STANISLAUS COUNTY PLANNING COMMISSION

February 16, 2017

STAFF REPORT

USE PERMIT APPLICATION NO. PLN2015-0019
TRINKLER DAIRY FARMS, INC.
SCH #2015032067

REQUEST: TO INCREASE THE DAIRY HERD SIZE FROM 3,150 TO 5,175 ANIMAL UNITS CONSISTING OF 3,180 MILK COWS, 600 DRY COWS, AND 1,395 HEIFERS, AND CONSTRUCT A NEW FREESTALL BARN, A MILK BARN, A FEED STORAGE PAD, AND WASTEWATER STORAGE POND ON AN EXISTING DAIRY FACILITY, ON A 220± ACRE SITE

APPLICATION INFORMATION

Owner:	Wendel Trinkler, Jr, Trust, Et AL
Applicant:	Jon Rebiero, Trinkler Dairy Farms, Inc.
Agent:	Joe Ramos, F & R Ag Services, Inc.
Location:	7251 Crows Landing Road, at the southwest corner of Crows Landing and W. Taylor Roads, in the Ceres area.
Section, Township, Range:	5-5-9
Supervisorial District:	Five (Supervisor DeMartini)
Assessor's Parcel:	022-007-013
Referrals:	See Exhibit I Environmental Review Referrals
Area of Parcel(s):	220± acres
Water Supply:	Private well
Sewage Disposal:	Private septic tank & leach field
Existing Zoning:	A-2-40 (General Agriculture)
General Plan Designation:	Agriculture
Sphere of Influence:	Not Applicable
Community Plan Designation:	Not Applicable
Williamson Act Contract No.:	71-0194
Environmental Review:	Negative Declaration
Present Land Use:	Dairy facility and cropland
Surrounding Land Use:	Row crops, orchards and scattered single-family dwellings north, east, south, and west; and unrelated dairies to the south and west; and Monterey Park Tract Subdivision to the southwest.

RECOMMENDATION

Staff recommends the Planning Commission approve this request based on the discussion below and on the whole of the record provided to the Planning Commission. If the Planning Commission chooses to approve the project, Exhibit A provides an overview of all of the findings required for project approval which include use permit findings.

PROJECT DESCRIPTION

Request to increase the permitted herd size of an existing dairy facility from 3,150 to 5,175 animal units. The increase in animal units will consist of: 3,180 milk cows and 600 dry cows, not to exceed a combined total of 3,780 mature cows (milk and dry), and 1,395 heifers [275 (15-24 months); 520 (4-6 months); and 600 calves (0-3 months)]. Medium heifers (7-14 months) will not be kept at this facility. This expansion will require the construction of a 165,240 square-foot freestall barn, a 26,100 square-foot rotary milk barn, a 10,800 square-foot calf barn, a 307,500 square-foot feed storage pad, and a new wastewater storage pond (lagoon). A new domestic well will be constructed to serve the new milk barn. The existing milk barn shall remain in use. The new lagoon, located adjacent to the existing lagoon, will be 375 feet wide by 500 feet long by 15 feet deep with 3:1 embankment slopes. Of the 15-foot depth, only five feet will be below existing grade. Additional construction details can be found in the attached Pond Construction Work Plan. (See *Exhibit F.*)

The dairy currently averages between seven and eight truck trips per day; truck trips are expected to increase to 11 and 12 per day at full build-out. Feed and supplement deliveries are anticipated to increase from an average of one to two deliveries per day. Milk transport trips are anticipated to increase from approximately three to six trips per day. Calf transport occurs daily with no additional trips expected. The duration of weekly pregnancy checks and breeding conducted by the veterinarian will increase in time but not frequency. Transfer of heifers to and from the facility will roughly double from two per week to four per week. The number of employees is anticipated to increase from eight (8) current employees, to a maximum of 14 employees post-project.

The expansion will result in an increase in volume of waste and, as such, requires Waste Discharge Requirements (WDR) from the Regional Water Quality Control Board. The new lagoon will accommodate the additional waste and be constructed in such a way so as to reduce impacts to air and water quality. A new Waste Management Plan (WMP) and Nutrient Management Plan (NMP) provide details on managing the increase in animal units and resulting waste. (See *Exhibits D and E.*) The WMP evaluated the impact of the expansion on existing lagoon capacity as well as the need for an additional lagoon to accommodate additional liquid waste generated by an increase in dairy cows. The NMP has been prepared to ensure that wastewater application on to cropland will not result in significant impacts to groundwater. Wastewater and/or dry manure will be utilized on 1,003 acres of land application areas currently planted in corn, wheat, or almonds (See *WMP Figure 3 – Field and Cropping Map*).

RWQCB (Regional Water Quality Control Board) staff has determined that the revised NMP and WMP are in accordance with the standards outlined in the General Order and that implementation of these plans will minimize the impacts of animal waste on surface and groundwater quality. Furthermore, the SJVAPCD (San Joaquin Valley Air Pollution Control District) has determined that implementation of SJVAPCD Best Available Control Technology (BACT) standards will result in project specific criteria pollutant emissions having no significant adverse impacts on air quality.

SITE DESCRIPTION

The project site is located at 7251 Crows Landing Road, at the southwest corner of the Crows Landing and W. Taylor Roads intersection, in the Ceres area. The dairy facility is located on a 220± acre parcel bound by W. Taylor Road and Turlock Irrigation District's Lateral No. 3 canal to the north, Crows Landing Road to the east, and W. Zeering Road to the south. The site is currently improved with four homes served by private well and septic systems, 370,610± square feet of existing dairy facility structures and two lagoons. The proposed feed storage area, calf barn, and lagoon will be located to the north of the existing dairy footprint; whereas the proposed freestall barn and rotary milk barn will be located south of the existing dairy footprint. (See *Exhibit B – Maps.*) Surrounding uses include row crops and orchards with scattered single-family dwellings to the north,

east, south, and west; and unrelated dairies south and west of the project site. The Monterey Park Tract residential subdivision is located approximately 650 feet west of the project site's southwestern property line, and approximately three-quarters of a mile southwest of the proposed rotary milk barn.

ISSUES

No issues have been identified as a part of this request. Standard Conditions of Approval, along with those discussed in the "Environmental Review" section of this report, have been added to the project.

GENERAL PLAN CONSISTENCY

The site is currently designated as "Agriculture" in the Stanislaus County General Plan and this designation is consistent with the A-2 (General Agriculture) zoning district. The agricultural designation recognizes the value and importance of agriculture by acting to preclude incompatible urban development within agricultural areas.

Agriculture is the leading industry in Stanislaus County generating an annual gross agricultural value in excess of a billion dollars into the local economy. As reflected in the County's 2015 Crop Report, milk is the County's second top-grossing commodity. Staff believes this project is consistent with the General Plan.

ZONING ORDINANCE CONSISTENCY

The site is currently zoned A-2-40 (General Agriculture). It is the intent of the General Agriculture (A-2) zoning district to support and enhance agriculture as the predominant land use in the unincorporated areas of Stanislaus County. The procedures contained within the A-2 zoning district are specifically established to ensure that all land uses are compatible with agriculture and open-space, including natural resource management, outdoor recreation, and enjoyment of scenic beauty.

Confined Animal Facilities (CAF), which include dairies and feed lots, are considered to be permitted agricultural uses; however, a use permit is required for new or expanding CAFs requiring a new or modified permit, waiver, order, or Wastewater Discharge Requirements (WDR) from the RWQCB, where the issuance of such permit, waiver, order, or WDR requires compliance with the California Environmental Quality Act (CEQA). The County adopted the use permit requirement in 2003 in order to allow the County to facilitate the environmental review (in accordance with CEQA) required for issuance of any permit, waiver, order, or WDR by the RWQCB. Trinkler Dairy Farms, Inc. is subject to a use permit because the RWQCB determined that the proposed expansion is subject to issuance of WDRs requiring CEQA review.

Since the project is subject to obtaining a use permit, the following finding is required for approval:

1. *The establishment, maintenance, and operation of the proposed use or building applied for is consistent with the General Plan designation of "Agriculture" and will not, under the circumstances of the particular case, be detrimental to the health, safety, and general welfare of persons residing or working in the neighborhood of the use and that it will not be detrimental or injurious to property and improvements in the neighborhood or to the general welfare of the County.*

Conditions have been added to the project requiring best management practices be implemented for odor and vector control and lighting. Furthermore, the project will need to comply with SJVAPCD's Rules which are designed to reduce a facility's impact to air quality. (See Exhibit C - *Conditions of Approval*.) The RWQCB monitors dairies for compliance with their NMP, WMP, and WDRs. A NMP

and WMP are required by the RWQCB in order to determine the need for permits, waivers, or WDRs.

CAFs are agricultural uses protected by the County's Right-to-Farm Ordinance which was adopted in 1991. The ordinance states that:

> *The County of Stanislaus recognizes and supports the right-to-farm agricultural lands in a manner consistent with accepted customs and standards. Residents of property on or near agricultural land should be prepared to accept the inconveniences or discomforts associated with agricultural operations, including but not limited to noise, odors, flies, fumes, dust, the operation of machinery of any kind during any 24-hour period (including aircraft), the storage and disposal of manure, and the application by spraying or otherwise of chemical fertilizers, soil amendments, herbicides, and pesticides. Stanislaus County has determined that inconveniences or discomforts associated with such agricultural operations shall not be considered to be a nuisance if such operations are consistent with accepted customs and standards.*

Staff believes the necessary findings for approval of this project can be made. With conditions of approval in place, there is no indication that, under the circumstances of this particular case, the proposed project will be detrimental to the health, safety, and general welfare of persons residing or working in the neighborhood of the use or that it will be detrimental or injurious to property and improvements in the neighborhood or to the general welfare of the County. Dairy facilities are an important component of the agricultural economy in Stanislaus County. There is no indication this project will interfere or conflict with other agricultural uses in the area.

The project site is enrolled in Williamson Act Contract No. 71-0194. Section 21.20.045(A) of the A-2 zoning district requires that all uses requiring use permits that are approved on Williamson Act contracted lands shall be consistent with the following three principles of compatibility:

1. *The use will not significantly compromise the long-term productive agricultural capability of the subject contracted parcel or parcels or on other contracted lands in the A-2 zoning district;*

2. *The use will not significantly displace or impair current or reasonably foreseeable agricultural operations on the subject contracted parcel or parcels or on other contracted lands in the A-2 zoning district. Uses that significantly displace agricultural operations on the subject contracted parcel or parcels may be deemed compatible if they relate directly to the production of commercial agricultural products on the subject contracted parcel or parcels or neighboring lands, including activities such as harvesting, processing, or shipping; and*

3. *The use will not result in the significant removal of adjacent contracted land from agricultural or open-space use.*

The proposed expansion of the existing dairy supports the long-term productive agricultural capability of the subject property. Project approval will not result in the removal of any adjacent contracted land from agricultural or open-space use. All surrounding lands will be able to continue their agricultural operations.

The project was referred to the State Department of Conservation during the Early Consultation and 30-day Initial Study reviews and no comments were received.

The specific findings required for approval of the proposed use permit are outlined in Exhibit A of this report. Based on the information provided in this report, staff believes that all of the findings necessary for approval of this request can be made.

ENVIRONMENTAL REVIEW

A referral response from the SJVAPCD indicating potentially significant impacts was received as a part of the Early Consultation referral for this project. In order to reduce potentially significant environmental impact to air quality, SJVAPCD Best Available Control Technology (BACT) standards were incorporated into the project and the new lagoon design. Consequently, the incorporation of BACT, the categorization of support stock into age ranges, and the exclusive use of a sealed feed storage system for bagged silage will reduce project impacts to air quality to less than significant.

Pursuant to the California Environmental Quality Act (CEQA), the proposed project was circulated to all interested parties and responsible agencies for review and comment and no significant issues were raised. (See Exhibit I - *Environmental Review Referrals*.) A Negative Declaration has been prepared for approval prior to action on the use permit itself as the project will not have a significant effect on the environment. (See Exhibit H - *Negative Declaration*.) Conditions of Approval reflecting referral responses have been placed on the project. (See Exhibit C - *Conditions of Approval*.)

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Note: Pursuant to California Fish and Game Code Section 711.4, all project applicants subject to the California Environmental Quality Act (CEQA) shall pay a filing fee for each project; therefore, the applicant will further be required to pay **$2,273.25** for the California Department of Fish and Wildlife (formerly the Department of Fish and Game) and the Clerk Recorder filing fees. The attached Conditions of Approval ensure that this will occur.

Contact Person: Rachel Wyse, Associate Planner, (209) 525-6330

Attachments:
Exhibit A - Findings and Actions Required for Project Approval
Exhibit B - Maps
Exhibit C - Conditions of Approval
Exhibit D - Waste Management Plan
Exhibit E - Nutrient Management Plan
Exhibit F - Pond Construction Plan
Exhibit G - Initial Study
Exhibit H - Negative Declaration
Exhibit I - Environmental Review Referrals

Exhibit A
Findings and Actions Required for Project Approval

1. Adopt the Negative Declaration pursuant to CEQA Guidelines Section 15074(b), by finding that on the basis of the whole record, including the Initial Study and any comments received, that there is no substantial evidence the project will have a significant effect on the environment and that the Negative Declaration reflects Stanislaus County's independent judgment and analysis.

2. Order the filing of a Notice of Determination with the Stanislaus County Clerk-Recorder's Office pursuant to Public Resources Code Section 21152 and CEQA Guidelines Section 15075.

3. Find that:

   (a) The establishment, maintenance, and operation of the proposed use or building applied for is consistent with the General Plan designation of "Agriculture" and will not, under the circumstances of the particular case, be detrimental to the health, safety, and general welfare of persons residing or working in the neighborhood of the use and that it will not be detrimental or injurious to property and improvements in the neighborhood or to the general welfare of the County.

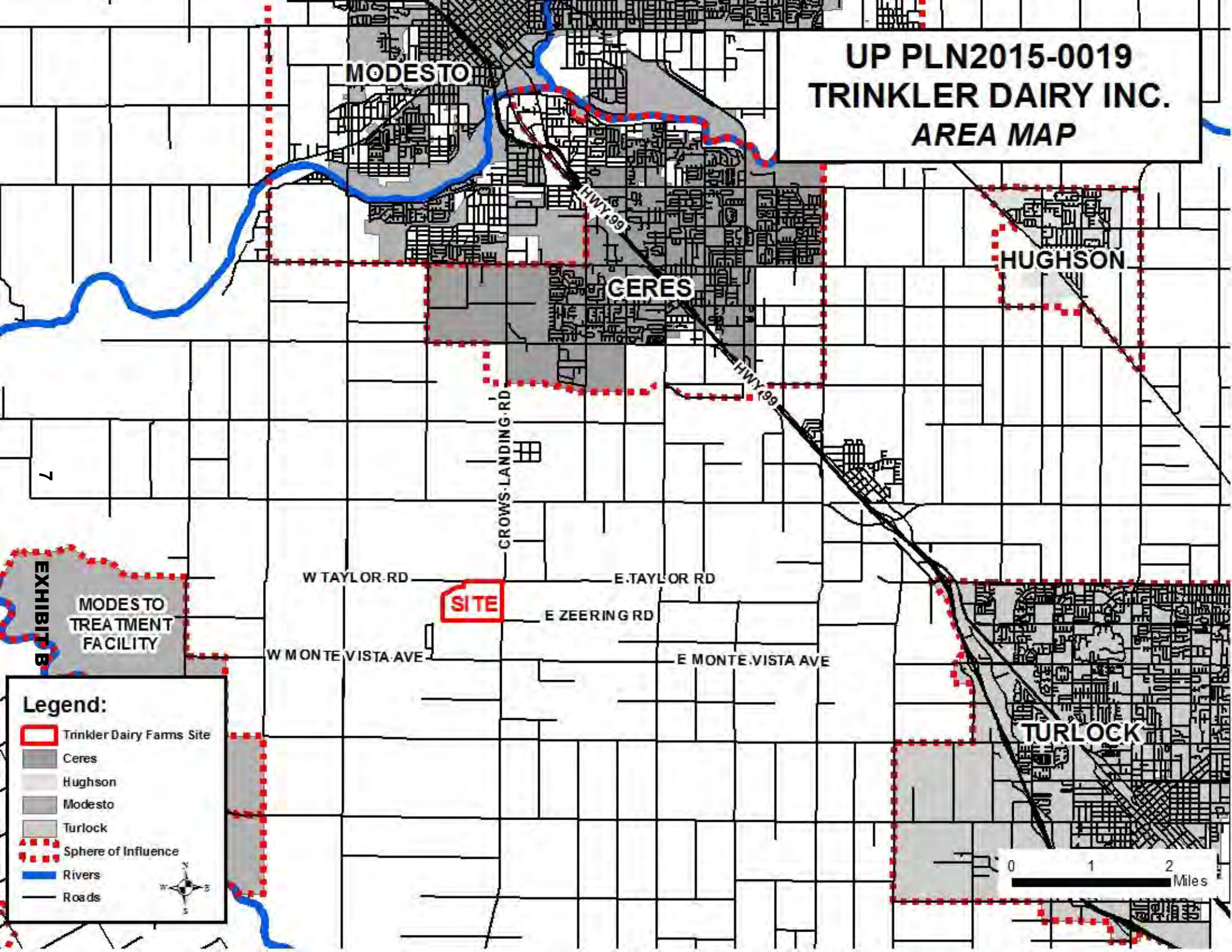
   (b) The use will not significantly compromise the long-term productive agricultural capability of the subject contracted parcel or parcels or on other contracted lands in the A-2 zoning district.

   (c) The use will not significantly displace or impair current or reasonably foreseeable agricultural operations on the subject contracted parcel or parcels or on other contracted lands in the A-2 zoning district. Uses that significantly displace agricultural operations on the subject contracted parcel or parcels may be deemed compatible if they relate directly to the production of commercial agricultural products on the subject contracted parcel or parcels or neighboring lands, including activities such as harvesting, processing, or shipping.

   (d) The use will not result in the significant removal of adjacent contracted land from agricultural or open-space use.

4. The project will increase activities in and around the project area, and increase demands for roads and services, thereby requiring dedication and improvements.

5. Approve Use Permit Application No. PLN2015-0019 –Trinkler Dairy Farms, Inc., subject to the attached Conditions of Approval.


UP PLN2015-0019
TRINKLER DAIRY INC.
AREA MAP
MODESTO
CERES
HUGHSON
TURLOCK
HWY 99
HWY 99
CROWS LANDING RD
W TAYLOR RD
E TAYLOR RD
SITE
E ZEERING RD
W MONTE VISTA AVE
E MONTE VISTA AVE
MODESTO TREATMENT FACILITY
EXHIBIT B
7
Legend:
Trinkler Dairy Farms Site
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Hughson
Modesto
Turlock
Sphere of Influence
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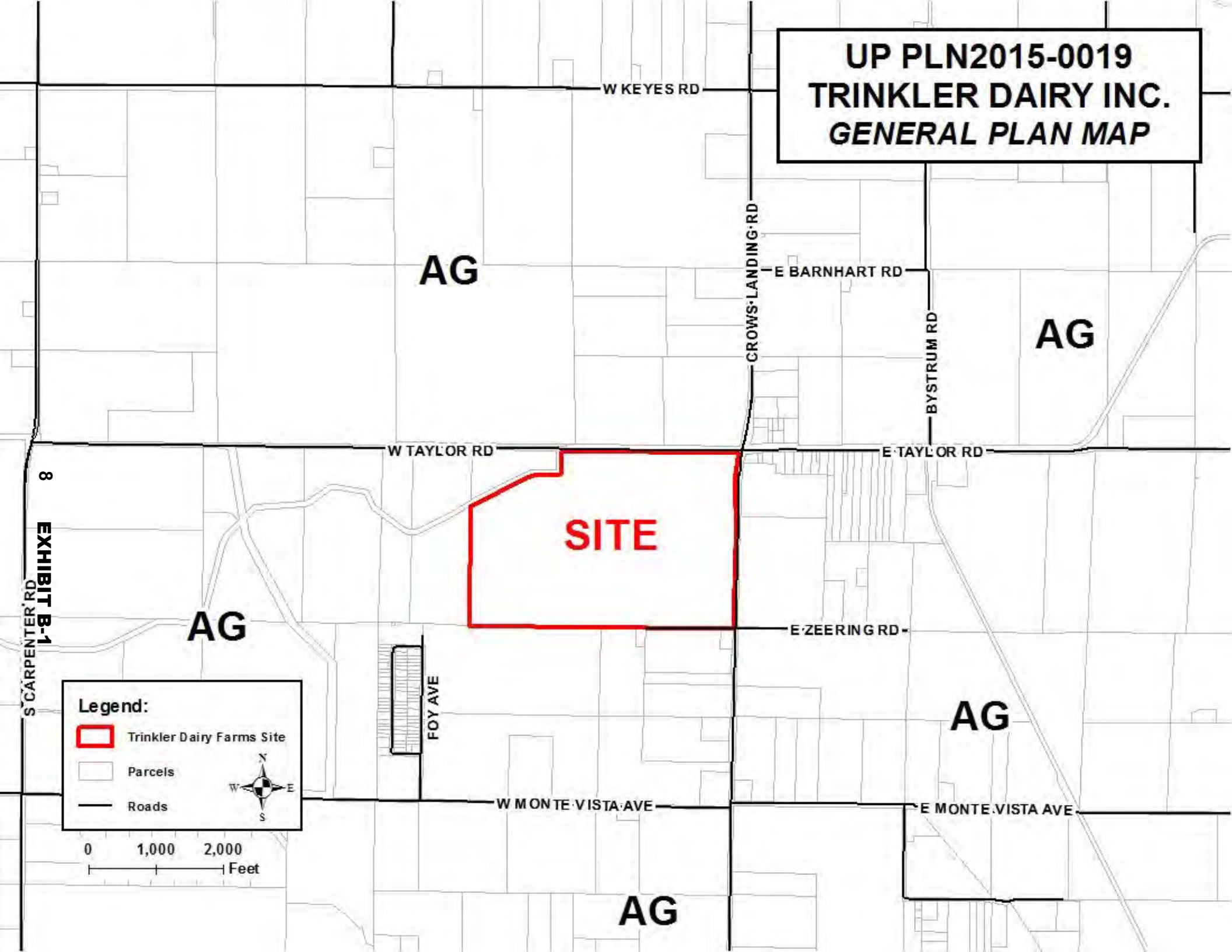
UP PLN2015-0019
TRINKLER DAIRY INC.
GENERAL PLAN MAP
W KEYES RD
CROWS LANDING RD
E BARNHART RD
BYSTRUM RD
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W TAYLOR RD
E TAYLOR RD
SITE
S CARPENTER RD
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E ZEERING RD
FOY AVE
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W MONTE VISTA AVE
E MONTE VISTA AVE
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Trinkler Dairy Farms Site
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Feet

