainfall (in)	MAR	26.74			
Direct Mean Annual Rainfall within berms (cf)	DM=OB*MAR	384,388			
Mean Annual Lake Evaporation (in)	ME	33			
Evaporation Midpoint (elev)				1936.78	
Surface Area at Evaporation Midpoint (ac)	ESA	2.51			
Net Evaporation at Midpoint (cf)	NE=ME*ESA	300,754			
Net Moisture used for design (evap[-] or rain[+]) (cf)	M	83,633	0.53		
Apparent Operation Level considering Net Moisture adj.	A=O-M	3.61		1947.02	
Volume Provided for Net Moisture (cf)	avg(O,A)*(O-A)	84,012			
Waste Storage Depth (ft) excluding residual depth	D	21.55			
Surface area at top of residual layer (acres/elev)	SS=O-D	1.54		1926.00	
Net Storage Depth provided	D-M	21.0	21.0		
Total Storage Volume from Net Storage Depth (cf)		2,292,655			
Residual Layer Depth (in)	SD	12	1.00		
Top of Liner, surface area, acres	SS-SD	1.46		1925.00	1925.0