EXHIBIT B-1

8

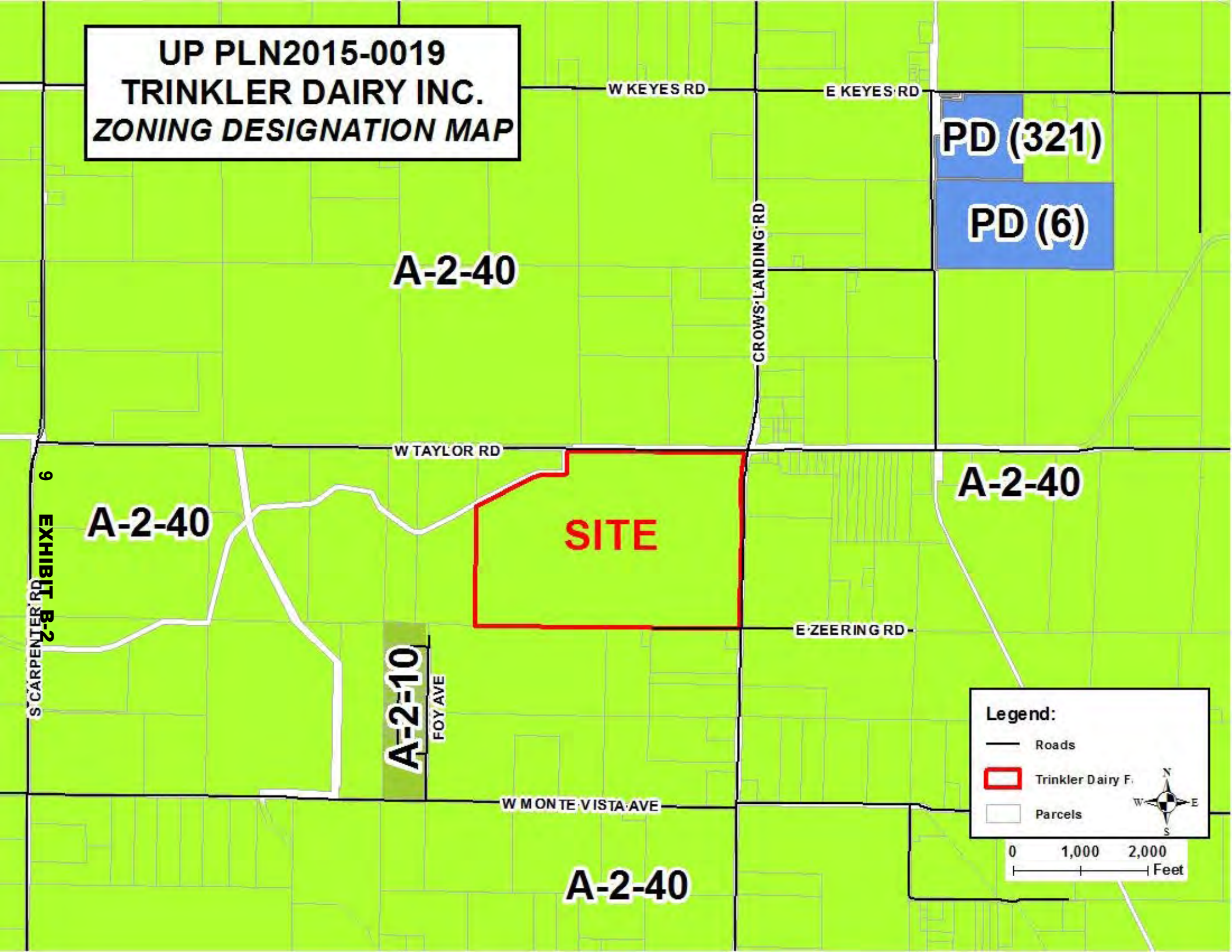
UP PLN2015-0019
TRINKLER DAIRY INC.
ZONING DESIGNATION MAP
W KEYES RD
E KEYES RD
PD (321)
PD (6)
A-2-40
CROWS LANDING RD
W TAYLOR RD
A-2-40
A-2-40
SITE
S CARPENTER RD
A-2-10
FOY AVE
E ZEERING RD
W MONTE VISTA AVE
A-2-40
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EXHIBIT B-2
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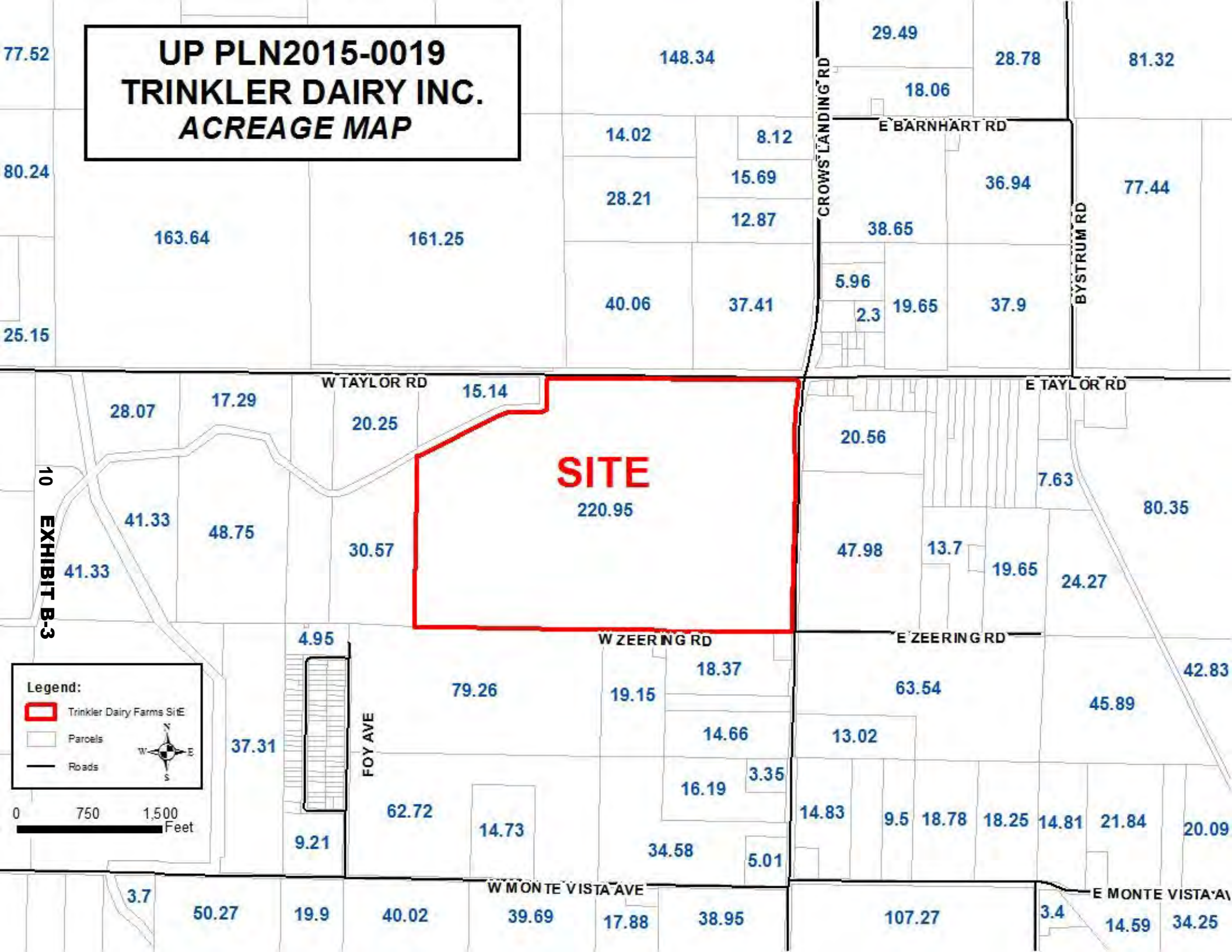
UP PLN2015-0019
TRINKLER DAIRY INC.
ACREAGE MAP
SITE
220.95
W TAYLOR RD
E TAYLOR RD
CROWS LANDING RD
E BARNHART RD
BYSTRUM RD
W ZEERING RD
E ZEERING RD
FOY AVE
W MONTE VISTA AVE
E MONTE VISTA AV
10 EXHIBIT B-3
Legend:
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77.52
148.34
29.49
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81.32
18.06
14.02
8.12
80.24
15.69
28.21
36.94
77.44
12.87
163.64
161.25
38.65
5.96
40.06
37.41
2.3
19.65
37.9
25.15
28.07
17.29
15.14
20.25
20.56
7.63
80.35
41.33
48.75
30.57
47.98
13.7
19.65
24.27
41.33
4.95
18.37
42.83
79.26
19.15
63.54
45.89
37.31
14.66
13.02
3.35
16.19
14.83
9.5
18.78
18.25
14.81
21.84
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62.72
14.73
9.21
34.58
5.01
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39.69
17.88
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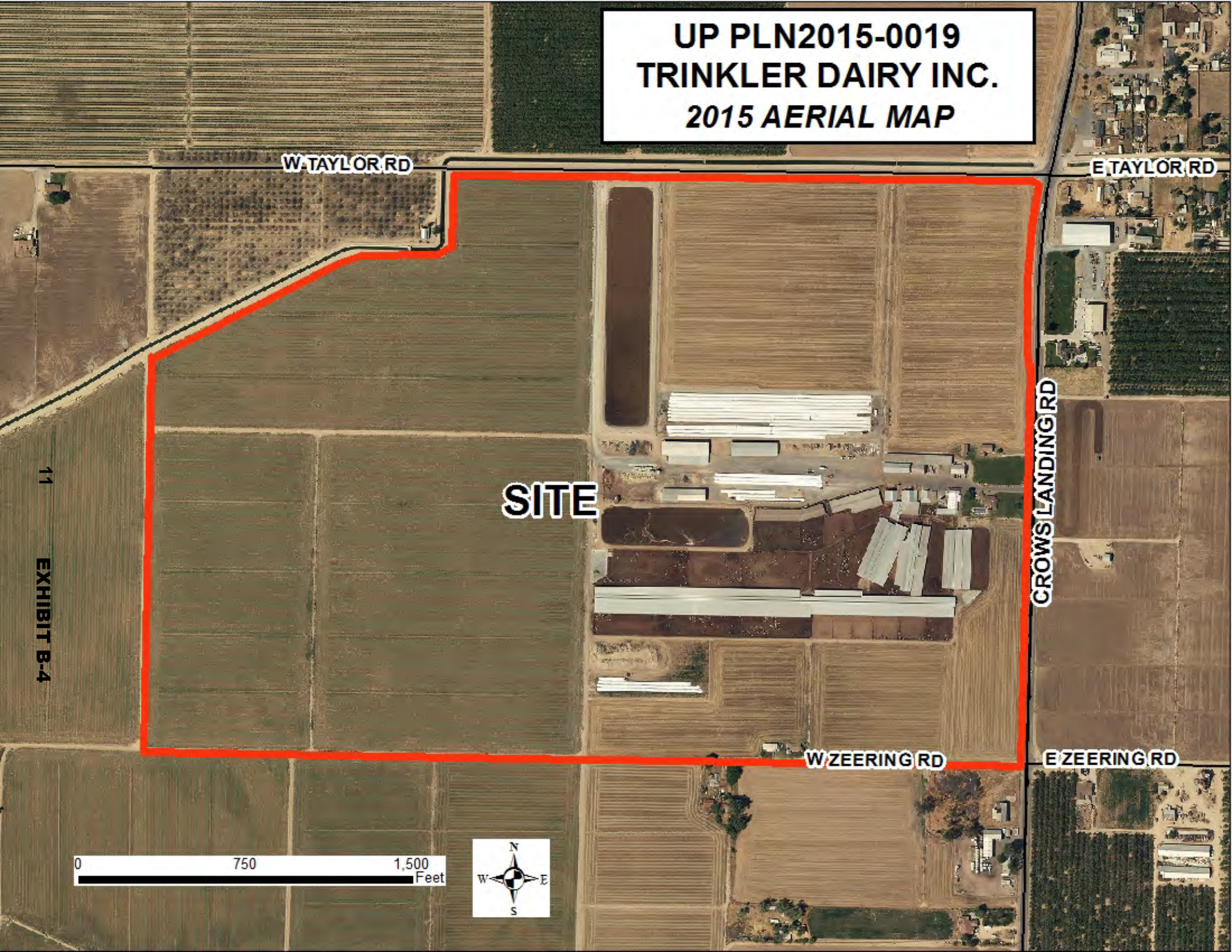
UP PLN2015-0019
TRINKLER DAIRY INC.
2015 AERIAL MAP
W TAYLOR RD
E TAYLOR RD
CROWS LANDING RD
SITE
W ZEERING RD
E ZEERING RD
11
EXHIBIT B-4
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750
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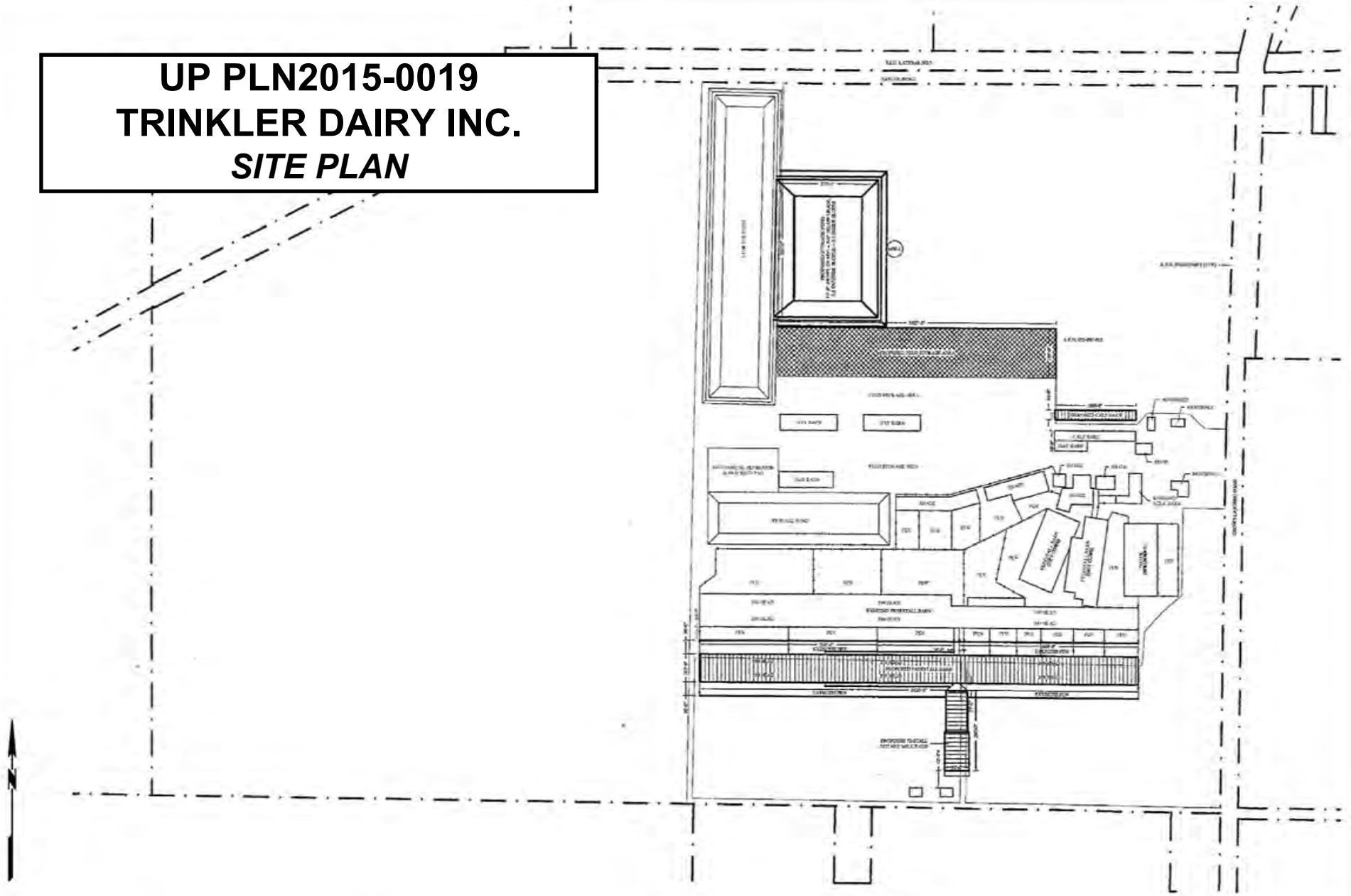
UP PLN2015-0019
TRINKLER DAIRY INC.
SITE PLAN



SCALE:
0 500 1,000
APPROXIMATE SCALE IN FEET

TRINKLER DAIRY
STANISLAUS COUNTY, CA

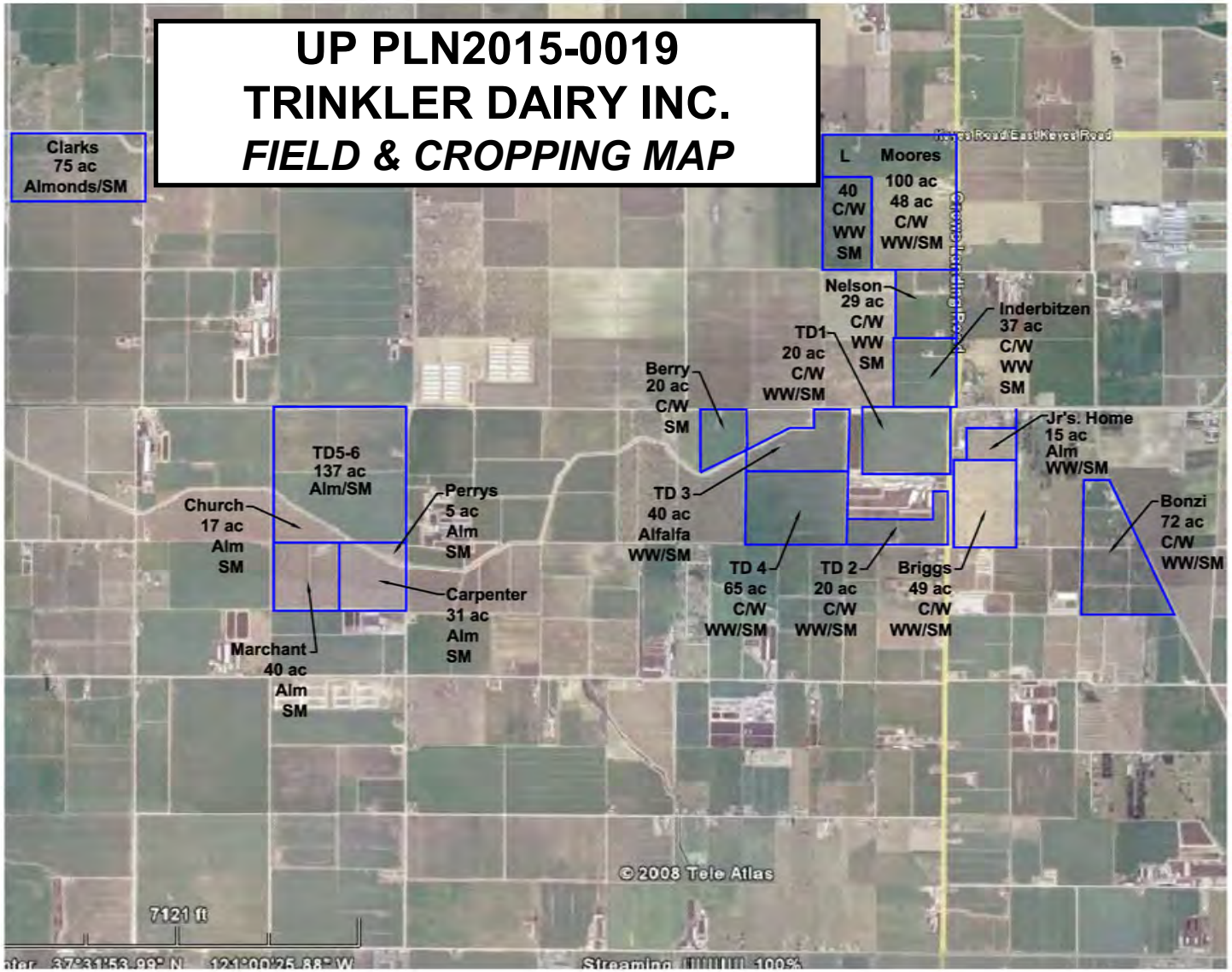
FIGURE 2
CUP SITE PLAN

Ag Services, Inc.

PROJECT NO.	DATE:	DRAWN BY:	APP. BY:
FRA-00	1/11/16	SB	JR

Trinkler Dairy

UP PLN2015-0019
TRINKLER DAIRY INC.
FIELD & CROPPING MAP



Owned-lagoon water	APN	Acres
TD 1-4	0022-0007-0013-0000	171
Inderbitzen	0041-0044-0006-0000	37
Nelson 1	0041-0045-0008-0000	16
Nelson 2	0041-0045-0009-0000	13
Berry	0022-0007-0004-0000	20
Briggs	0022-0024-0013-0000	49
Bonzi 1	0022-0010-0006-0000	24
Bonzi 2	0022-0010-0007-0000	48
Jr.'s Home	0022-0024-0012-0000	15
	Total	**393**

Rented-lagoon water	APN	Acres
Moores Home	0041-0044-0005-0000	148
	Total	**148**

Owned-dry manure	APN	Acres
T&R Jones 1	0058-0022-0007-0000	80
T&R Jones 2	0058-0022-0038-0000	75
TD 5&6 (trees)	0022-0002-0012-0000	137
Clarks (trees)	0017-0062-0006-0000	77
Carp. Trees	0022-0002-0014-0000	31
Perry (trees)	0022-0002-0013-0000	5
Church (trees)	0022-0002-0011-0000	17
Marchant (trees)	0022-0002-0015-0000	40
	Total	**462**
	total	1003

LEGEND

Fields	SM	Solid Manure	C	Corn	Alm	Almonds
	WW	Wastewater	W	Wheat	L	Leased

Ag Services, Inc.

SCALE:
0 3200 6400
APPROXIMATE SCALE IN FEET

TRINKLER DAIRY
STANISLAUS COUNTY, CA

FIGURE 3
FIELD AND CROPPING MAP

PROJECT NO.	DATE:	DRAWN BY:	APP. BY:
FRA-00	2/9/15	SB	JR

Trinkler Dairy

EXHIBIT B-6

NOTE: Approval of this application is valid only if the following conditions are met. This permit shall expire unless activated within 18 months of the date of approval. In order to activate the permit, it must be signed by the applicant and one of the following actions must occur: (a) a valid building permit must be obtained to construct the necessary structures and appurtenances; or, (b) the property must be used for the purpose for which the permit is granted. (Stanislaus County Ordinance 21.104.030)

CONDITIONS OF APPROVAL

USE PERMIT APPLICATION NO. PLN2015-0019
TRINKLER DAIRY FARMS
SCH #2015032067

Department of Planning and Community Development

1. Use(s) shall be conducted as described in the application and supporting information (including the plot plan) as approved by the Planning Commission and/or Board of Supervisors and in accordance with other laws and ordinances.

2. Pursuant to Section 711.4 of the California Fish and Game Code (effective January 1, 2017), the applicant is required to pay a California Department of Fish and Wildlife (formerly the Department of Fish and Game) fee at the time of filing a "Notice of Determination." Within five (5) days of approval of this project by the Planning Commission or Board of Supervisors, the applicant shall submit to the Department of Planning and Community Development a check for **$2,273.25**, made payable to **Stanislaus County**, for the payment of California Department of Fish and Wildlife and Clerk Recorder filing fees.

   Pursuant to Section 711.4 (e) (3) of the California Fish and Game Code, no project shall be operative, vested, or final, nor shall local government permits for the project be valid, until the filing fees required pursuant to this section are paid.

3. Developer shall pay all Public Facilities Impact Fees and Fire Facilities Fees as adopted by Resolution of the Board of Supervisors. The fees shall be payable at the time of issuance of a building permit for any construction in the development project and shall be based on the rates in effect at the time of building permit issuance.

4. The applicant/owner is required to defend, indemnify, or hold harmless the County, its officers, and employees from any claim, action, or proceedings against the County to set aside the approval of the project which is brought within the applicable statute of limitations. The County shall promptly notify the applicant of any claim, action, or proceeding to set aside the approval and shall cooperate fully in the defense.

5. All exterior lighting shall be designed (aimed down and toward the site) to provide adequate illumination without a glare effect. This shall include, but not be limited to, the use of shielded light fixtures to prevent skyglow (light spilling into the night sky) and the installation of shielded fixtures to prevent light trespass (glare and spill light that shines onto neighboring properties).

6. The facility operator shall use best management practices for odor and vector control at all times. If the operator is unable to control flies, then the operator shall retain the services of a licensed vector control service.

7. A sign plan for all proposed on-site signs indicating the location, height, area of the sign(s), and message must be approved by the Planning Director or appointed designee(s) prior to installation.

8. The Department of Planning and Community Development shall record a Notice of Administrative Conditions and Restrictions with the County Recorder's Office within 30 days of project approval. The Notice includes: Conditions of Approval/Development Standards and Schedule; any adopted Mitigation Measures; and a project area map.

9. Should any archeological or human remains be discovered during development, work shall be immediately halted within 150 feet of the find until it can be evaluated by a qualified archaeologist. If the find is determined to be historically or culturally significant, appropriate mitigation measures to protect and preserve the resource shall be formulated and implemented. The Central California Information Center shall be notified if the find is deemed historically or culturally significant.

10. Trinkler Dairy shall implement any applicable Best Management Practices for the reduction of Greenhouse Gases from dairy operations in the event that they are adopted by the County, State or Federal government.

11. The incorporation of SJVAPCD Best Available Control Technology (BACT) including but not limited to the use of silage bags, the proposed wastewater (lagoon) pond design, and the categorization of support stock into age ranges shall be implemented as a part of this project.

Department of Public Works

12. An encroachment permit shall be taken out for any new driveway or for any work to be done in the Crows Landing Road right-of-way.

13. Crows Landing Road is classified as 135-foot six lane expressway. The required ½ width of Crows Landing Road is 67.5 feet west of the centerline of the roadway. If 67.5 feet of the road right-of-way does not exist, then the remainder 67.5 feet shall be dedicated with an Irrevocable Offer of Dedication for the parcel frontage before approval of the first building or grading permit. The Irrevocable Offer of Dedication shall start from the south corner of the property to the north edge of the driveway north of the main entrance which is approximately 1420' long.

14. No parking, loading or unloading of vehicles will be permitted within the County Road right-of-way.

15. A grading, drainage, and erosion/sediment control plan for the project site shall be submitted before any building permit for the site is issued that creates a new or bigger building footprint on this parcel. Public Works will review and approve the drainage calculations. The grading and drainage plan shall include the following information:

A. The plan shall contain enough information to verify that all runoff will be kept from going onto adjacent properties and Stanislaus County road right-of-way.

B. The grading drainage and erosion/sediment control plan shall comply with the current State of California National Pollutant Discharge Elimination System (NPDES) General Construction Permit.

C. The grading, drainage, and associated work shall be accepted by Stanislaus County Public Works prior to a final inspection or occupancy, as required by the building permit.

D. The applicant of the building permit shall pay the current Stanislaus County Public Works weighted labor rate for the plan review of the building and/or grading plan.

E. The applicant of the building permit shall pay the current Stanislaus County Public Works weighted labor rate for all on-site inspections. The Public Works inspector shall be contacted 48 hours prior to the commencement of any grading or drainage work on-site.

Building Permits Division

16. Building permits, in accordance with the most current adopted California Code of Regulations - Title 24, will be required for all proposed structures.

Department of Environmental Resources – Hazardous Materials Division

17. The applicant shall determine, to the satisfaction of the Department of Environmental Resources (DER) that the property has been fully investigated (via Phase I study, and Phase II study if necessary) prior to the issuance of a grading permit. DER recommends research be conducted to determine if pesticides were used on the proposed development site; if confirmed, suspect site areas should be tested for organic pesticides and metals. Any discovery of underground storage tanks, former underground storage tank locations, buried chemicals, buried refuse, or contaminated soil shall be brought to the immediate attention of DER.

Turlock Irrigation District (TID)

18. The owner/developer must provide load information when applying for new electric service. The owner/developer must apply for a facility change for any pole or electrical facility relocation. Facility changes are performed at developer's expense.

Regional Water Quality Control Board (RWQCB)

19. The facility operator shall, at all times, implement and comply with all waste and nutrient management practices and waste discharge requirements as approved by the RWQCB; including future modifications to the Waste Management Plan (WMP), and Nutrient Management Plan (NMP) in accordance with RWQCB review, permitting, and approval.

20. This project is subject to Individual Waste Discharge Requirements as determined by RWQCB. Individual Waste Discharge Requirements will be prepared and issued by RWQCB.

21. The facility operator shall prevent infiltration and/or discharge from silage leachate, manure solids, and process wastewater, by implementing manure management and process wastewater management during dairy operation and at the time of dairy closure.

22. No construction can begin on the proposed wastewater storage pond (lagoon) until the design is approved by the RWQCB executive officer.

23. The proposed lagoon cannot be used until the CQA report has been approved.

San Joaquin Valley Air Pollution Control District (SJVAPCD)

24. The proposed project is subject to District Rule 2010 (Permits Required) and Rule 2201 (New and Modified Stationary Source Review). A change in emissions or change in method of operation/equipment, as determined during the inspection process, shall require the submittal of a new Authority to Construct Permit application.

25. All new construction requires completion of an Authority to Construct (ATC) Permit and may be subject to the following District Rules: Regulation VIII (Fugitive PM 10 Prohibitions), Rule 4102 (Nuisance), Rule 4601 (Architectural Coatings), Rule 4641 (Cutback, Slow Cure, and Emulsified Asphalt, Paving and Maintenance Operations), and Rule 4550 (Conservation Management Practices). The applicant shall comply with all applicable Rules.

26. A Rule 4570 (Confined Animal Facilities) application shall be submitted to the District.

27. To reduce impacts from construction related exhaust emissions, the developer shall utilize off-road construction fleets that can achieve fleet average emissions equal to or cleaner than the Tier II emission standards, as set for in §2423 of Title 13 of the California Code of Regulations, and Part 89 of Title 40 Code of Federal Regulations. This can be achieved through any combination of uncontrolled engines and engines complying with Tier II and above engine standards.

28. To reduce potential health impacts created by toxic air contaminants (TAC) and to insure that the proposed wastewater storage pond (lagoon) passes the Ambient Air Quality Analysis (AAQA) for Hydrogen Sulfide (H2S), the proposed lagoon shall be a minimum of 87 meters (375 feet) wide and 200 meters (500 feet) long. The lagoon shall be set back a minimum distance of 140 meters away from the northern fence line. Construction of the pond, as required, will insure that the project will be under the SJVAPCD's threshold of significance for TACs.

29. To ensure the project passes the Risk Management Review (RMR) portion of the project the two homes, located directly east of the proposed calf barn, shall only be utilized by single employees of the dairies. No families are permitted to reside in these residences.

****

*Please note: If Conditions of Approval/Development Standards are amended by the Planning Commission or Board of Supervisors, such amendments will be noted in the upper right-hand corner of the Conditions of Approval/Development Standards; new wording is in **bold**, and deleted wording will have a ~~line through it.~~*

Waste Management Plan Report
General Order No. R5-2007-0035, Attachment B
July 1, 2010 deadline

DAIRY FACILITY INFORMATION

A. NAME OF DAIRY OR BUSINESS OPERATING THE DAIRY: Trinkler Dairy Farms Inc.

Physical address of dairy:

7251 Crowslanding RD	Ceres	Stanislaus	95307
Number and Street	City	County	Zip Code

Street and nearest cross street (if no address):

TRS Data and Coordinates:

5S	9E	5	Mt. Diablo	37° 31' 57.03" N	120° 59' 43.66" W
Township (T_)	Range (R_)	Section (S_)	Baseline meridian	Latitude (N)	Longitude (W)

Date facility was originally placed in operation: 01/01/1930

Regional Water Quality Control Board Basin Plan designation: San Joaquin River Basin

County Assessor Parcel Number(s) for dairy facility:

0022-0007-0013-0000

B. OPERATOR NAME: Trinkler, Wendel Jr. Telephone no.: (209) 537-9883 (Landline) (Cellular)

P.O. Box 10	Ceres	CA	95307
Mailing Address Number and Street	City	State	Zip Code

Operator should receive Regional Board correspondence (check): [X] Yes [ ] No

C. LEGAL OWNER NAME: Trinkler, Wendel Jr. Telephone no.: (209) 537-9883 (Landline) (Cellular)

P.O. Box 10	Ceres	CA	95307
Mailing Address Number and Street	City	State	Zip Code

Owner should receive Regional Board correspondence (check): [X] Yes [ ] No

D. CONTACT NAME: Mitchell, Michael Telephone no.: (209) 664-1067 (Landline) (Cellular)

Title: Professional Engineer

18836 E Clausen RD	Turlock	CA	95380
Mailing Address Number and Street	City	State	Zip Code

CONTACT NAME: Ramos, Joe Telephone no.: (209) 250-2471 (209) 226-2375 (Landline) (Cellular)

Title: Technical Service Provider

2857 Geer RD, STE A	Turlock	CA	95382
Mailing Address Number and Street	City	State	Zip Code

Waste Management Plan Report
General Order No. R5-2007-0035, Attachment B
July 1, 2010 deadline

HERD AND MILKING EQUIPMENT

A. HERD AND MILKING

The milk cow dairy is currently regulated under individual Waste Discharge Requirements.

Total number of milk and dry cows combined as a baseline value in response to the Report of Waste Discharge (ROWD) request of October, 2005:

3,780 milk and dry cows combined (regulatory review is required for any expansion)

Type of Animal	Present Count	Maximum Count	Daily Flush Hours	Avg Live Weight (lbs)
Milk Cows	3,180	3,180	22	1,400
Dry Cows	600	600	22	1,400
Bred Heifers (15-24 mo.)	275	275	6	900
Heifers (7-14 mo.)	0	0	0	0
Calves (4-6 mo.)	520	520	6	
Calves (0-3 mo.)	600	600	24	

Predominant milk cow breed: Holstein

Average milk production: 75 pounds per cow per day

Average number of milk cows per string sent to the milkbarn: 460 milk cows per string

Number of milkings per day: 2.0 milkings per day

Number of times milk tank is emptied/filled each day: 5.0 per day

Number of hours spent milking each day: 20.0 hours per day

B. MILKBARN EQUIPMENT AND FLOOR WASH

Bulk tank wash and sanitizing: 4.0 run cycles/wash

Bulk tank wash vat volume: 50 gallons/cycle

Bulk tank wash wastewater: 1,000.0 gallons/day

Pipeline wash and sanitizing: 4.0 run cycles/wash

Pipeline wash vat volume: 75 gallons/cycle

Pipeline wash wastewater: 600.0 gallons/day

Reused / recycled water is the source of parlor floor wash water: [X] Yes [ ] No

Milkbarn / parlor floor wash volume: 24,000 gallons/day

Plate coolers type: Well Water Cooled (Water Reused/Recycled)

Plate coolers volume: 55,465 gallons/day

Vacuum pumps / air compressors / chillers type: Mechanically/Air Cooled

Vacuum pumps / air compressors / chillers volume: 0 gallons/day

Milkbarn and equipment wastewater volume generated daily: 57,386 gallons/day

C. OTHER WATER USES

Reused/recycled water is the source of herd drinking water: [ ] Yes [X] No

	Milk Cows	Dry Cows	Bred Heifers (15-24 mo.)	Bred Heifers (7-14 mo.)	Calves (4-6 mo.)	Calves (0-3 mo.)
Number of cows drinking from reusable water:	0 *of 3,180*	0 *of 600*	0 *of 275*	0 *of 0*	0 *of 520*	0 *of 600*
Gallons per head per day:	0	0	0	0	0	0

Total reusable water consumed by herd: 0 gallons/day

Reused/recycled water is the source of sprinkler pen water: [X] Yes [ ] No

Number of sprinklers in the holding pen: 230 sprinklers

Duration of each sprinkler cycle: 1.0 minutes

Number of sprinkler pen runs/milking: 2 cycles/milking

Flow rate for each sprinkler head: 5.0 gallons/minute

Total sprinkler pen wastewater volume: 31,786 gallons/day

Total fresh water used in manure flush lane system(s): 6,000 gallons/day

D. MISCELLANEOUS EQUIPMENT

No miscellaneous equipment entered.

E. MILKBARN AND EQUIPMENT SUMMARY

Number of days in storage period: 120 days

Water available for reuse/recycle: 55,465 gallons/day

Recycled water reused: 55,786 gallons/day

Recycled water leaving system: 0 gallons/day

Reusable water balance: 0 gallons/day

Volume of milkbarn and equipment wastewater generated for storage period: 6,886,320 gallons/storage period

MANURE AND BEDDING SOLIDS

A. IMPORTED AND FACILITY GENERATED BEDDING

Bedding Type	Imported or Generated (tons)	Density (lbs/cu. ft.)	Applied Separation Efficiency (default)	Solids to Pond (cu. ft./period)
Almond shells	250	20.0	85%	3,750
Straw (chopped)	250	7.0	75%	17,857
Facility generated bedding	286	40.0	50%	7,150
			Total:	28,757

B. SOLIDS SEPARATION PROCESS

Combined manure solids separation efficiency (weight basis): 50 %

Description of all solids separation equipment used in flushed lane manure management systems:

Mechanical Separators

C. MANURE AND BEDDING SOLIDS SUMMARY

	cubic feet		gallons	
	day	storage period	day	storage period
Manure generated by the herd (pre-separation):	8,642.90	1,037,148	64,653.39	7,758,406
Manure generated by the herd sent to pond(s):	6,391.04	766,924	47,808.27	5,736,993
Manure generated by the herd sent to dry lot(s):	974.68	116,961	7,291.08	874,929
Manure solids (herd) removed by separation:	618.28	74,194	4,625.07	555,009
Liquid component in separated solids not send to pond(s):	658.91	79,069	4,928.96	591,476
Imported and facility generated bedding sent to pond(s):	239.64	28,757	1,792.65	215,118
Total manure and bedding sent to pond(s):	6,630.68	795,682	49,600.93	5,952,111
Residual manure solids and bedding sent to pond(s) w/factor:	428.96	51,476	3,208.86	385,064
	cubic feet per year		gallons per year	
Residual manure solids and bedding sent to pond(s) w/factor:	156,571		1,171,235	

RAINFALL AND RUNOFF

A. RAINFALL ESTIMATES

Rainfall station nearest the facility: Turlock

25 year/24 hour storm event (default NOAA Atlas 2, 1973): 2.50 inches/storage period

25 year/24 hour storm event (user-override): _____ inches/storage period

Storage period rainfall (default DWR climate data): 8.56 inches/storage period

Storage period rainfall (user-override): _____ inches/storage period

Flood zone: Zone X

B. IMPERVIOUS AREAS

Name	Surface Area (sq. ft.)	Quantity	25yr/24hr Storm Runoff Coefficient	Storage Period Runoff Coefficient	Runoff Destination
Existing concrete holding areas and control lanes	30,707	1	0.97	0.50	Drains into pond(s).
Existing manure separator pad	32,947	1	0.97	0.50	Drains into pond(s).
Existing manure stacking pad south of WWS1	9,803	1	0.97	0.50	Drains into pond(s).
Existing north feed storage area	108,940	1	0.97	0.50	Drains into pond(s).
Existing south feed storage area	151,741	1	0.97	0.50	Drains into pond(s).
Existing west manure stacking pad	6,908	1	0.97	0.50	Drains into pond(s).

Existing yard north of milk barn	31,174	1	0.97	0.50	Drains into pond(s).
Proposed north feed storage addition	307,500	1	0.97	0.50	Drains into pond(s).

Surface area that does not run off into pond(s):	0 sq. ft.
Surface area that runs off into pond(s):	679,720 sq. ft.
Total surface area:	679,720 sq. ft.
Runoff from normal storage period rainfall:	1,813,528 gallons/storage period
Runoff from normal storage period rainfall with 1.5 factor:	2,720,292 gallons/storage period
25 year/24 hour storm event runoff:	1,027,525 gallons/storage period
Total surface area runoff:	2,841,053 gallons/storage period
Total surface area runoff with 1.5 factor:	3,747,817 gallons/storage period

C. ROOF AREAS

Name	Surface Area (sq. ft.)	Quantity	Runoff Destination
Existing calf hutch barn	12,445	1	Wastewater pond
Existing Center Group Pen Calf Barn	3,132	1	Wastewater pond
Existing commodity barn	18,525	1	Wastewater pond
Existing dry cow barn east of WWS1	15,402	1	Wastewater pond
Existing dry cow barn west of group pens	15,680	1	Wastewater pond
Existing East Group Pen Calf Barn	3,611	1	Wastewater pond
Existing freestall barn south of spec. needs bar	37,275	1	Wastewater pond
Existing freestall barn south of sprinkler pen	35,575	1	Wastewater pond
Existing hay barn east of commodity barn	12,514	1	Wastewater pond
Existing hay barn north of WWS1	10,881	1	Wastewater pond
Existing hay barn south of calf hutch barn	7,467	1	Wastewater pond
Existing Milking parlor and covered holding pen	6,730	1	Wastewater pond
Existing shade barn south of milk barn	30,018	1	Wastewater pond
Existing south combination freestall/shade barn	176,090	1	Wastewater pond
Existing special needs barn	7,959	1	Wastewater pond
Existing West Group Pen Calf Barn	2,524	1	Wastewater pond
Proposed calf barn	10,800	1	Wastewater pond
Proposed rotary milk barn	26,100	1	Field
Proposed south freestall barn	165,240	1	Field

Surface area that does not run off into pond(s):	191,340 sq. ft.
Surface area that runs off into pond(s):	406,628 sq. ft.
Total surface area:	597,968 sq. ft.
Runoff from normal storage period rainfall:	2,169,809 gallons/storage period
Runoff from normal storage period rainfall with 1.5 factor:	3,254,714 gallons/storage period
25 year/24 hour storm event runoff:	633,706 gallons/storage period
Total surface area runoff:	2,803,515 gallons/storage period
Total surface area runoff with 1.5 factor:	3,888,420 gallons/storage period

D. EARTHEN AREAS

Name	Surface Area (sq. ft.)	Quantity	25yr/24 Storm Coefficient	Storage Period Coefficient	Runoff Destination
Earthen areas minus roofed and concreted areas	649,856	1	0.35	0.20	Drains into pond(s).
Proposed freestall exercise pens	81,000	3	0.35	0.20	Drains into pond(s).

Surface area that does not run off into pond(s):	0 sq. ft.
Surface area that runs off into pond(s):	892,856 sq. ft.
Total surface area:	892,856 sq. ft.
Runoff from normal storage period rainfall:	952,874 gallons/storage period
Runoff from normal storage period rainfall with 1.5 factor:	1,429,312 gallons/storage period
25 year/24 hour storm event runoff:	487,012 gallons/storage period
Total surface area runoff:	1,439,887 gallons/storage period
Total surface area runoff with 1.5 factor:	1,916,324 gallons/storage period

E. TAILWATER MANAGEMENT

No fields with tailwater entered.

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LIQUID STORAGE

A. POND OR BASIN DESCRIPTION: Proposed WWS 3

Pond is rectangular in shape: [X] Yes [ ] No

Dimensions			
Earthen Length (EL):	500 ft.	Earthen Depth (ED):	15 ft.
Earthen Width (EW):	370 ft.	Side Slope (S):	3.0 ft. (h:1v)
Free Board (FB):	2 ft.	Dead Storage Loss (DS):	5.0 ft.
Calculations			
Liquid Length (LL):	488 ft.	Storage Volume Adjusted for Dead Storage Loss:	1,241,344 cu. ft.
Liquid Width (LW):	358 ft.		
Pond Surface Area:	185,000 sq. ft.	Pond Marker Elevation:	12.2 ft.
Storage Volume:	1,868,594 cu. ft.	Evaporation Volume:	928,480 gals/period
		Adjusted Surface Area:	172,688 sq. ft.

POND OR BASIN DESCRIPTION: WWS 1

Pond is rectangular in shape: [X] Yes [ ] No

Dimensions			
Earthen Length (EL):	640 ft.	Earthen Depth (ED):	12 ft.
Earthen Width (EW):	175 ft.	Side Slope (S):	2.0 ft. (h:1v)
Free Board (FB):	2 ft.	Dead Storage Loss (DS):	2.0 ft.
Calculations			
Liquid Length (LL):	632 ft.	Storage Volume Adjusted for Dead Storage Loss:	744,811 cu. ft.
Liquid Width (LW):	167 ft.		
Pond Surface Area:	112,000 sq. ft.	Pond Marker Elevation:	9.2 ft.
Storage Volume:	900,973 cu. ft.	Evaporation Volume:	560,627 gals/period
		Adjusted Surface Area:	104,271 sq. ft.

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POND OR BASIN DESCRIPTION: WWS 2

Pond is rectangular in shape: [X] Yes [ ] No

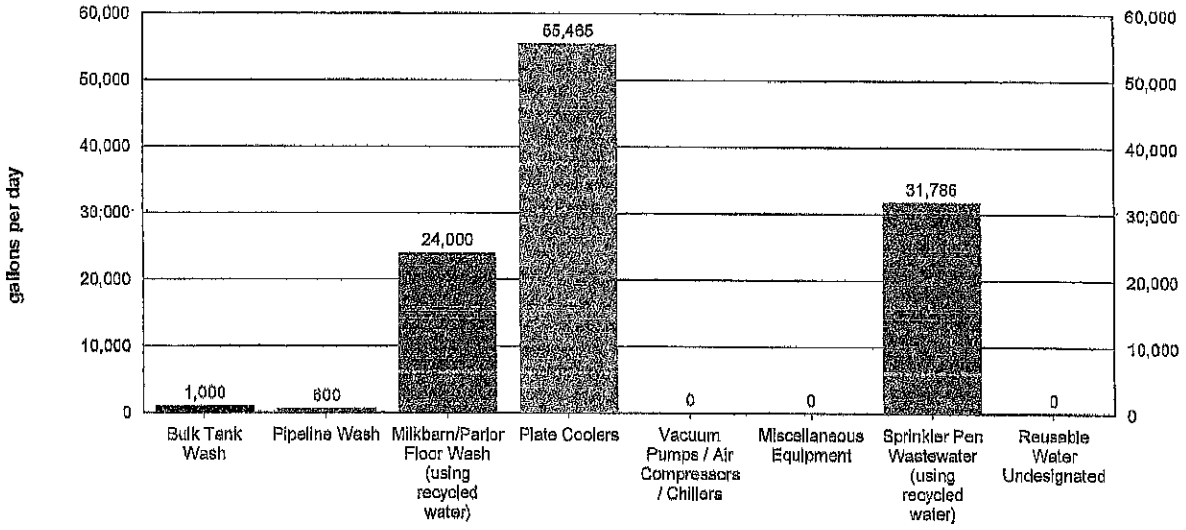
Dimensions			
Earthen Length (EL):	1,075 ft.	Earthen Depth (ED):	13 ft.
Earthen Width (EW):	215 ft.	Side Slope (S):	2.5 ft. (h:1v)
Free Board (FB):	2 ft.	Dead Storage Loss (DS):	2.0 ft.

Calculations			
Liquid Length (LL):	1,065 ft.	Storage Volume Adjusted for Dead Storage Loss:	1,713,825 cu. ft.
Liquid Width (LW):	205 ft.		
Pond Surface Area:	231,125 sq. ft.	Pond Marker Elevation:	10.2 ft.
Storage Volume:	2,028,492 cu. ft.	Evaporation Volume:	1,160,281 gals/period
		Adjusted Surface Area:	215,801 sq. ft.

Potential storage losses (due to dead storage):	1,098,079.0 cubic feet - or -	8,214,201.3 gallons
Liquid storage surface area:	498,573 sq. ft.	
Rainfall onto retention pond(s):	2,818,130 gallons/storage period	
Rainfall runoff into retention pond(s):	4,936,212 gallons/storage period	
Normal rainfall onto retention pond(s) with 1.5 factor:	4,227,195 gallons/storage period	
Normal rainfall runoff into retention pond(s) with 1.5 factor:	7,404,318 gallons/storage period	
Storage period evaporation (default):	11.50 inches/storage period	
Storage period evaporation (user-override):	inches/storage period	
Storage period evaporation volume:	2,649,388 gallons/storage period	
Manure and bedding sent to pond(s):	5,952,111 gallons/storage period	
Milkbarn water sent to pond(s):	6,886,320 gallons/storage period	
Fresh flush water for storage period:	720,000 gallons/storage period	

CHARTS

A. MILKBARN WASTEWATER SENT TO POND(S)

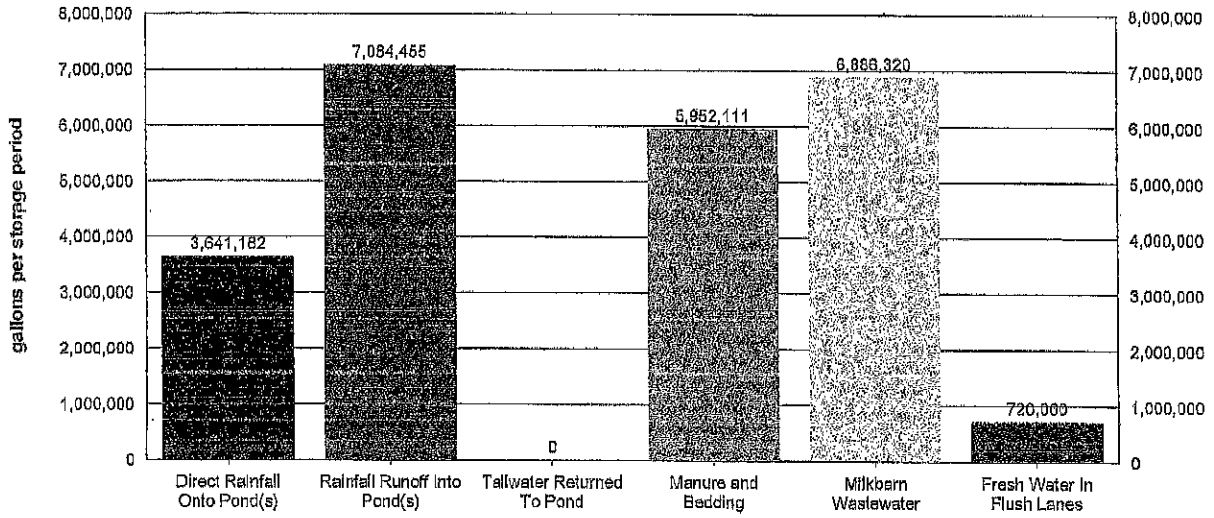


Values shown in chart are approximate values per day.

Total milkbarn wastewater generated daily: 57,386 gallons/day

Total milkbarn wastewater generated per period: 6,886,320 gallons/storage period

B. PROCESS WASTEWATER (NORMAL PRECIPITATION)

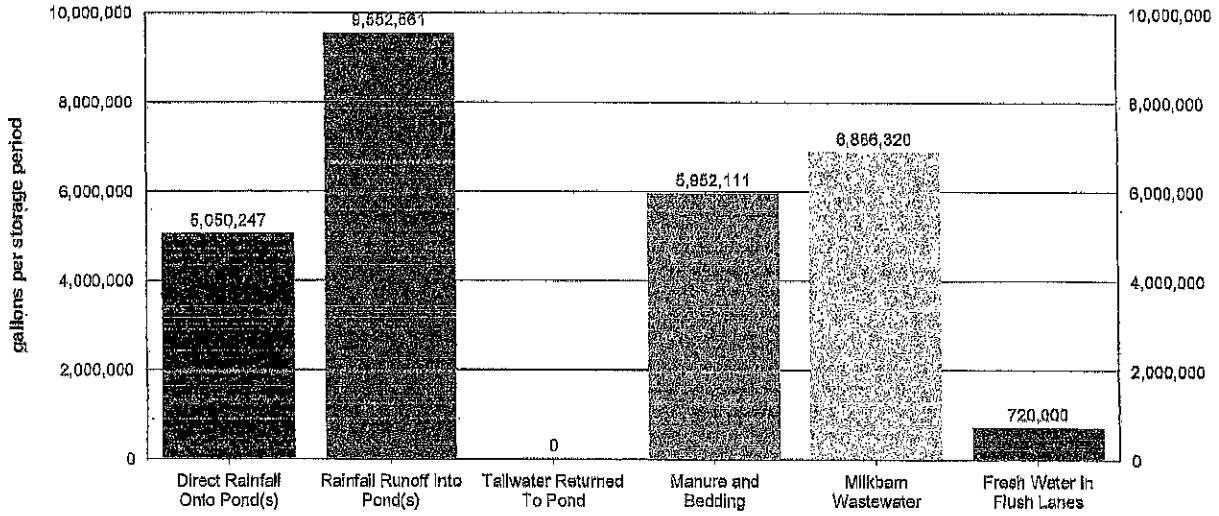


Values shown in chart are approximate values for storage period.

Storage period:	120	days
Total process wastewater generated daily:	202,367	gallons/day
Total process wastewater generated per period:	24,284,068	gallons/storage period
Total process wastewater removed due to evaporation:	2,649,388	gallons/storage period
Total storage capacity required:	21,634,680	gallons
	2,892,136	cu. ft.
Existing storage capacity (adjusted for dead storage loss):	27,677,772	gallons
	3,699,980	cu. ft.

Considering normal precipitation, existing capacity meets estimated storage needs: [X] Yes [ ] No

C. PROCESS WASTEWATER (NORMAL PRECIPITATION WITH 1.5 FACTOR)

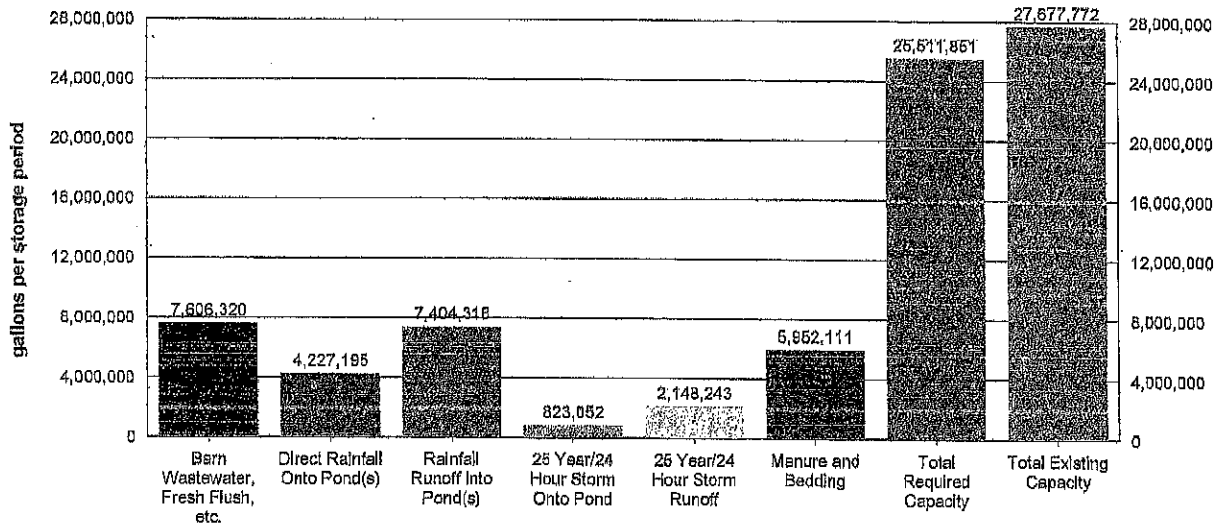


Values shown in chart are approximate values for storage period.

Storage period:	120	days
Total process wastewater generated daily:	234,677	gallons/day
Total process wastewater generated per period:	28,161,239	gallons/storage period
Total process wastewater removed due to evaporation:	2,649,388	gallons/storage period
Total storage capacity required:	25,511,851	gallons
	3,410,438	cu. ft.
Existing storage capacity (adjusted for dead storage loss):	27,677,772	gallons
	3,699,980	cu. ft.

Considering factored precipitation, existing capacity meets estimated storage needs: [X] Yes [ ] No

D. STORAGE VOLUME ASSESSMENT (NORMAL PRECIPITATION WITH 1.5 FACTOR)



Values shown in chart are approximate values for storage period.

Storage period:	120 days
Barn wastewater, fresh flush water, and tailwater:	7,606,320 gallons/storage period
Manure and bedding sent to pond:	5,952,111 gallons/storage period
Precipitation onto pond:	4,227,195 gallons/storage period
Precipitation runoff:	7,404,318 gallons/storage period
25 year/24 hour storm onto pond:	823,052 gallons/storage period
25 year/24 hour storm runoff:	2,148,243 gallons/storage period
Residual solids after liquids have been removed (liquid equivalent):	385,064 gallons/storage period
Total process wastewater removed due to evaporation:	2,649,388 gallons/storage period
Total required capacity:	25,511,851 gallons/storage period
Total existing capacity:	27,677,772 gallons/storage period
Existing capacity meets estimated storage needs:	[X] Yes [ ] No

OPERATION AND MAINTENANCE PLAN

The goal of the Operation and Maintenance Plan is to eliminate discharges of waste or storm water to surface waters from the production area and the protection of underlying soils and ground water.

A. POND MAINTENANCE

i. FREEBOARD MONITORING

1. Freeboard will be monitored monthly from June 1 through September 1 (dry season) and weekly from October 1 through May 31 (wet season). The results will be recorded on a Dairy Production Area Visual Inspection Form.
2. Freeboard will be monitored during and after each significant storm event and the results recorded on a Production Area Significant Storm Event Inspection Form.
3. Ponds will be photographed on the first day of each month. Pond photos will be labeled and maintained with the dairy's monitoring records.

ii. PREPARATION FOR MAINTAINING WINTER STORAGE CAPACITY

1. The retention pond(s) will begin to be lowered to the minimum operating level on or before a designated date each year.
2. The minimum operating level will include the necessary storage volume as identified in Section II.A in Attachment B of the General Order.

iii. OTHER POND MONITORING

1. At the time of each monitoring for freeboard, the pond(s) will be inspected for evidence of excessive odors, mosquito breeding, algae, or equipment damage; and issues with berm integrity, including cracking, slumping, erosion, excess vegetation, animal burrows, and seepage. Any issues identified and corrective actions performed will be recorded on a Dairy Production Area Visual Inspection Form - Other Pond Monitoring.
2. At the time of each monitoring during and after each significant storm event, the ponds will be inspected for evidence of any discharge and issues with berm integrity, including cracking, slumping, erosion, excess vegetation, animal burrows, and seepage. Any issues identified and corrective actions performed will be recorded on a Production Area Significant Storm Event Inspection Form..

iv. SOLIDS REMOVAL PROCEDURES

1. The average thickness of the solids accumulated on the bottom of the pond(s) will be measured on the designated interval using the owner, operator, and/or designer specified procedure.
2. Once solids/sludge on the bottom of the pond(s) reach the owner, operator, and/or designer specified critical thickness, solids/sludge will be removed so that adequate capacity is maintained.
3. When necessary, solids/sludge will be removed using the owner, operator, and/or designer specified methods for protecting any pond liner.

OPERATIONS AND MAINTENANCE PLAN FOR POND: WWS 1

Dry season freeboard monitoring will occur on the 5th of each month.

Wet season freeboard monitoring will occur every Monday of each week.

Process wastewater pond contents will be lowered to the minimum operating level (elevation) of 2.5 feet above the pond invert beginning in March of each year.

Sludge accumulation will be measured annually.

The following method will be used to measure solids/sludge accumulation:

Storage is visually monitored or professionally measured to evaluate solid accumulation. Storage is typically cleaned multiple times throughout the irrigation season through pumping.

When solids/sludge accumulate to a thickness of 3.0 feet, the following method will be used to maintain adequate storage capacity while protecting any pond liner:

Water is added throughout the year to dilute solids. Solids are pumped out during irrigations. If necessary, storage can also be agitated and pumped into slurry wagons or directly excavated for Spring and/or Fall application. If excavation is required, cleaning equipment operator will be informed as to overall depth of storage and instructed to remain 6-12 inches from the floor

OPERATIONS AND MAINTENANCE PLAN FOR POND: WWS 2

Dry season freeboard monitoring will occur on the 5th of each month.

Wet season freeboard monitoring will occur every Monday of each week.

Process wastewater pond contents will be lowered to the minimum operating level (elevation) of 2.0 feet above the pond invert beginning in March of each year.

Sludge accumulation will be measured annually.

The following method will be used to measure solids/sludge accumulation:

Sludge accumulation should be measured at pond drawdown with a probe that can indicate sludge thickness.

When solids/sludge accumulate to a thickness of 2.0 feet, the following method will be used to maintain adequate storage capacity while protecting any pond liner:

Water is added throughout the year to dilute solids. Solids are pumped out during irrigations. If necessary, storage can also be agitated and pumped into slurry wagons or directly excavated for Spring and/or Fall application. If excavation is required, cleaning equipment operator will be informed as to overall depth of storage and instructed to remain 6-12 inches from the floor.

OPERATIONS AND MAINTENANCE PLAN FOR POND: Proposed WWS 3

Dry season freeboard monitoring will occur on the 5th of each month.

Wet season freeboard monitoring will occur every Monday of each week.

Process wastewater pond contents will be lowered to the minimum operating level (elevation) of 5.0 feet above the pond invert beginning in March of each year.

Sludge accumulation will be measured annually.

The following method will be used to measure solids/sludge accumulation:

Sludge accumulation should be measured at pond drawdown with a probe that can indicate sludge thickness. Precautions should be taken to ensure that probing tool is designed to not damage the storages synthetic liner.

When solids/sludge accumulate to a thickness of 5.0 feet, the following method will be used to maintain adequate storage capacity while protecting any pond liner:

Water is added throughout the year to dilute solids. Solids are pumped out during irrigations. If necessary, storage can also be agitated and pumped into slurry wagons. As this proposed storage will be synthetically lined, standard cleaning methods such as direct excavation should be avoided to protect the integrity of the liner.

B. RAINFALL COLLECTION SYSTEM MAINTENANCE

i. Annually, rainfall collection systems will be assessed to ensure:

1. Conveyances are free of debris and operating within designer/manufacturer specifications.
2. Components are properly fastened according to designer/manufacturer specifications.
3. All downspouts and related infrastructure are connected to conveyances that divert water away from manured areas.
4. Water from the rainfall collection system(s) is diverted to an appropriate destination.

Buildings with rooftop rainfall collection systems	Quantity	Surface Area (sq. ft.)
Existing calf hutch barn	1	12,445
Existing Center Group Pen Calf Barn	1	3,132
Existing commodity barn	1	18,525
Existing dry cow barn east of WWS1	1	15,402
Existing dry cow barn west of group pens	1	15,680
Existing East Group Pen Calf Barn	1	3,611
Existing freestall barn south of spec. needs bar	1	37,275
Existing freestall barn south of sprinkler pen	1	35,575
Existing hay barn east of commodity barn	1	12,514
Existing hay barn north of WWS1	1	10,881
Existing hay barn south of calf hutch barn	1	7,467
Existing Milking parlor and covered holding pen	1	6,730
Existing shade barn south of milk barn	1	30,018
Existing south combination freestall/shade barn	1	176,090
Existing special needs barn	1	7,959
Existing West Group Pen Calf Barn	1	2,524
Proposed calf barn	1	10,800
Proposed rotary milk barn	1	26,100
Proposed south freestall barn	1	165,240

Assessment for buildings with rooftop rainfall collection systems will occur on or before: 5th of October

Assessment for other rainfall collections systems will occur on or before: 5th of October

Description of how rainfall collection systems will be assessed:

Gutters and downspouts will be cleaned and repaired as needed.

C. CORRAL MAINTENANCE

i. Monthly from June 1st through September 30th (dry season) and weekly from October 1st through May 31st (wet season), the perimeter of the corrals and pens will be assessed to ensure that runon and runoff controls such as berms are functioning correctly, and that all water that contacts waste is collected and diverted into the wastewater retention pond (s). Any issues identified and corrective actions performed will be recorded on a Dairy Production Area Visual Inspection Form - Corrals.

ii. The corrals will be assessed by the designated date to determine:

1. Whether manure needs to be removed from the corrals based on the owner, operator, and/or designer specified conditions.

2. Whether there are depressions within the corrals that should be filled/groomed to prevent ponding.

iii. Removal of manure and/or regrading, when necessary, will be completed on or before the designated month/day of each year.

Day of the month dry season assessment will occur:	5th of each month
Day of the week wet season assessment will occur:	Monday
Solid manure removal and regrading assessment will occur on or before:	5th of October

Conditions requiring manure removal and/or regrading:

Solids are removed twice per year, usually in the Spring and Fall following harvest.

Solid manure removal and/or regrading will occur on or before: 5th of November

D. FEED STORAGE AREA MAINTENANCE

i. During the dry season and prior to the wet season, the perimeter of storage areas will be assessed to ensure all runon and runoff controls such as berms are functioning correctly and runoff and leachate from the areas are collected and diverted into the wastewater pond(s). Any issues identified and corrective actions performed will be recorded on a Dairy Production Area Visual Inspection Form - Manure and Feed Storage Areas.

ii. During the wet season, feed storage area(s) will be assessed to determine if there are depressions within any feed storage area that should be filled or repaired to prevent ponding.

iii. Any necessary regrading/resurfacing and berm/conveyance maintenance will be completed on an annual basis.

Day of the month dry season assessment will occur:	5th of each month
Day of the week wet season assessment will occur:	Monday
Regrading/resurfacing and berm maintenance assessment will occur on or before:	5th of October
Regrading/resurfacing and berm maintenance completion will occur on or before:	5th of November

E. SOLID MANURE STORAGE AREA MAINTENANCE

i. During the dry season and prior to the wet season, the perimeter of manure storage areas will be assessed to ensure all runon and runoff controls such as berms are functioning correctly and runoff and leachate from the areas are collected and diverted into the wastewater pond(s). Any issues identified and corrective actions performed will be recorded on a Dairy Production Area Visual Inspection Form - Manure and Feed Storage Areas.

ii. During the wet season, manure storage area(s) will be assessed to determine if there are depressions within any manure storage area that should be filled to prevent ponding.

iii. Any necessary regrading/resurfacing and berm/conveyance maintenance will be completed on an annual basis.

Day of the month dry season assessment will occur: 5th of each month

Day of the month wet season assessment will occur: Monday

Regrading/resurfacing and berm maintenance assessment will occur on or before: 5th of October

Regrading/resurfacing and berm maintenance completion will occur on or before: 5th of November

F. ANIMAL HOUSING AND FLUSH WATER CONVEYANCE SYSTEM MAINTENANCE

i. A map will be attached that identifies critical points for monitoring the animal housing and flush water conveyance system to verify that water is being managed as identified in this Waste Management Plan. These points will be maintained at owner, operator, and/or designer specified intervals.

Animal housing area assessment will occur on or before: 5th of October

Animal housing drainage system maintenance will occur on or before: 5th of November

Animal housing area drainage system assessment and maintenance methods:

-Debris is removed from flush lanes, flush drains and corral drains as needed.
-Pumps are monitored daily.
-Corrals are regraded and dirt is added as needed to prevent ponding.

G. MORTALITY MANAGEMENT

i. Dead animals will be stored, removed, and disposed of properly.

Rendering company or landfill name: Baker Commodities Inc.

Rendering company or landfill telephone number: (559) 237-4310

H. ANIMALS AND SURFACE WATER MANAGEMENT

i. A system will be in place, monitored, and maintained to prevent animals from entering any surface waters when a stream or other surface water crosses or adjoins the corral(s).

Does a stream or any other surface water cross or adjoin the corrals? [ ] Yes [X] No

I. MONITORING SALT IN ANIMAL RATIONS

i. The combined quantity of minerals as salt in animal drinking water and feed rations will be reviewed by a qualified nutritionist on a routine basis to verify that minerals are limited to the amount required to maintain animal health and optimum production. As feed rations change, mineral content may change.

Assessment interval: Annually

J. CHEMICAL MANAGEMENT

l. Chemicals and other contaminants handled at the facility will not be disposed of in any manure or process wastewater, storm water storage or treatment system unless specifically designed to treat such chemicals and other contaminants.

Chemical Name	Quantity	Units	Frequency	Usage Area	Destination (Used Chemical / Container)	Disposal Company		Collection Frequency
						Name	Phone	
Iodine	18,000	gallons	year	Milkbarn	Picked up by distributor			
Acid	1,200	gallons	year	Milkbarn	Picked up by distributor			
Soap	3,600	gallons	year	Milkbarn	Picked up by distributor			

REQUIRED ATTACHMENTS

The following list, based upon user selections and data entries, describes the minimum required attachments that must be submitted with the Waste Management Plan for the reporting schedule of 'July 1, 2010'.

A. SITE MAP(S)

Provide a site map (or maps) of appropriate scale to show property boundaries and the location of the features of the production area including the following in sufficient detail: structures used for animal housing, milk parlor, and other buildings; corrals and ponds; solids separation facilities (settling basins or mechanical separators); other areas where animal wastes are deposited or stored; feed storage areas; drainage flow directions and nearby surface waters; all water supply wells (domestic, irrigation, and barn wells) and groundwater monitoring wells.

Production area map reference number: Figure 2

Provide a site map (or maps) of appropriate scale to show property boundaries and the location of the features of all land application areas (land under the Discharger's control, whether it is owned, rented, or leased, to which manure or process wastewater from the production area is or may be applied for nutrient recycling) including the following in sufficient detail: a field identification system (Assessor's Parcel Number; field by name or number; total acreage of each field; crops grown; indication if each field is owned, leased, or used pursuant to a formal agreement); indication of what type of waste is applied (solid manure only, wastewater only, or both solid manure and wastewater); drainage flow direction in each field, nearby surface waters, and storm water discharge points; tailwater and storm water drainage controls; subsurface (tile) drainage systems (including discharge points and lateral extent); irrigation supply wells and groundwater monitoring wells; sampling locations for discharges of storm water and tailwater to surface water from the field.

Application area map reference number: Figures 3-4

Provide a site map (or maps) of appropriate scale to show property boundaries and the location of all cropland (land that is part of the dairy but not used for dairy waste application) including the following in sufficient detail: Assessor's Parcel Number, total acreage, crops grown, and information on who owns or leases the field. The Waste Management Plan shall indicate if such cropland is covered under the Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Order No. R5-2006-0053 for Coalition Group or Order No. R5-2006-0054 for Individual Discharger, or updates thereto).

Non-application area map reference number: None

Provide a site map (or maps) of appropriate scale to show property boundaries and the location of all off-property domestic wells within 600 feet of the production area or land application area(s) associated with the dairy and the location of all municipal supply wells within 1,500 feet of the production area or land application area(s) associated with the dairy.

Well area map reference number: Figures 2-4

Provide a site map (or maps) of appropriate scale to show property boundaries and a vicinity map, north arrow and the date the map was prepared. The map shall be drawn on a published base map (e.g., a topographic map or aerial photo) using an appropriate scale that shows sufficient details of all facilities.

Vicinity map reference number: Figure 1

B. PROCESS WASTEWATER MAP(S)

Provide a site map (or maps) of appropriate scale to show property boundaries and the location of the features of the production area including the following in sufficient detail: process wastewater conveyance structures, discharge points, and discharge /mixing points with irrigation water supplies; pumping facilities and flow meter locations; upstream diversion structures, drainage ditches and canals, culverts, drainage controls (berms/levees, etc.), and drainage easements; and any additional components of the waste handling and storage system.

Production infrastructure system area map reference number: Figures 3-4

Provide a site map (or maps) of appropriate scale to show property boundaries and the location of the features of all land application areas (land under the Discharger's control, whether it is owned, rented, or leased, to which manure or process wastewater from the production area is or may be applied for nutrient recycling) including the following in sufficient detail: process wastewater conveyance structures, discharge points and discharge mixing points with irrigation water supplies; pumping facilities ; flow meter locations; drainage ditches and canals, culverts, drainage controls (berms, levees, etc.), and drainage easements.

Land application infrastructure system area map reference number: Figures 3-4

C. EXCESS PRECIPITATION CONTINGENCY REPORT

There were no attachment references entered or required for this attachment section.

D. OPERATION AND MAINTENANCE PLAN

Attach a map that identifies critical points for monitoring the system to verify that water is being managed as identified in this Waste Management Plan (see Attachment B, Pg B-7 V.F, V.G, and V.H for additional requirements).

Animal housing assessment map reference number: Figures 2 & 3

E. FLOOD PROTECTION / INUNDATION REPORT

Provide a published flood zone map that shows the facility is outside the relevant flood zones.

Flood zone map and/or document reference number: 06099C0545E

F. BACKFLOW PROTECTION

Attach documentation from a trained professional (i.e. a person certified by the American Backflow Prevention Association, an inspector from a state or local governmental agency who has experience and/or training in backflow prevention, or a consultant with such experience and/or training), as specified in Required Reports and Notices H.1 of Waste Discharge Requirements General Order No. R5-2007-0035, that there are no cross-connections that would allow the backflow of wastewater into a water supply well, irrigation well, or surface water as identified on the Site Map.

Backflow documentation reference number: Backflow Certificate

CERTIFICATION

A. DAIRY FACILITY INFORMATION

Name of dairy or business operating the dairy: Trinkler Dairy Farms Inc.

Physical address of dairy:

7251 Crowslanding RD	Ceres	Stanislaus	95307
Number and Street	City	County	Zip Code

Street and nearest cross street (if no address):

B. DOCUMENTATION OF QUALIFICATIONS AND PLAN DEVELOPMENT

I have reviewed the portion of the waste management plan that is related to storage capacity facility and design specifications in accordance with Item II, Attachment B of the Waste Discharge Requirements General Order for Existing Milk Cow Dairies - Order No. R5-2007-0035 and certify that this plan was prepared by, or under the responsible charge of, and certified by a civil engineer who is registered pursuant to California law or other person as may be permitted under the provisions of the California Business and Professions Code to assume responsible charge of such work.

Storage capacity is:

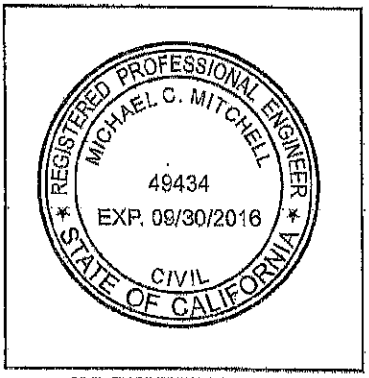
Insufficient

☐ Retrofitting Plan/Schedule/Design Criteria attached in accordance with Attachment B, II.B. 1-5 and Attachment B, II. C.

Sufficient

☒ Certification 1 - Certified in accordance with Attachment B, II. A. 1-8. (no contingency plan)

☐ Certification 2 - Certified in accordance with Attachment B, II. A. 1-8, II. C. (with contingency plan attached)



CIVIL ENGINEER'S WET STAMP

Michael C. Mitchell — 1/21/16

SIGNATURE OF CIVIL ENGINEER — DATE

Michael Mitchell

PRINT OR TYPE NAME

18836 E Clausen RD; Turlock, CA 95380

MAILING ADDRESS

(209) 664-1067

PHONE NUMBER

C. OWNER AND/OR OPERATOR CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Wendel Trinkler, Jr. Pres.
SIGNATURE OF OWNER

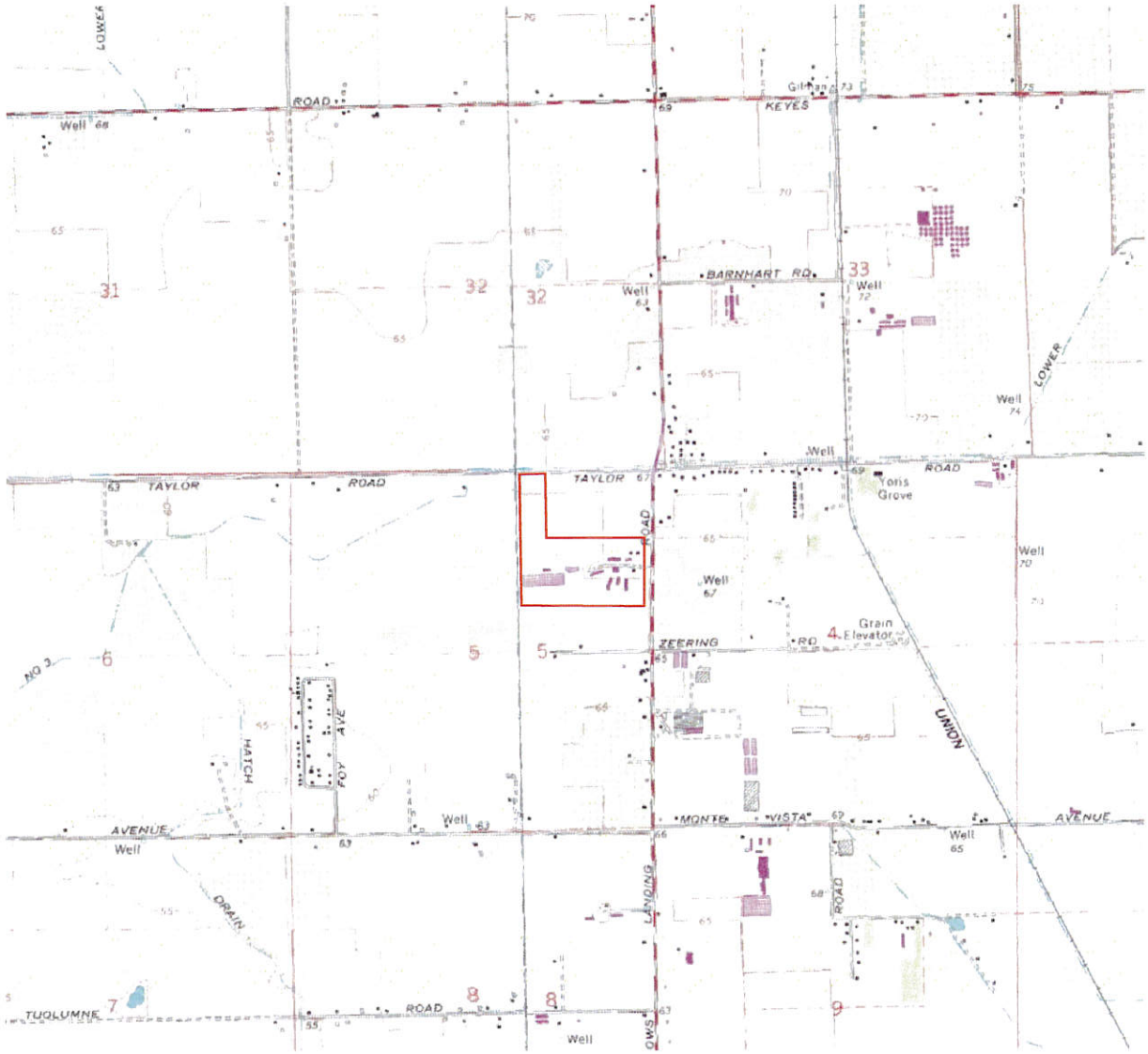
Wendel Trinkler, Jr.
PRINT OR TYPE NAME

1/22/16
DATE

Wendel Trinkler Jr.
SIGNATURE OF OPERATOR

Wendel Trinkler Jr.
PRINT OR TYPE NAME

1/22/16
DATE

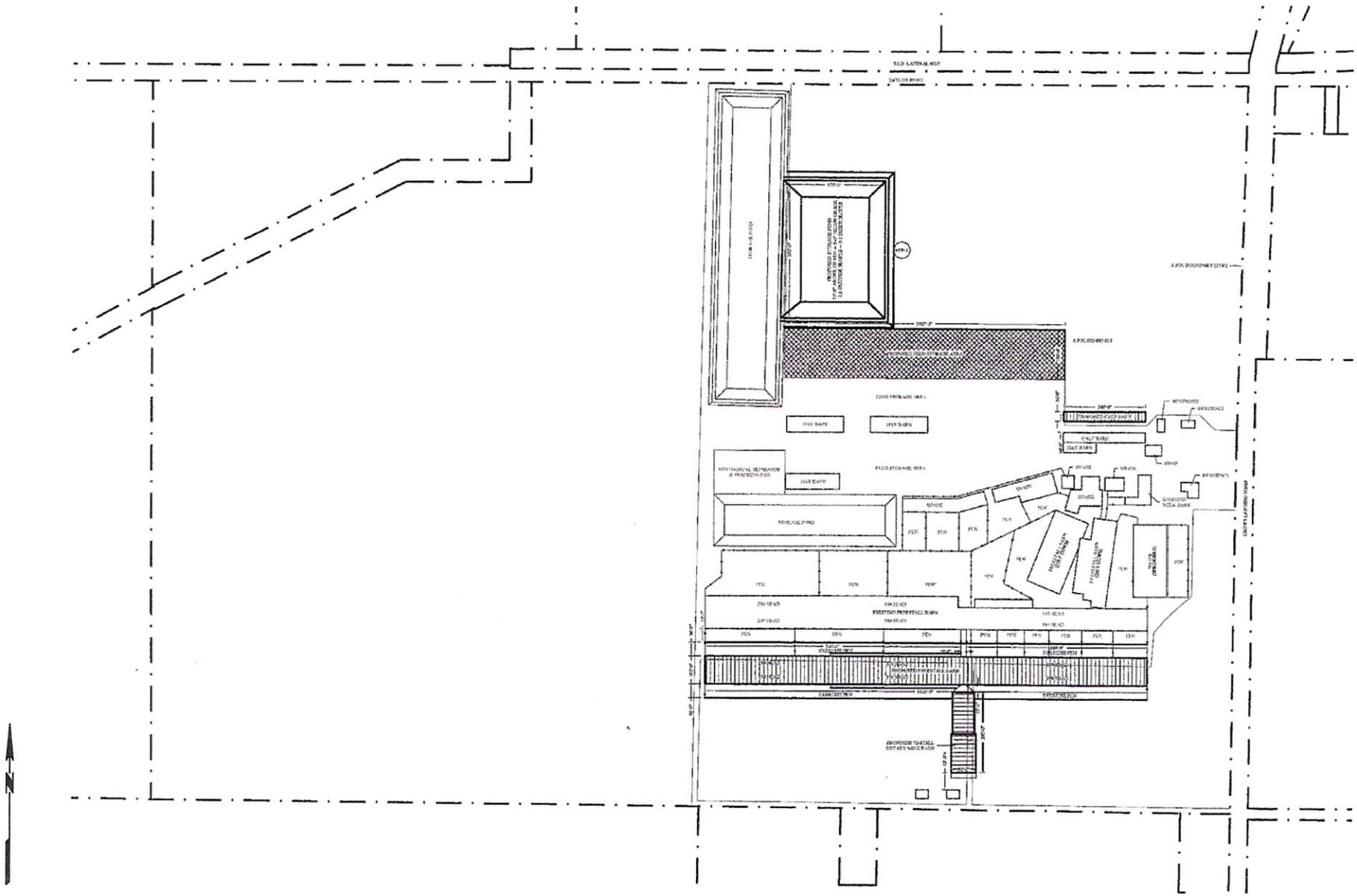


LEGEND

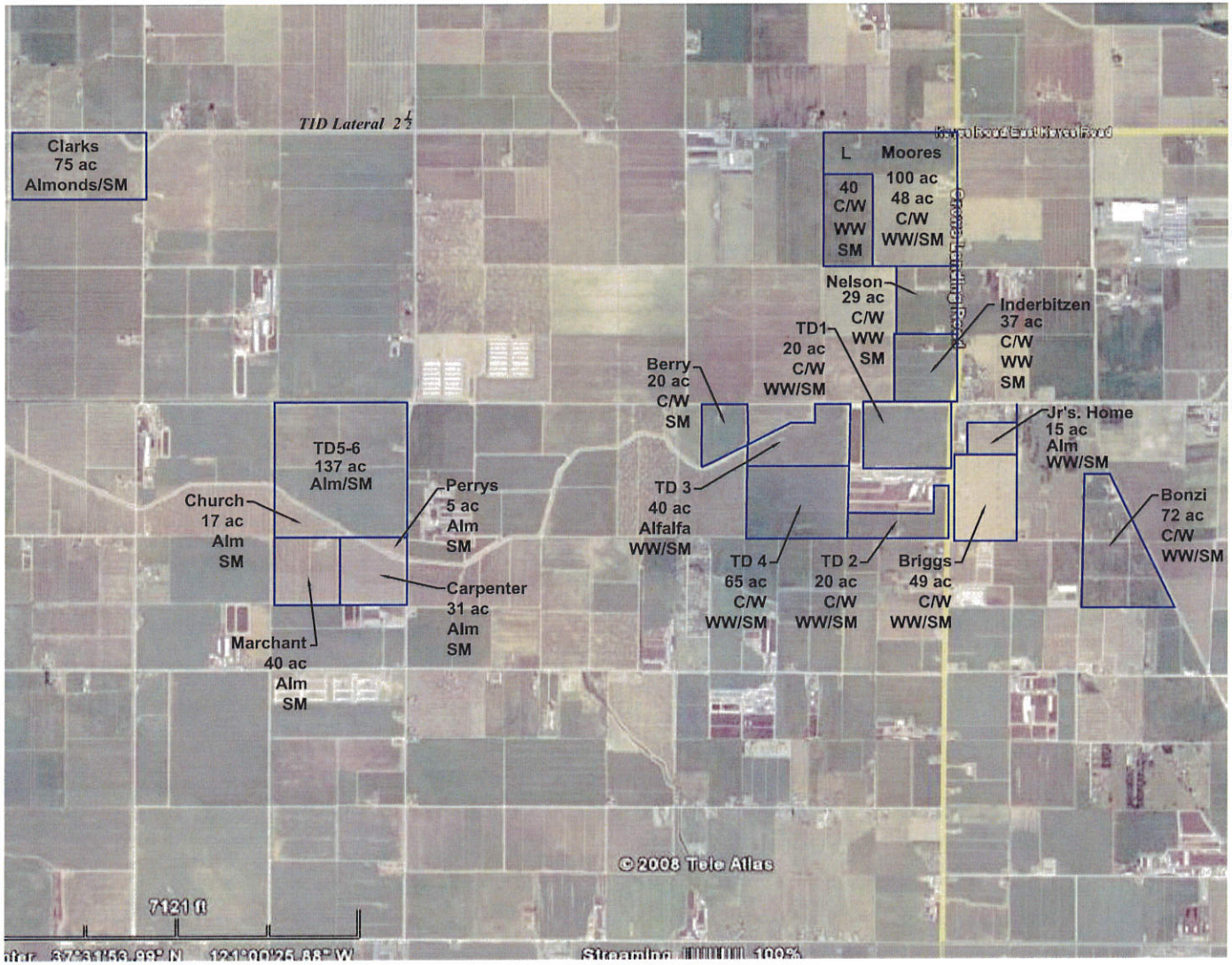
Facility Boundary

N

Ag Services, Inc.	SCALE: 0 4,000 8,000 APPROXIMATE SCALE IN FEET	TRINKLER DAIRY STANISLAUS COUNTY, CA			**FIGURE 1** TOPOGRAPHIC MAP
	PROJECT NO. FRA-00	DATE: 10/17/14	DRAWN BY: SB	APP. BY: JR	Trinkler Dairy



Ag Services, Inc.	SCALE: 0 500 1,000 APPROXIMATE SCALE IN FEET	TRINKLER DAIRY STANISLAUS COUNTY, CA			**FIGURE 2** CUP SITE PLAN
	PROJECT NO. FRA-00	DATE: 1/11/16	DRAWN BY: SB	APP. BY: JR	Trinkler Dairy



Owned-lagoon water	APN	Acres
TD 1-4	0022-0007-0013-0000	171
Inderbitzen	0041-0044-0006-0000	37
Nelson 1	0041-0045-0008-0000	16
Nelson 2	0041-0045-0009-0000	13
Berry	0022-0007-0004-0000	20
Briggs	0022-0024-0013-0000	49
Bonzi 1	0022-0010-0006-0000	24
Bonzi 2	0022-0010-0007-0000	48
Jr.'s Home	0022-0024-0012-0000	15
	Total	**393**

Rented-lagoon water	APN	Acres
Moores Home	0041-0044-0005-0000	148
	Total	**148**

Owned-dry manure	APN	Acres
T&R Jones 1	0058-0022-0007-0000	80
T&R Jones 2	0058-0022-0038-0000	75
TD 5&6 (trees)	0022-0002-0012-0000	137
Clarks (trees)	0017-0062-0006-0000	77
Carp. Trees	0022-0002-0014-0000	31
Perry (trees)	0022-0002-0013-0000	5
Church (trees)	0022-0002-0011-0000	17
Marchant (trees)	0022-0002-0015-0000	40
	Total	**462**
	total	1003

LEGEND

☐	Fields	SM	Solid Manure	C	Corn	Alm	Almonds
		WW	Wastewater	W	Wheat	L	Leased

Ag Services, Inc.

SCALE:
0 3200 6400
APPROXIMATE SCALE IN FEET

TRINKLER DAIRY
STANISLAUS COUNTY, CA

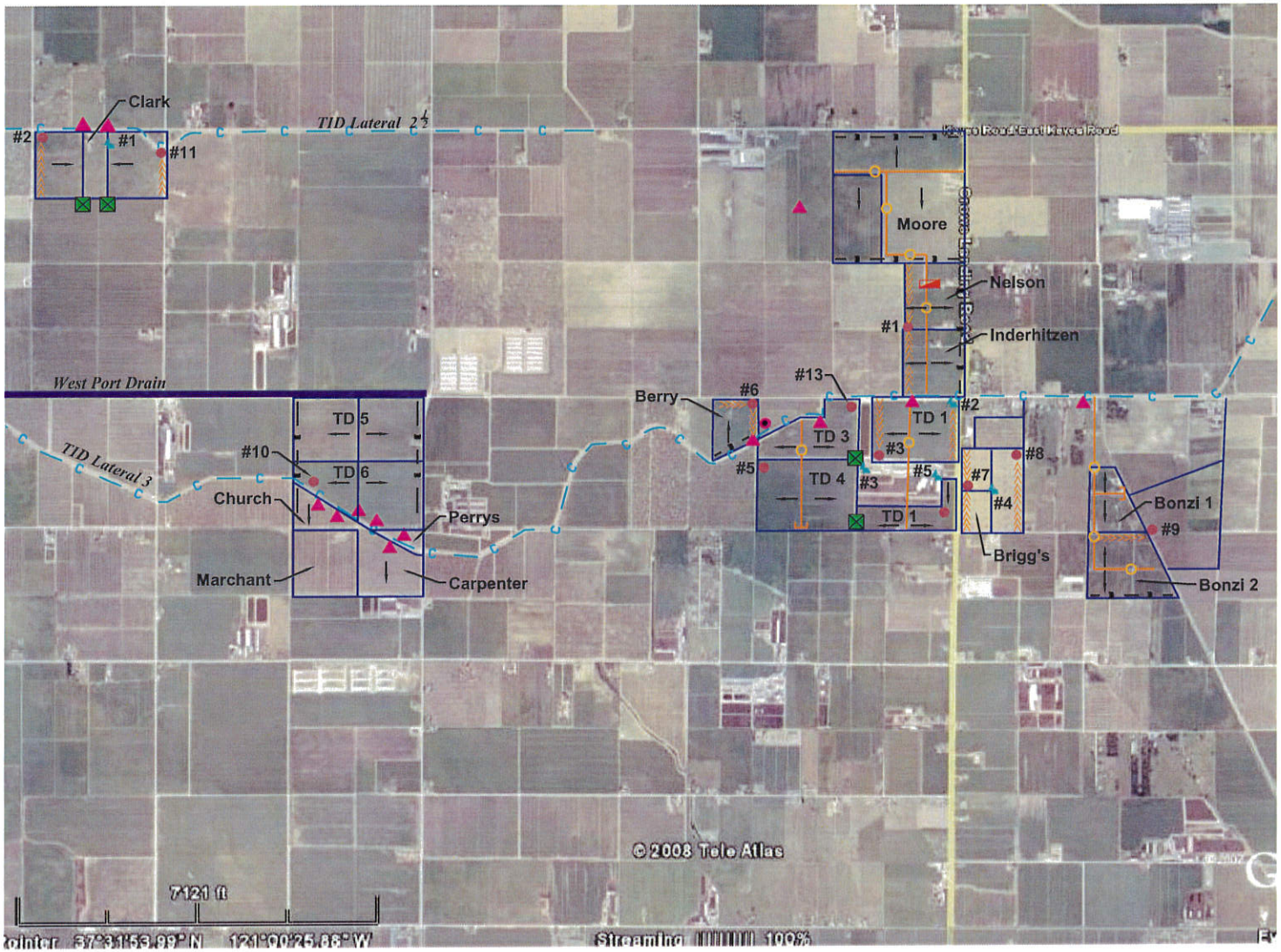
FIGURE 3
FIELD AND CROPPING MAP

PROJECT NO.	DATE:	DRAWN BY:	APP. BY:
FRA-00	2/9/15	SB	JR

Trinkler Dairy

LEGEND

- Fields
- Irrigation Well
- TID Inlet Valve
- Tailwater Pump
- Tailwater Drain Pump
- Drainage Ditches
- Irrigation Mixing Box
- Irrigation Flow
- Irrigation Pipeline
- Tailwater Recovery
- Canal
- Wastewater Lift Station
- Irrigation Control Box



Ag Services, Inc.	SCALE: 0 3200 6400 APPROXIMATE SCALE IN FEET	TRINKLER DAIRY STANISLAUS COUNTY, CA		**FIGURE 4** IRRIGATION SCHEMATIC
	PROJECT NO. FRA-00	DATE: 10/17/14	DRAWN BY: SB	APP. BY: JR

Trinkler Dairy

Nutrient Management Plan Report
General Order No. R5-2007-0035, Attachment C
July 1, 2009 deadline

DAIRY FACILITY INFORMATION

A. NAME OF DAIRY OR BUSINESS OPERATING THE DAIRY: Trinkler Dairy Farms Inc.

Physical address of dairy:

7251 Crowslanding RD	Ceres	Stanislaus	95307
Number and Street	City	County	Zip Code

Street and nearest cross street (if no address):

Date facility was originally placed in operation: 01/01/1930

Regional Water Quality Control Board Basin Plan designation: San Joaquin River Basin

County Assessor Parcel Number(s) for dairy facility:

0022-0007-0013-0000

B. OPERATOR NAME: Trinkler, Wendel Jr. Telephone no.: (209) 537-9883 (Landline)

P.O. Box 10	Ceres	CA	95307
Mailing Address Number and Street	City	State	Zip Code

Operator should receive Regional Board correspondence (check): [X] Yes [ ] No

C. LEGAL OWNER NAME: Trinkler, Wendel Jr. Telephone no.: (209) 537-9883 (Landline)

P.O. Box 10	Ceres	CA	95307
Mailing Address Number and Street	City	State	Zip Code

Owner should receive Regional Board correspondence (check): [X] Yes [ ] No

D. CONTACT NAME: Ramos, Joe Telephone no.: (209) 250-2471 (Landline) (209) 226-2375 (Cellular)

Title: Technical Service Provider

2857 Geer RD	Turlock	CA	95382
Mailing Address Number and Street	City	State	Zip Code

AVAILABLE NUTRIENTS

A. HERD INFORMATION

The milk cow dairy is currently regulated under individual Waste Discharge Requirements.

Total number of milk and dry cows combined as a baseline value in response to the Report of Waste Discharge (ROWD) request of October, 2005:

3,780 *milk and dry cows combined (regulatory review is required for any expansion)*

	Milk Cows	Dry Cows	Bred Heifers (15-24 mo.)	Heifers (7-14 mo. to breeding)	Calves (4-6 mo.)	Calves (0-3 mo.)
Present count	3,180	600	275	0	520	600
Maximum count	3,180	600	275	0	520	600
Avg live weight (lbs)	1,400	1,400	900	0		
Daily hours on flush	22	22	6	0	6	24

Predominant milk cow breed: Holstein

Average milk production: 72 *pounds per cow per day*

B. IRRIGATION SOURCES

Irrigation Source Name	Type	Nitrogen (mg/L)	Phosphorus (mg/L)	Potassium (mg/L)	Discharge Rate
Ag Well 1	Groundwater (well)	24.60			2,500 *gpm*
Ag Well 2	Groundwater (well)	24.20			3,000 *gpm*
Ag Well 3	Groundwater (well)	46.30			1,500 *gpm*
Ag Well 4	Groundwater (well)	39.50			2,000 *gpm*
Ag Well 5	Groundwater (well)	34.10			2,500 *gpm*
TID Canal	Surface water (canal, river)	0.50			15 *cfs*

C. NUTRIENT IMPORTS

Nutrient Type/Name	Quantity	Moisture	Nitrogen	Phosphorus (as P2O5)	Potassium (as K2O)
UN 32	72.00 *ton*	0.1%	32.000%	0.000%	0.000%
Starter 4-10-10	82.00 *ton*	0.1%	4.000%	10.000%	10.000%

Total nitrogen imported: 52,587.36 *lbs*

Total phosphorus imported: 7,159.63 *lbs*

Total potassium imported: 13,598.39 *lbs*

D. NUTRIENT EXPORTS

Nutrient Type/Name	Quantity	Moisture	Nitrogen	Phosphorus (as P2O5)	Potassium (as K2O)
Separated Solids Fall	9,000.00 *ton*	60.0%	2.000%	0.300%	1.000%

Nutrient Type/Name	Quantity	Moisture	Nitrogen	Phosphorus (as P2O5)	Potassium (as K2O)
Separated Solids Spring	9,000.00 *ton*	60.0%	1.500%	0.300%	1.000%
Corral Solids	9,900.00 *ton*	30.0%	1.500%	0.660%	1.500%

Total nitrogen exported: 459,900.00 *lbs*

Total phosphorus exported: 58,853.41 *lbs*

Total potassium exported: 292,077.00 *lbs*

E. STORAGE PERIOD

Storage period is the maximum period of time anticipated between land application of process wastewater (from storage ponds/lagoons) to croplands. A qualified agronomist and civil engineer should collaborate and collectively consider predominant soil types, soil infiltration rates, maximum depth, available water, field capacity, permanent wilting point, allowable depletion, crop water use, evapotranspiration, precipitation, irrigation system capacity, water delivery constraints, crop nutrient requirements, soil nutrient adsorbtion/desorption, rooting depth, nutrient accumulation/availability for current and future crop needs, facility wide process wastewater storage capacity and other factors as deemed necessary across all croplands where process wastewater is applied in selecting a storage period. In many cases conflicts will arise between crop water demands, crop nutrient demands and insufficient process wastewater storage capacity. Process wastewater may not be the best choice as a source of either water and/or nutrients to meet crop demands throughout the year. Groundwater and surface water vulnerability has been considered.

The storage period selected in this Nutrient Management Plan is consistent with the storage period selected in the Waste Management Plan.

Storage period: 120 *days*

APPLICATION AREA

A. ASSESSOR PARCEL NUMBER: 0017-0062-0006-0000
Legal owner of parcel: Owned by Dairy

ASSESSOR PARCEL NUMBER: 0022-0002-0011-0000
Legal owner of parcel: Owned by Dairy

ASSESSOR PARCEL NUMBER: 0022-0002-0012-0000
Legal owner of parcel: Owned by Dairy

ASSESSOR PARCEL NUMBER: 0022-0002-0013-0000
Legal owner of parcel: Owned by Dairy

ASSESSOR PARCEL NUMBER: 0022-0002-0014-0000
Legal owner of parcel: Owned by Dairy

ASSESSOR PARCEL NUMBER: 0022-0002-0015-0000
Legal owner of parcel: Owned by Dairy

ASSESSOR PARCEL NUMBER: 0022-0007-0004-0000
Legal owner of parcel: Owned by Dairy

ASSESSOR PARCEL NUMBER: 0022-0007-0013-0000
Legal owner of parcel: Owned by Dairy

ASSESSOR PARCEL NUMBER: 0022-0010-0006-0000
Legal owner of parcel: Owned by Dairy

ASSESSOR PARCEL NUMBER: 0022-0010-0007-0000
Legal owner of parcel: Owned by Dairy

ASSESSOR PARCEL NUMBER: 0022-0024-0012-0000
Legal owner of parcel: Owned by Dairy

ASSESSOR PARCEL NUMBER: 0022-0024-0013-0000
Legal owner of parcel: Owned by Dairy

ASSESSOR PARCEL NUMBER: 0041-0044-0005-0000
Legal owner of parcel: Moore, Ronald Telephone no.: (209) 000-0000

6125 Crows landing RD	Ceres	CA	95307
Mailing Address Number and Street	City	State	Zip Code

Landline Cellular

ASSESSOR PARCEL NUMBER: 0041-0044-0006-0000

ASSESSOR PARCEL NUMBER (CONTINUED): 0041-0044-0006-0000

Legal owner of parcel: Moore, Ronald Telephone no.: (209) 000-0000

Landline	Cellular

6125 Crows landing RD	Ceres	CA	95307
Mailing Address Number and Street	City	State	Zip Code

ASSESSOR PARCEL NUMBER: 0041-0045-0008-0000

Legal owner of parcel: Owned by Dairy

ASSESSOR PARCEL NUMBER: 0041-0045-0009-0000

Legal owner of parcel: Owned by Dairy

ASSESSOR PARCEL NUMBER: 0058-0022-0007-0000

Legal owner of parcel: Owned by Dairy

ASSESSOR PARCEL NUMBER: 0058-0022-0038-0000

Legal owner of parcel: Owned by Dairy

B. FIELD NAME: Berry

Cropable acres: 20

Predominant soil type: Sandy loam

Do irrigation system head-to-head flow conditions exist on the field? [ ] Yes [X] No

Can fresh water for irrigation purposes be delived to the field year round? [X] Yes [ ] No

Can process wastewater be delivered to the field at agronomic rates and times? [X] Yes [ ] No

Tailwater management method: Returned to top of field

Crops grown and rotation:

Crop Type	Plant Date	Harvest Date	Acres Planted
Wheat, silage, soft dough	Late October	Middle April	20
Corn, silage	Late May	Early October	20

FIELD NAME: Bonzi 1 and 2

Cropable acres: 72

Predominant soil type: Sandy loam

Do irrigation system head-to-head flow conditions exist on the field? [ ] Yes [X] No

Can fresh water for irrigation purposes be delived to the field year round? [X] Yes [ ] No

Can process wastewater be delivered to the field at agronomic rates and times? [X] Yes [ ] No

Tailwater management method: Returned to top of field

Crops grown and rotation:

Crop Type	Plant Date	Harvest Date	Acres Planted
Wheat, silage, soft dough	Late October	Middle April	72
Corn, silage	Late May	Early October	72

FIELD NAME: Briggs

Cropable acres: 49

Predominant soil type: Sandy loam

Do irrigation system head-to-head flow conditions exist on the field? [ ] Yes [X] No

Can fresh water for irrigation purposes be delived to the field year round? [X] Yes [ ] No

Can process wastewater be delivered to the field at agronomic rates and times? [X] Yes [ ] No

Tailwater management method: Returned to top of field

Crops grown and rotation:

Crop Type	Plant Date	Harvest Date	Acres Planted
Wheat, silage, soft dough	Late October	Middle April	49
Corn, silage	Late May	Early October	49

FIELD NAME: Carpenter

Cropable acres: 31

Predominant soil type: Sandy loam

Do irrigation system head-to-head flow conditions exist on the field? [ ] Yes [X] No

Can fresh water for irrigation purposes be delived to the field year round? [X] Yes [ ] No

Can process wastewater be delivered to the field at agronomic rates and times? [ ] Yes [X] No

Tailwater management method: Sprinklers

Crops grown and rotation:

Crop Type	Plant Date	Harvest Date	Acres Planted
Almond, in shell	Middle January	Early October	31

FIELD NAME: Church

Cropable acres: 17

Predominant soil type: Sandy loam

Do irrigation system head-to-head flow conditions exist on the field? [ ] Yes [X] No

Can fresh water for irrigation purposes be delived to the field year round? [X] Yes [ ] No

Can process wastewater be delivered to the field at agronomic rates and times? [ ] Yes [X] No

Tailwater management method: Sprinklers

Crops grown and rotation:

Crop Type	Plant Date	Harvest Date	Acres Planted
Almond, in shell	Middle January	Early October	17

FIELD NAME: Clark

Cropable acres: 77

Predominant soil type: Sandy loam

Do irrigation system head-to-head flow conditions exist on the field? [ ] Yes [X] No

Can fresh water for irrigation purposes be delived to the field year round? [X] Yes [ ] No

Can process wastewater be delivered to the field at agronomic rates and times? [ ] Yes [X] No

Tailwater management method: Sprinkler

Crops grown and rotation:

Crop Type	Plant Date	Harvest Date	Acres Planted
Almond, in shell	Middle January	Early October	77

FIELD NAME: Inderbitzen

Cropable acres: 37

Predominant soil type: Sandy loam

Do irrigation system head-to-head flow conditions exist on the field? [ ] Yes [X] No

Can fresh water for irrigation purposes be delived to the field year round? [X] Yes [ ] No

Can process wastewater be delivered to the field at agronomic rates and times? [X] Yes [ ] No

Tailwater management method: Returned to top of field

Crops grown and rotation:

Crop Type	Plant Date	Harvest Date	Acres Planted
Wheat, silage, soft dough	Late October	Middle April	37
Corn, silage	Late May	Early October	37

FIELD NAME: JR's Home

Cropable acres: 15

Predominant soil type: Sandy loam

Do irrigation system head-to-head flow conditions exist on the field? [ ] Yes [X] No

Can fresh water for irrigation purposes be delived to the field year round? [X] Yes [ ] No

Can process wastewater be delivered to the field at agronomic rates and times? [X] Yes [ ] No

Tailwater management method: Returned to top of field

Crops grown and rotation:

Crop Type	Plant Date	Harvest Date	Acres Planted
Almond, in shell	Middle January	Early October	15

FIELD NAME: Marchant

Cropable acres: 40

Predominant soil type: Sandy loam

Do irrigation system head-to-head flow conditions exist on the field? [ ] Yes [X] No

Can fresh water for irrigation purposes be delived to the field year round? [X] Yes [ ] No

Can process wastewater be delivered to the field at agronomic rates and times? [ ] Yes [X] No

Tailwater management method: Sprinklers

Crops grown and rotation:

Crop Type	Plant Date	Harvest Date	Acres Planted
Almond, in shell	Middle January	Early October	40

FIELD NAME: Moores

Cropable acres: 148

Predominant soil type: Sandy loam

Do irrigation system head-to-head flow conditions exist on the field? [ ] Yes [X] No

Can fresh water for irrigation purposes be delived to the field year round? [X] Yes [ ] No

Can process wastewater be delivered to the field at agronomic rates and times? [X] Yes [ ] No

Tailwater management method: Bermed

Crops grown and rotation:

Crop Type	Plant Date	Harvest Date	Acres Planted
Wheat, silage, soft dough	Late October	Middle April	148
Corn, silage	Late May	Early October	148

FIELD NAME: Nelson 1 and 2

Cropable acres: 29

Predominant soil type: Sandy loam

Do irrigation system head-to-head flow conditions exist on the field? [ ] Yes [X] No

Can fresh water for irrigation purposes be delived to the field year round? [X] Yes [ ] No

Can process wastewater be delivered to the field at agronomic rates and times? [X] Yes [ ] No

Tailwater management method: Returned to top of field

Crops grown and rotation:

Crop Type	Plant Date	Harvest Date	Acres Planted
Wheat, silage, soft dough	Late October	Middle April	29
Corn, silage	Late May	Early October	29

FIELD NAME: Perrys

Cropable acres: 5

Predominant soil type: Sandy loam

Do irrigation system head-to-head flow conditions exist on the field? [ ] Yes [X] No

Can fresh water for irrigation purposes be delived to the field year round? [X] Yes [ ] No

Can process wastewater be delivered to the field at agronomic rates and times? [ ] Yes [X] No

Tailwater management method: Sprinklers

Crops grown and rotation:

Crop Type	Plant Date	Harvest Date	Acres Planted
Almond, in shell	Middle January	Early October	5

FIELD NAME: T&R Jones 1

Cropable acres: 80

Predominant soil type: Sandy loam

Do irrigation system head-to-head flow conditions exist on the field? [ ] Yes [X] No

Can fresh water for irrigation purposes be delived to the field year round? [X] Yes [ ] No

Can process wastewater be delivered to the field at agronomic rates and times? [ ] Yes [X] No

Tailwater management method: Returned to top of field

Crops grown and rotation:

Crop Type	Plant Date	Harvest Date	Acres Planted
Wheat, silage, soft dough	Late October	Middle April	80
Corn, silage	Late May	Early October	80

FIELD NAME: T&R Jones 2

Cropable acres: 75

Predominant soil type: Sandy loam

Do irrigation system head-to-head flow conditions exist on the field? [ ] Yes [X] No

Can fresh water for irrigation purposes be delived to the field year round? [X] Yes [ ] No

Can process wastewater be delivered to the field at agronomic rates and times? [ ] Yes [X] No

Tailwater management method: Returned to top of field

Crops grown and rotation:

Crop Type	Plant Date	Harvest Date	Acres Planted
Wheat, silage, soft dough	Late October	Middle April	75
Corn, silage	Late May	Early October	75

FIELD NAME: TD 5-6

Cropable acres: 137

Predominant soil type: Sandy loam

Do irrigation system head-to-head flow conditions exist on the field? [ ] Yes [X] No

Can fresh water for irrigation purposes be delived to the field year round? [X] Yes [ ] No

Can process wastewater be delivered to the field at agronomic rates and times? [ ] Yes [X] No

Tailwater management method: Sprinkler

Crops grown and rotation:

Crop Type	Plant Date	Harvest Date	Acres Planted
Almond, in shell	Middle January	Early October	137

FIELD NAME: TD-1-4

Cropable acres: 150

Predominant soil type: Sandy loam

Do irrigation system head-to-head flow conditions exist on the field? [ ] Yes [X] No

Can fresh water for irrigation purposes be delived to the field year round? [X] Yes [ ] No

Can process wastewater be delivered to the field at agronomic rates and times? [X] Yes [ ] No

Tailwater management method: Returned to retention pond

Crops grown and rotation:

Crop Type	Plant Date	Harvest Date	Acres Planted
Wheat, silage, soft dough	Late October	Middle April	150
Corn, silage	Late May	Early October	150

C. LAND APPLICATION AREA FIELDS AND PARCELS

Field name	Cropable acres	Total harvests	Parcel number
Berry	20	2	0022-0007-00040000
Bonzi 1 and 2	72	2	0022-0010-00060000 0022-0010-00070000
Briggs	49	2	0022-0024-00130000
Carpenter	31	1	0022-0002-00140000
Church	17	1	0022-0002-00110000
Clark	77	1	0017-0062-00060000
Inderbitzen	37	2	0041-0044-00060000
JR's Home	15	1	0022-0024-00120000
Marchant	40	1	0022-0002-00150000
Moores	148	2	0041-0044-00050000
Nelson 1 and 2	29	2	0041-0045-00080000 0041-0045-00090000
Perrys	5	1	0022-0002-00130000
T&R Jones 1	80	2	0058-0022-00070000
T&R Jones 2	75	2	0058-0022-00380000
TD 5-6	137	1	0022-0002-00120000
TD-1-4	150	2	0022-0007-00130000
Land application area totals	1,083	29	

NUTRIENT BUDGET

A. NUTRIENT BUDGET FOR CROP: Berry / Wheat, silage, soft dough

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Pre-irrigation prior to planting (with fertilizer) *Nutrient source:* Retention pond (lagoon) *Application method:* Pipeline	1	100.0 60%	20.0 80%	133.0 80%	100.7

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.7	0.0	0.0	8.0
	0.7	0.0	0.0	

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (with fertilizer) *Nutrient source:* Retention pond (lagoon) *Application method:* Pipeline	1	150.0 60%	25.0 80%	150.0 80%	150.7

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.7	0.0	0.0	8.0
	0.7	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	1.3	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	0.0	0.0	0.0
Dry manure	0.0	0.0	0.0
Liquid manure	250.0	45.0	283.0
Other	0.0	0.0	0.0
Atmospheric deposition	7.0		
Nutrients applied	258.3	45.0	283.0
Potential crop nutrient removal	198.0	30.6	149.4
Nutrient balance	60.3	14.4	133.6
Applied to removal ratio	1.30	1.47	1.89

Fresh water applied: 0.99 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: Berry / Corn, silage

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Starter fertilizer at planting *Nutrient source:* Commercial fertilizer *Application method:* Sidedress	1	12.0 100%	30.0 100%	30.0 100%	12.0

NUTRIENT BUDGET FOR CROP (CONTINUED): Berry / Corn, silage

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Pre-irrigation prior to planting (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	1	0.0 0%	0.0 0%	0.0 0%	0.7

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.7	0.0	0.0	8.0
	0.7	0.0	0.0	

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	6	0.0 0%	0.0 0%	0.0 0%	3.0

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.5	0.0	0.0	6.0
	0.5	0.0	0.0	

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (with fertilizer) *Nutrient source:* Retention pond (lagoon) *Application method:* Pipeline	3	110.0 60%	20.0 80%	140.0 80%	331.5

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.5	0.0	0.0	6.0
	0.5	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	5.2	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	12.0	30.0	30.0
Dry manure	0.0	0.0	0.0
Liquid manure	330.0	60.0	420.0
Other	0.0	0.0	0.0
Atmospheric deposition	7.0		
Nutrients applied	354.2	90.0	450.0
Potential crop nutrient removal	256.0	48.0	211.2
Nutrient balance	98.2	42.0	238.8
Applied to removal ratio	1.38	1.88	2.13

Fresh water applied: 3.84 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: Bonzi 1 and 2 / Wheat, silage, soft dough

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)

NUTRIENT BUDGET FOR CROP (CONTINUED): Bonzi 1 and 2 / Wheat, silage, soft dough

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Pre-irrigation prior to planting (with fertilizer) *Nutrient source:* Retention pond (lagoon) *Application method:* Pipeline	1	100.0 60%	20.0 80%	133.0 80%	100.6

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.6	0.0	0.0	24.0
	0.6	0.0	0.0	

In season irrigation (with fertilizer) *Nutrient source:* Retention pond (lagoon) *Application method:* Pipeline	1	150.0 60%	25.0 80%	150.0 80%	150.6

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.6	0.0	0.0	24.0
	0.6	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	1.1	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	0.0	0.0	0.0
Dry manure	0.0	0.0	0.0
Liquid manure	250.0	45.0	283.0
Other	0.0	0.0	0.0
Atmospheric deposition	7.0		
Nutrients applied	258.1	45.0	283.0
Potential crop nutrient removal	198.0	30.6	149.4
Nutrient balance	60.1	14.4	133.6
Applied to removal ratio	1.30	1.47	1.89

Fresh water applied: 0.83 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: Bonzi 1 and 2 / Corn, silage

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Starter fertilizer at planting *Nutrient source:* Commercial fertilizer *Application method:* Sidedress	1	12.0 100%	30.0 100%	30.0 100%	12.0

NUTRIENT BUDGET FOR CROP (CONTINUED): Bonzi 1 and 2 / Corn, silage

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Pre-irrigation prior to planting (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	1	0.0 0%	0.0 0%	0.0 0%	0.6

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.6	0.0	0.0	24.0
	0.6	0.0	0.0	

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	6	0.0 0%	0.0 0%	0.0 0%	2.5

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.4	0.0	0.0	18.0
	0.4	0.0	0.0	

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (with fertilizer) *Nutrient source:* Retention pond (lagoon) *Application method:* Pipeline	3	110.0 60%	20.0 80%	140.0 80%	331.3

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.4	0.0	0.0	18.0
	0.4	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	4.4	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	12.0	30.0	30.0
Dry manure	0.0	0.0	0.0
Liquid manure	330.0	60.0	420.0
Other	0.0	0.0	0.0
Atmospheric deposition	7.0		
Nutrients applied	353.4	90.0	450.0
Potential crop nutrient removal	256.0	48.0	211.2
Nutrient balance	97.4	42.0	238.8
Applied to removal ratio	1.38	1.88	2.13

Fresh water applied: 3.20 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: Briggs / Wheat, silage, soft dough

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)

NUTRIENT BUDGET FOR CROP (CONTINUED): Briggs / Wheat, silage, soft dough

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Pre-irrigation prior to planting (with fertilizer) *Nutrient source:* Retention pond (lagoon) *Application method:* Pipeline	1	100.0 60%	20.0 80%	133.0 80%	100.8

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.8	0.0	0.0	24.0
	0.8	0.0	0.0	

In season irrigation (with fertilizer) *Nutrient source:* Retention pond (lagoon) *Application method:* Pipeline	1	150.0 60%	25.0 80%	150.0 80%	169.4

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
Ag Well 4	19.4	0.0	0.0	24.0
	19.4	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	20.2	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	0.0	0.0	0.0
Dry manure	0.0	0.0	0.0
Liquid manure	250.0	45.0	283.0
Other	0.0	0.0	0.0
Atmospheric deposition	7.0		
Nutrients applied	277.2	45.0	283.0
Potential crop nutrient removal	198.0	30.6	149.4
Nutrient balance	79.2	14.4	133.6
Applied to removal ratio	1.40	1.47	1.89

Fresh water applied: 0.79 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: Briggs / Corn, silage

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Starter fertilizer at planting *Nutrient source:* Commercial fertilizer *Application method:* Sidedress	1	12.0 100%	30.0 100%	30.0 100%	12.0

NUTRIENT BUDGET FOR CROP (CONTINUED): Briggs / Corn, silage

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Pre-irrigation prior to planting (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	1	0.0 0%	0.0 0%	0.0 0%	0.6

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.6	0.0	0.0	18.0
	0.6	0.0	0.0	

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	6	0.0 0%	0.0 0%	0.0 0%	2.5

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.4	0.0	0.0	12.0
	0.4	0.0	0.0	

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (with fertilizer) *Nutrient source:* Retention pond (lagoon) *Application method:* Pipeline	3	110.0 60%	20.0 80%	140.0 80%	331.2

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.4	0.0	0.0	12.0
	0.4	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	4.3	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	12.0	30.0	30.0
Dry manure	0.0	0.0	0.0
Liquid manure	330.0	60.0	420.0
Other	0.0	0.0	0.0
Atmospheric deposition	7.0		
Nutrients applied	353.3	90.0	450.0
Potential crop nutrient removal	256.0	48.0	211.2
Nutrient balance	97.3	42.0	238.8
Applied to removal ratio	1.38	1.88	2.13

Fresh water applied: 3.19 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: Carpenter / Almond, in shell

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)

NUTRIENT BUDGET FOR CROP (CONTINUED): Carpenter / Almond, in shell

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Dry manure *Nutrient source:* From dairy *Application method:* Broadcast/incorporate	1	120.0 50%	25.0 50%	150.0 50%	120.0
In season irrigation (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	8	0.0 0%	0.0 0%	0.0 0%	4.3

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.5	0.0	0.0	10.0
	0.5	0.0	0.0	

In season irrigation (with fertilizer) *Nutrient source:* Commercial fertilizer *Application method:* Pipeline	2	50.0 100%	0.0 100%	0.0 100%	101.1

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.5	0.0	0.0	10.0
	0.5	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	5.4	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	100.0	0.0	0.0
Dry manure	120.0	25.0	150.0
Liquid manure	0.0	0.0	0.0
Other	0.0	0.0	0.0
Atmospheric deposition	14.0		
Nutrients applied	239.4	25.0	150.0
Potential crop nutrient removal	195.0	30.0	148.5
Nutrient balance	44.4	-5.0	1.5
Applied to removal ratio	1.23	0.83	1.01

Fresh water applied: 4.00 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: Church / Almond, in shell

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Dry manure *Nutrient source:* From dairy *Application method:* Broadcast/incorporate	1	120.0 50%	25.0 50%	150.0 50%	120.0

NUTRIENT BUDGET FOR CROP (CONTINUED): Church / Almond, in shell

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	6	0.0 0%	0.0 0%	0.0 0%	3.6

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.6	0.0	0.0	6.0
	0.6	0.0	0.0	

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (with fertilizer) *Nutrient source:* Commercial fertilizer *Application method:* Pipeline	2	50.0 100%	0.0 100%	0.0 100%	101.2

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.6	0.0	0.0	6.0
	0.6	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	4.8	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	100.0	0.0	0.0
Dry manure	120.0	25.0	150.0
Liquid manure	0.0	0.0	0.0
Other	0.0	0.0	0.0
Atmospheric deposition	14.0		
Nutrients applied	238.8	25.0	150.0
Potential crop nutrient removal	195.0	30.0	148.5
Nutrient balance	43.8	-5.0	1.5
Applied to removal ratio	1.22	0.83	1.01

Fresh water applied: 3.50 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: Clark / Almond, in shell

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Dry manure *Nutrient source:* From dairy *Application method:* Broadcast/incorporate	1	125.0 50%	25.0 50%	150.0 50%	125.0

NUTRIENT BUDGET FOR CROP (CONTINUED): Clark / Almond, in shell

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	8	0.0 0%	0.0 0%	0.0 0%	4.2

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.5	0.0	0.0	24.0
	0.5	0.0	0.0	

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (with fertilizer) *Nutrient source:* Commercial fertilizer *Application method:* Pipeline	2	50.0 100%	0.0 100%	0.0 100%	101.1

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.5	0.0	0.0	24.0
	0.5	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	5.3	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	100.0	0.0	0.0
Dry manure	125.0	25.0	150.0
Liquid manure	0.0	0.0	0.0
Other	0.0	0.0	0.0
Atmospheric deposition	14.0		
Nutrients applied	244.3	25.0	150.0
Potential crop nutrient removal	195.0	30.0	148.5
Nutrient balance	49.3	-5.0	1.5
Applied to removal ratio	1.25	0.83	1.01

Fresh water applied: 3.86 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: Inderbitzen / Wheat, silage, soft dough

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Pre-irrigation prior to planting (with fertilizer) *Nutrient source:* Retention pond (lagoon) *Application method:* Pipeline	1	100.0 60%	20.0 80%	133.0 80%	100.7

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.7	0.0	0.0	16.0
	0.7	0.0	0.0	

NUTRIENT BUDGET FOR CROP (CONTINUED): Inderbitzen / Wheat, silage, soft dough

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (with fertilizer) *Nutrient source:* Retention pond (lagoon) *Application method:* Pipeline	1	150.0 60%	25.0 80%	150.0 80%	169.6

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
Ag Well 2	19.6	0.0	0.0	20.0
	19.6	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	20.4	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	0.0	0.0	0.0
Dry manure	0.0	0.0	0.0
Liquid manure	250.0	45.0	283.0
Other	0.0	0.0	0.0
Atmospheric deposition	7.0		
Nutrients applied	277.4	45.0	283.0
Potential crop nutrient removal	198.0	30.6	149.4
Nutrient balance	79.4	14.4	133.6
Applied to removal ratio	1.40	1.47	1.89

Fresh water applied: 0.83 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: Inderbitzen / Corn, silage

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Starter fertilizer at planting *Nutrient source:* Commercial fertilizer *Application method:* Sidedress	1	12.0 100%	30.0 100%	30.0 100%	12.0
Pre-irrigation prior to planting (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	1	0.0 0%	0.0 0%	0.0 0%	0.7

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.7	0.0	0.0	16.0
	0.7	0.0	0.0	

NUTRIENT BUDGET FOR CROP (CONTINUED): Inderbitzen / Corn, silage

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	6	0.0 0%	0.0 0%	0.0 0%	2.7

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.5	0.0	0.0	10.0
	0.5	0.0	0.0	

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (with fertilizer) *Nutrient source:* Commercial fertilizer *Application method:* Pipeline	3	110.0 60%	20.0 80%	140.0 80%	331.4

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.5	0.0	0.0	10.0
	0.5	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	4.8	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	342.0	90.0	450.0
Dry manure	0.0	0.0	0.0
Liquid manure	0.0	0.0	0.0
Other	0.0	0.0	0.0
Atmospheric deposition	7.0		
Nutrients applied	353.8	90.0	450.0
Potential crop nutrient removal	256.0	48.0	211.2
Nutrient balance	97.8	42.0	238.8
Applied to removal ratio	1.38	1.88	2.13

Fresh water applied: 3.55 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: JR's Home / Almond, in shell

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Dry manure *Nutrient source:* From dairy *Application method:* Broadcast/incorporate	1	120.0 50%	25.0 50%	150.0 50%	120.0

NUTRIENT BUDGET FOR CROP (CONTINUED): JR's Home / Almond, in shell

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	8	0.0 0%	0.0 0%	0.0 0%	3.6

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.4	0.0	0.0	4.0
	0.4	0.0	0.0	

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (with fertilizer) *Nutrient source:* Commercial fertilizer *Application method:* Pipeline	2	50.0 100%	0.0 100%	0.0 100%	100.9

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.4	0.0	0.0	4.0
	0.4	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	4.5	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	100.0	0.0	0.0
Dry manure	120.0	25.0	150.0
Liquid manure	0.0	0.0	0.0
Other	0.0	0.0	0.0
Atmospheric deposition	14.0		
Nutrients applied	238.5	25.0	150.0
Potential crop nutrient removal	195.0	30.0	148.5
Nutrient balance	43.5	-5.0	1.5
Applied to removal ratio	1.22	0.83	1.01

Fresh water applied: 3.31 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: Marchant / Almond, in shell

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Dry manure *Nutrient source:* From dairy *Application method:* Broadcast/incorporate	1	120.0 50%	25.0 50%	150.0 50%	120.0

NUTRIENT BUDGET FOR CROP (CONTINUED): Marchant / Almond, in shell

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	8	0.0 0%	0.0 0%	0.0 0%	3.4

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.4	0.0	0.0	10.0
	0.4	0.0	0.0	

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (with fertilizer) *Nutrient source:* Commercial fertilizer *Application method:* Pipeline	2	50.0 100%	0.0 100%	0.0 100%	100.8

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.4	0.0	0.0	10.0
	0.4	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	4.2	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	100.0	0.0	0.0
Dry manure	120.0	25.0	150.0
Liquid manure	0.0	0.0	0.0
Other	0.0	0.0	0.0
Atmospheric deposition	14.0		
Nutrients applied	238.2	25.0	150.0
Potential crop nutrient removal	195.0	30.0	148.5
Nutrient balance	43.2	-5.0	1.5
Applied to removal ratio	1.22	0.83	1.01

Fresh water applied: 3.10 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: Moores / Wheat, silage, soft dough

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Pre-irrigation prior to planting (with fertilizer) *Nutrient source:* Retention pond (lagoon) *Application method:* Pipeline	1	100.0 60%	20.0 80%	133.0 80%	100.5

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.5	0.0	0.0	48.0
	0.5	0.0	0.0	

NUTRIENT BUDGET FOR CROP (CONTINUED): Moores / Wheat, silage, soft dough

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (with fertilizer) *Nutrient source:* Retention pond (lagoon) *Application method:* Pipeline	1	150.0 60%	25.0 80%	150.0 80%	170.6

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
Ag Well 2	20.6	0.0	0.0	84.0
	20.6	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	21.2	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	0.0	0.0	0.0
Dry manure	0.0	0.0	0.0
Liquid manure	250.0	45.0	283.0
Other	0.0	0.0	0.0
Atmospheric deposition	7.0		
Nutrients applied	278.2	45.0	283.0
Potential crop nutrient removal	198.0	30.6	149.4
Nutrient balance	80.2	14.4	133.6
Applied to removal ratio	1.40	1.47	1.89

Fresh water applied: 0.72 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: Moores / Corn, silage

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Starter fertilizer at planting *Nutrient source:* Commercial fertilizer *Application method:* Sidedress	1	12.0 100%	30.0 100%	30.0 100%	12.0
Pre-irrigation prior to planting (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	1	0.0 0%	0.0 0%	0.0 0%	0.5

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.5	0.0	0.0	48.0
	0.5	0.0	0.0	

NUTRIENT BUDGET FOR CROP (CONTINUED): Moores / Corn, silage

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	6	0.0 0%	0.0 0%	0.0 0%	2.5

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.4	0.0	0.0	36.0
	0.4	0.0	0.0	

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (with fertilizer) *Nutrient source:* Commercial fertilizer *Application method:* Pipeline	3	110.0 60%	20.0 80%	140.0 80%	331.2

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.4	0.0	0.0	36.0
	0.4	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	4.2	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	342.0	90.0	450.0
Dry manure	0.0	0.0	0.0
Liquid manure	0.0	0.0	0.0
Other	0.0	0.0	0.0
Atmospheric deposition	7.0		
Nutrients applied	353.2	90.0	450.0
Potential crop nutrient removal	256.0	48.0	211.2
Nutrient balance	97.2	42.0	238.8
Applied to removal ratio	1.38	1.88	2.13

Fresh water applied: 3.12 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: Nelson 1 and 2 / Wheat, silage, soft dough

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Pre-irrigation prior to planting (with fertilizer) *Nutrient source:* Retention pond (lagoon) *Application method:* Pipeline	1	100.0 60%	20.0 80%	133.0 80%	100.7

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.7	0.0	0.0	12.0
	0.7	0.0	0.0	

NUTRIENT BUDGET FOR CROP (CONTINUED): Nelson 1 and 2 / Wheat, silage, soft dough

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (with fertilizer) *Nutrient source:* Retention pond (lagoon) *Application method:* Pipeline	1	150.0 60%	25.0 80%	150.0 80%	170.1

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
Ag Well 2	20.1	0.0	0.0	16.0
	20.1	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	20.8	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	0.0	0.0	0.0
Dry manure	0.0	0.0	0.0
Liquid manure	250.0	45.0	283.0
Other	0.0	0.0	0.0
Atmospheric deposition	7.0		
Nutrients applied	277.8	45.0	283.0
Potential crop nutrient removal	198.0	30.6	149.4
Nutrient balance	79.8	14.4	133.6
Applied to removal ratio	1.40	1.47	1.89

Fresh water applied: 0.82 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: Nelson 1 and 2 / Corn, silage

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Starter fertilizer at planting *Nutrient source:* Commercial fertilizer *Application method:* Sidedress	1	12.0 100%	30.0 100%	30.0 100%	12.0
Pre-irrigation prior to planting (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	1	0.0 0%	0.0 0%	0.0 0%	0.7

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.7	0.0	0.0	12.0
	0.7	0.0	0.0	

NUTRIENT BUDGET FOR CROP (CONTINUED): Nelson 1 and 2 / Corn, silage

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	6	0.0 0%	0.0 0%	0.0 0%	2.8

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.5	0.0	0.0	8.0
	0.5	0.0	0.0	

In season irrigation (with fertilizer) *Nutrient source:* Commercial fertilizer *Application method:* Pipeline	1	32.0 100%	0.0 100%	0.0 100%	32.0
In season irrigation (with fertilizer) *Nutrient source:* Commercial fertilizer *Application method:* Pipeline	3	100.0 60%	15.0 80%	125.0 80%	301.4

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.5	0.0	0.0	8.0
	0.5	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	4.9	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	344.0	75.0	405.0
Dry manure	0.0	0.0	0.0
Liquid manure	0.0	0.0	0.0
Other	0.0	0.0	0.0
Atmospheric deposition	7.0		
Nutrients applied	355.9	75.0	405.0
Potential crop nutrient removal	256.0	48.0	211.2
Nutrient balance	99.9	27.0	193.8
Applied to removal ratio	1.39	1.56	1.92

Fresh water applied: 3.59 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: Perrys / Almond, in shell

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Dry manure *Nutrient source:* From dairy *Application method:* Broadcast/incorporate	1	120.0 50%	25.0 50%	150.0 50%	120.0

NUTRIENT BUDGET FOR CROP (CONTINUED): Perrys / Almond, in shell

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	8	0.0 0%	0.0 0%	0.0 0%	4.0

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.5	0.0	0.0	1.5
	0.5	0.0	0.0	

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (with fertilizer) *Nutrient source:* Commercial fertilizer *Application method:* Pipeline	2	50.0 100%	0.0 100%	0.0 100%	101.0

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.5	0.0	0.0	1.5
	0.5	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	5.1	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	100.0	0.0	0.0
Dry manure	120.0	25.0	150.0
Liquid manure	0.0	0.0	0.0
Other	0.0	0.0	0.0
Atmospheric deposition	14.0		
Nutrients applied	239.1	25.0	150.0
Potential crop nutrient removal	195.0	30.0	148.5
Nutrient balance	44.1	-5.0	1.5
Applied to removal ratio	1.23	0.83	1.01

Fresh water applied: 3.72 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: T&R Jones 1 / Wheat, silage, soft dough

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Dry manure *Nutrient source:* From dairy *Application method:* Broadcast/incorporate	1	240.0 50%	50.0 50%	300.0 50%	240.0

NUTRIENT BUDGET FOR CROP (CONTINUED): T&R Jones 1 / Wheat, silage, soft dough

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Pre-irrigation prior to planting (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	1	0.0 0%	0.0 0%	0.0 0%	0.5

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.5	0.0	0.0	24.0
	0.5	0.0	0.0	

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	1	0.0 0%	0.0 0%	0.0 0%	0.5

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.5	0.0	0.0	24.0
	0.5	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	1.0	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	0.0	0.0	0.0
Dry manure	240.0	50.0	300.0
Liquid manure	0.0	0.0	0.0
Other	0.0	0.0	0.0
Atmospheric deposition	7.0		
Nutrients applied	248.0	50.0	300.0
Potential crop nutrient removal	198.0	30.6	149.4
Nutrient balance	50.0	19.4	150.6
Applied to removal ratio	1.25	1.63	2.01

Fresh water applied: 0.74 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: T&R Jones 1 / Corn, silage

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Dry manure *Nutrient source:* From dairy *Application method:* Broadcast/incorporate	1	240.0 50%	50.0 50%	300.0 50%	240.0
Starter fertilizer at planting *Nutrient source:* Commercial fertilizer *Application method:* Sidedress	1	12.0 100%	30.0 100%	30.0 100%	12.0

NUTRIENT BUDGET FOR CROP (CONTINUED): T&R Jones 1 / Corn, silage

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Pre-irrigation prior to planting (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	1	0.0 0%	0.0 0%	0.0 0%	0.8

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.8	0.0	0.0	36.0
	0.8	0.0	0.0	

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	5	0.0 0%	0.0 0%	0.0 0%	2.5

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.5	0.0	0.0	24.0
	0.5	0.0	0.0	

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (with fertilizer) *Nutrient source:* Commercial fertilizer *Application method:* Pipeline	3	30.0 100%	0.0 100%	0.0 100%	91.5

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.5	0.0	0.0	24.0
	0.5	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	4.8	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	102.0	30.0	30.0
Dry manure	240.0	50.0	300.0
Liquid manure	0.0	0.0	0.0
Other	0.0	0.0	0.0
Atmospheric deposition	7.0		
Nutrients applied	353.8	80.0	330.0
Potential crop nutrient removal	256.0	48.0	211.2
Nutrient balance	97.8	32.0	118.8
Applied to removal ratio	1.38	1.67	1.56

Fresh water applied: 3.53 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: T&R Jones 2 / Wheat, silage, soft dough

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)

NUTRIENT BUDGET FOR CROP (CONTINUED): T&R Jones 2 / Wheat, silage, soft dough

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Dry manure	1	240.0	50.0	300.0	240.0
Nutrient source: From dairy		50%	50%	50%	
Application method: Broadcast/incorporate					
Pre-irrigation prior to planting (no fertilizer)	1	0.0	0.0	0.0	0.5
Nutrient source: Water only		0%	0%	0%	
Application method: Surface					

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.5	0.0	0.0	24.0
	0.5	0.0	0.0	

In season irrigation (no fertilizer)		1	0.0	0.0	0.5
Nutrient source: Water only			0%	0%	0%
Application method: Surface					

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.5	0.0	0.0	24.0
	0.5	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	1.1	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	0.0	0.0	0.0
Dry manure	240.0	50.0	300.0
Liquid manure	0.0	0.0	0.0
Other	0.0	0.0	0.0
Atmospheric deposition	7.0		
Nutrients applied	248.1	50.0	300.0
Potential crop nutrient removal	198.0	30.6	149.4
Nutrient balance	50.1	19.4	150.6
Applied to removal ratio	1.25	1.63	2.01

Fresh water applied: 0.79 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: T&R Jones 2 / Corn, silage

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Dry manure	1	240.0	50.0	300.0	240.0
Nutrient source: From dairy		50%	50%	50%	
Application method: Broadcast/incorporate					

NUTRIENT BUDGET FOR CROP (CONTINUED): T&R Jones 2 / Corn, silage

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Starter fertilizer at planting	1	12.0	30.0	30.0	12.0
Nutrient source: Commercial fertilizer		100%	100%	100%	
Application method: Sidedress					
Pre-irrigation prior to planting (no fertilizer)	1	0.0	0.0	0.0	0.8
Nutrient source: Water only		0%	0%	0%	
Application method: Surface					

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.8	0.0	0.0	36.0
	0.8	0.0	0.0	

In season irrigation (no fertilizer)	5	0.0	0.0	0.0	2.7
Nutrient source: Water only		0%	0%	0%	
Application method: Surface					

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.5	0.0	0.0	24.0
	0.5	0.0	0.0	

In season irrigation (with fertilizer)	3	30.0	0.0	0.0	91.6
Nutrient source: Commercial fertilizer		100%	100%	100%	
Application method: Pipeline					

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.5	0.0	0.0	24.0
	0.5	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	5.1	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	102.0	30.0	30.0
Dry manure	240.0	50.0	300.0
Liquid manure	0.0	0.0	0.0
Other	0.0	0.0	0.0
Atmospheric deposition	7.0		
Nutrients applied	354.1	80.0	330.0
Potential crop nutrient removal	256.0	48.0	211.2
Nutrient balance	98.1	32.0	118.8
Applied to removal ratio	1.38	1.67	1.56

Fresh water applied: 3.77 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: TD 5-6 / Almond, in shell

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Dry manure	1	125.0	25.0	150.0	125.0
Nutrient source: From dairy		50%	50%	50%	
Application method: Broadcast/incorporate					
In season irrigation (no fertilizer)	8	0.0	0.0	0.0	3.5
Nutrient source: Water only		0%	0%	0%	
Application method: Surface					

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.4	0.0	0.0	36.0
	0.4	0.0	0.0	

In season irrigation (with fertilizer)		2	50.0	0.0	0.0	100.9
Nutrient source: Commercial fertilizer			100%	100%	100%	
Application method: Pipeline						

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.4	0.0	0.0	36.0
	0.4	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	4.4	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	100.0	0.0	0.0
Dry manure	125.0	25.0	150.0
Liquid manure	0.0	0.0	0.0
Other	0.0	0.0	0.0
Atmospheric deposition	14.0		
Nutrients applied	243.4	25.0	150.0
Potential crop nutrient removal	195.0	30.0	148.5
Nutrient balance	48.4	-5.0	1.5
Applied to removal ratio	1.25	0.83	1.01

Fresh water applied: 3.26 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: TD-1-4 / Wheat, silage, soft dough

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)

NUTRIENT BUDGET FOR CROP (CONTINUED): TD-1-4 / Wheat, silage, soft dough

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Pre-irrigation prior to planting (with fertilizer) *Nutrient source:* Retention pond (lagoon) *Application method:* Pipeline	1	100.0 60%	20.0 80%	133.0 80%	100.7

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.7	0.0	0.0	60.0
	0.7	0.0	0.0	

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (with fertilizer) *Nutrient source:* Retention pond (lagoon) *Application method:* Pipeline	1	150.0 60%	25.0 80%	150.0 80%	169.5

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
Ag Well 3	19.5	0.0	0.0	84.0
	19.5	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	20.1	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	0.0	0.0	0.0
Dry manure	0.0	0.0	0.0
Liquid manure	250.0	45.0	283.0
Other	0.0	0.0	0.0
Atmospheric deposition	7.0		
Nutrients applied	277.1	45.0	283.0
Potential crop nutrient removal	198.0	30.6	149.4
Nutrient balance	79.1	14.4	133.6
Applied to removal ratio	1.40	1.47	1.89

Fresh water applied: 0.65 *feet* Total harvests: 1

NUTRIENT BUDGET FOR CROP: TD-1-4 / Corn, silage

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Starter fertilizer at planting *Nutrient source:* Commercial fertilizer *Application method:* Sidedress	1	12.0 100%	30.0 100%	30.0 100%	12.0

NUTRIENT BUDGET FOR CROP (CONTINUED): TD-1-4 / Corn, silage

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
Pre-irrigation prior to planting (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	1	0.0 0%	0.0 0%	0.0 0%	0.5

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.5	0.0	0.0	48.0
	0.5	0.0	0.0	

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (no fertilizer) *Nutrient source:* Water only *Application method:* Surface	6	0.0 0%	0.0 0%	0.0 0%	2.4

Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.4	0.0	0.0	36.0
	0.4	0.0	0.0	

Activity / Event	# of Events	N (lbs/acre) % avail.	P (lbs/acre) % avail.	K (lbs/acre) % avail.	Total N (lbs/acre)
In season irrigation (with fertilizer) *Nutrient source:* Commercial fertilizer *Application method:* Pipeline	3	110.0 60%	20.0 80%	140.0 80%	331.2

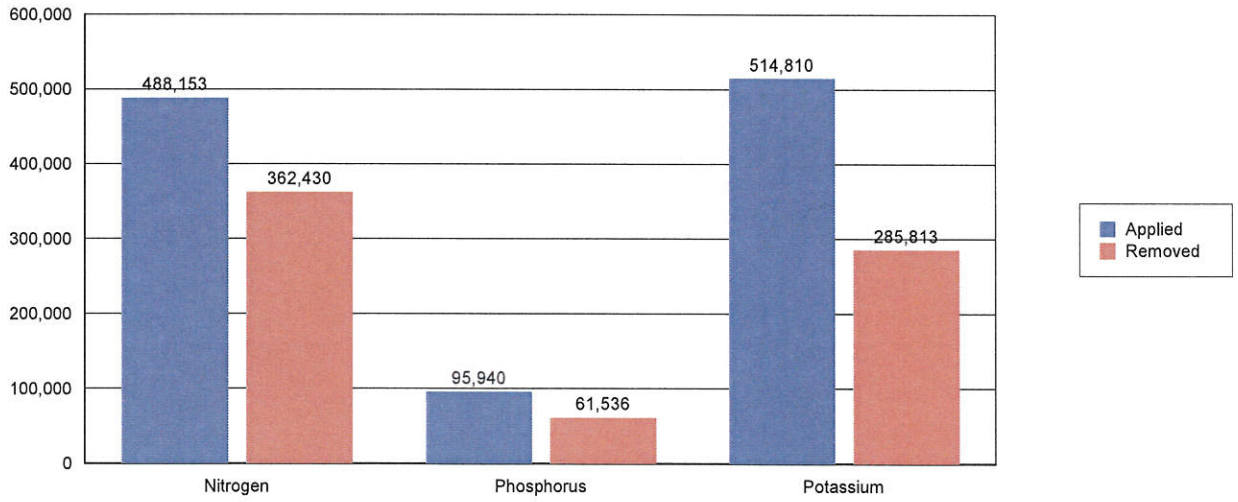
Irrigation Source	N (lbs/acre)	P (lbs/acre)	K (lbs/acre)	Runtime (hrs)
TID Canal	0.4	0.0	0.0	36.0
	0.4	0.0	0.0	

	Total N (lbs/acre)	Total P (lbs/acre)	Total K (lbs/acre)
Irrigation sources	4.2	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	342.0	90.0	450.0
Dry manure	0.0	0.0	0.0
Liquid manure	0.0	0.0	0.0
Other	0.0	0.0	0.0
Atmospheric deposition	7.0		
Nutrients applied	353.2	90.0	450.0
Potential crop nutrient removal	256.0	48.0	211.2
Nutrient balance	97.2	42.0	238.8
Applied to removal ratio	1.38	1.88	2.13

Fresh water applied: 3.07 *feet* Total harvests: 1

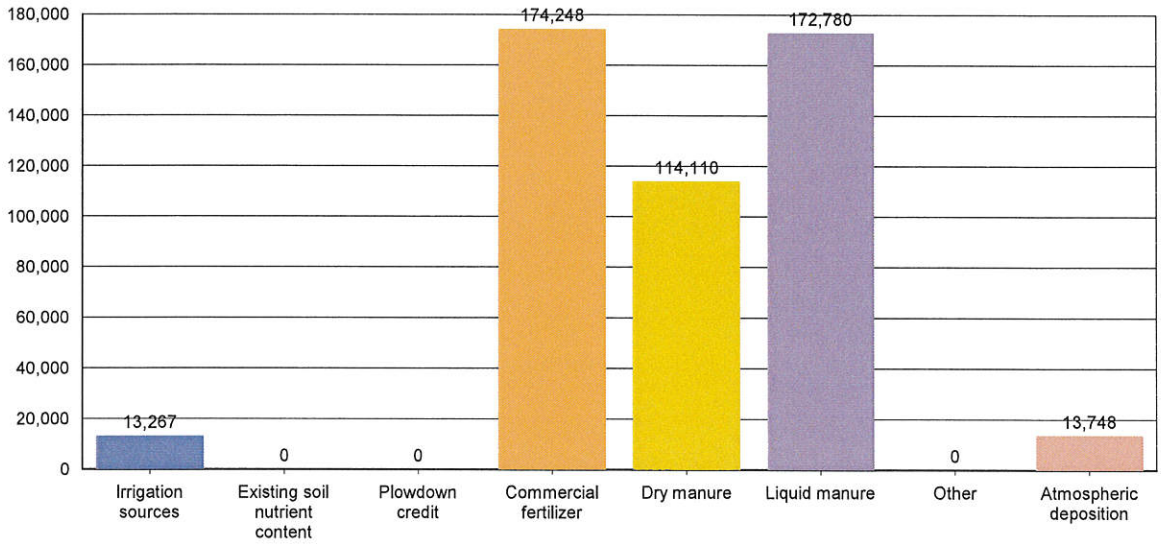
NUTRIENT APPLICATIONS, POTENTIAL REMOVAL, AND BALANCE

A. POUNDS OF NUTRIENT APPLIED VS. CROP REMOVAL POTENTIAL



	Total N (lbs)	Total P (lbs)	Total K (lbs)
Irrigation sources	13,266.9	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	174,248.0	41,205.0	171,375.0
Dry manure	114,110.0	23,550.0	141,300.0
Liquid manure	172,780.0	31,185.0	202,135.0
Other	0.0	0.0	0.0
Atmospheric deposition	13,748.0		
Nutrients applied to all crops	488,152.9	95,940.0	514,810.0
Potential crop nutrient removal	362,430.0	61,536.0	285,813.0
Nutrient balance	125,722.9	34,404.0	228,997.0
Applied to removal ratio	1.35	1.56	1.80

B. POUNDS OF NITROGEN APPLIED BY NUTRIENT SOURCE



	Total N (lbs)	Total P (lbs)	Total K (lbs)
Irrigation sources	13,266.9	0.0	0.0
Existing soil nutrient content	0.0	0.0	0.0
Plowdown credit	0.0	0.0	0.0
Commercial fertilizer	174,248.0	41,205.0	171,375.0
Dry manure	114,110.0	23,550.0	141,300.0
Liquid manure	172,780.0	31,185.0	202,135.0
Other	0.0	0.0	0.0
Atmospheric deposition	13,748.0		
Nutrients applied to all crops	488,152.9	95,940.0	514,810.0
Potential crop nutrient removal	362,430.0	61,536.0	285,813.0
Nutrient balance	125,722.9	34,404.0	228,997.0
Applied to removal ratio	1.35	1.56	1.80

NUTRIENT BALANCE

A. WHOLE FARM BALANCE

	Total N (lbs)	Total P (lbs)	Total K (lbs)
Nutrients in storage from herd*			
Daily gross	3,477.0	562.4	1,679.9
Annual gross	1,269,097.4	205,265.6	613,177.9
Net to pond storage after ammonia losses (30% loss applied)	791,546.9	184,143.8	562,079.7
Net to drylot storage after ammonia losses (30% loss applied)	96,821.3	21,121.8	51,098.2
Net in storage (30% loss applied)	888,368.2	205,265.6	613,177.9
Irrigation sources	13,266.9	0.0	0.0
Atmospheric deposition	13,748.0		
Imports	52,587.4	7,159.6	13,598.4
Exports	459,900.0	58,853.4	292,077.0
Potential crop nutrient removal	362,430.0	61,536.0	285,813.0
Nutrient balance	145,640.4	92,035.8	48,886.2
Nutrient balance ratio	1.40	2.50	1.17

* Potassium excretion from milk cows and dry cows only.

SAMPLING AND ANALYSIS PLAN

A. MANURE SAMPLING AND ANALYSIS PLAN

			Minimum data collection requirements	
Frequency	Sampling Methods	Source	Field Analytes	Lab Analytes
Annually	Annual estimation for total manure dry weight applied to each field will be quantified using the following: Dry weight applied from a source to a crop per application event = weight applied * (1 - (percent moisture / 100)) Dry weight applied to crop per application event = sum of dry weights applied from each source Dry weight applied to a crop = sum of dry weights applied during each application Dry weight applied to a field = sum of dry weights applied to each crop Annual estimation for total manure dry weight exported will be quantified using the following: Dry weight exported from a source per event = weight exported * (1 - (percent moisture / 100)) Dry weight exported per event = sum of dry weights exported from each source Dry weight exported to any offsite destination = sum of dry weights exported per event	Corral solids Separated solids	Total dry weight (tons) manure applied annually to each land application area, and total dry weight (tons) manure exported offsite annually	None required

A. MANURE SAMPLING AND ANALYSIS PLAN (CONTINUED)

			Minimum data collection requirements	
Frequency	Sampling Methods	Source	Field Analytes	Lab Analytes
Twice per year	For each manure source, a composite sample per the "Approved Sampling Procedures for Nutrient and Groundwater Monitoring at Existing Milk Cow Dairies" will be collected.	Corral solids Separated solids	None required	Total nitrogen, total phosphorus, total potassium, and percent moisture
Once every two years (biennially)	For each manure source, a composite sample per the "Approved Sampling Procedures for Nutrient and Groundwater Monitoring at Existing Milk Cow Dairies" will be collected.	Corral solids Separated solids	None required	General minerals, including: calcium, magnesium, sodium, sulfate, chloride Fixed solids (ash)
Each application to each land application area	For each applied manure source, a composite sample per the "Approved Sampling Procedures for Nutrient and Groundwater Monitoring at Existing Milk Cow Dairies" will be collected. For each applied manure source, a scaled weight by truckload will be recorded.	Corral solids Separated solids	Date applied and total weight (tons) applied	Percent moisture

A. MANURE SAMPLING AND ANALYSIS PLAN (CONTINUED)

Frequency	Sampling Methods	Source	Minimum data collection requirements	
			Field Analytes	Lab Analytes
Each offsite export of manure	For each manure source exported, a composite sample "Approved Sampling Procedures for Nutrient and Groundwater Monitoring at Existing Milk Cow Dairies" will be collected. For each manure source exported, a scaled weight by truckload will be recorded.	Corral solids Separated solids	Date exported and total weight (tons) exported	Percent moisture

B. PROCESS WASTEWATER SAMPLING AND ANALYSIS PLAN

Frequency	Sampling Methods	Source	Minimum data collection requirements	
			Field Analytes	Lab Analytes
Anually	A composite or grab sample prior to blending with irrigation water per the "Approved Sampling Procedures for Nutrient and Groundwater Monitoring at Existing Milk Cow Dairies" will be collected.	WWS 1 WWS 2	None required	pH, total dissolved solids, electrical conductivity, nitrate-nitrogen, ammonion-nitrogen, total Kjeldahl nitrogen, total phosphorus, and total potassium
Once every two years (biennially)	For each pond, a composite or grab sample per the "Approved Sampling Procedures for Nutrient and Groundwater Monitoring at Existing Milk Cow Dairies" will be collected.	WWS 1 WWS 2	None required	General minerals, including: calcium, magnesium, sodium, bicarbonate, carbonate, sulfate, and chloride

B. PROCESS WASTEWATER SAMPLING AND ANALYSIS PLAN (CONTINUED)

			Minimum data collection requirements	
Frequency	Sampling Methods	Source	Field Analytes	Lab Analytes
Each application	For each pond, a composite or grab sample per the "Approved Sampling Procedures for Nutrient and Groundwater Monitoring at Existing Milk Cow Dairies" will be collected.	WWS 1 WWS 2	Date applied and volume (gallons or acre-inches) applied	None required
Quarterly during one application event	For field measurement: For each pond, a composite or grab sample per the "Approved Sampling Procedures for Nutrient and Groundwater Monitoring at Existing Milk Cow Dairies" will be collected. For laboratory analyses: For each pond, a composite or grab sample per the "Approved Sampling Procedures for Nutrient and Groundwater Monitoring at Existing Milk Cow Dairies" will be collected.	WWS 1 WWS 2	Date applied and electrical conductivity	Nitrate-nitrogen (only when pond is aerated), un-ionized ammonia-nitrogen, total Kjeldahl nitrogen, total phosphorus, total potassium, and total dissolved solids

C. SOIL SAMPLING AND ANALYSIS PLAN

			Minimum data collection requirements	
Frequency	Sampling Methods	Source	Field Analytes	Lab Analytes

C. SOIL SAMPLING AND ANALYSIS PLAN (CONTINUED)

Frequency	Sampling Methods	Source	Minimum data collection requirements	
			Field Analytes	Lab Analytes
Once every five years for each land application area (may be distributed over a 5-year period by sampling 20% of the land application areas annually)	For each field, a composite sample per the "Approved Sampling Procedures for Nutrient and Groundwater Monitoring at Existing Milk Cow Dairies" will be collected.	TD 1-4 - 150 acres Inderbitzen - 37 acres Nelson 1&2 - 29 acres Berry - 20 acres Briggs - 49 acres Bonzi 1&2 - 72 acres Jr.'s Home - 15 acres Moores - 148 acres T&R Jones 1 - 80 acres T&R Jones 2 - 75 acres TD 5&6 - 137 acres Clarks - 77 acres Carpenter - 31 acres Perry - 5 acres Church - 17 acres Marchant - 40 acres	None required	Soluble phosphorus
Spring pre-plant for each crop	For each field, a composite sample per the "Approved Sampling Procedures for Nutrient and Groundwater Monitoring at Existing Milk Cow Dairies" will be collected.	TD 1-4 - 150 acres Inderbitzen - 37 acres Nelson 1&2 - 29 acres Berry - 20 acres Briggs - 49 acres Bonzi 1&2 - 72 acres Moores - 148 acres T&R Jones 1 - 80 acres T&R Jones 2 - 75 acres	None required	0 to 1 foot: Nitrate-nitrogen and organic matter 1 to 2 foot: Nitrate-nitrogen

D. PLANT TISSUE SAMPLING AND ANALYSIS PLAN

Frequency	Sampling Methods	Source	Minimum data collection requirements	
			Field Analytes	Lab Analytes

D. PLANT TISSUE SAMPLING AND ANALYSIS PLAN (CONTINUED)

			Minimum data collection requirements	
Frequency	Sampling Methods	Source	Field Analytes	Lab Analytes
Each crop harvest from each land application area	For each field and crop, a composite sample per the "Approved Sampling Procedures for Nutrient and Groundwater Monitoring at Existing Milk Cow Dairies" will be collected. For each field and crop, a scaled weight by truckload will be recorded.	TD 1-4 - Wheat/Corn Inderbitzen - Wheat/Corn Nelson 1&2 - Wheat/Corn Berry - Wheat/Corn Briggs - Wheat/Corn Bonzi 1&2 - Wheat/Corn Jr.'s Home - Almonds Moores - Wheat/Corn/Alfalfa T&R Jones 1 - Wheat/Corn T&R Jones 2 - Wheat/Corn TD 5&6 - Almonds Clarks - Almonds Carpenter - Almonds Perry - Almonds Church - Almonds Marchant - Almonds	Date harvested and total weight (tons) of harvested material removed from each land application area	Percent wet weight of harvested plant removed Laboratory analyses for total nitrogen, total phosphorus, total potassium (expressed on a dry weight basis), fixed solids (ash), and percent moisture

E. IRRIGATION WATER SAMPLING AND ANALYSIS PLAN

			Minimum data collection requirements	
Frequency	Sampling Methods	Source	Field Analytes	Lab Analytes
Each fresh water irrigation event for each land application area	Ag Well 1 - flow rate multiplied by runtime Ag Well 1 - flow rate multiplied by runtime Ag Well 2 - flow rate multiplied by runtime Ag Well 3 - flow rate multiplied by runtime Ag Well 4 - flow rate multiplied by runtime Ag Well 5 - flow rate multiplied by runtime TID Canal - flow rate multiplied by runtime	Ag Well 1 Ag Well 2 Ag Well 3 Ag Well 4 Ag Well 5 TID canal	Date applied and volume (gallons or acre-inches) applied	None required

E. IRRIGATION WATER SAMPLING AND ANALYSIS PLAN (CONTINUED)

			Minimum data collection requirements	
Frequency	Sampling Methods	Source	Field Analytes	Lab Analytes
One irrigation event during each irrigation season during actual irrigation events – for each irrigation water source (well and canal)	For each irrigation source, a grab sample per the "Approved Sampling Procedures for Nutrient and Groundwater Monitoring at Existing Milk Cow Dairies" will be collected. In lieu of sampling the irrigation water, the Discharger may provide equivalent data from the local irrigation district.	Ag Well 1 Ag Well 2 Ag Well 3 Ag Well 4 Ag Well 5 TID canal	None required	Electrical conductivity, total dissolved solids, and total nitrogen

F. GROUNDWATER MONITORING SAMPLING AND ANALYSIS PLAN

			Minimum data collection requirements	
Frequency	Sampling Methods	Source	Field Analytes	Lab Analytes
Every five years (may be distributed over a 5-year period by sampling 20% of the wells annually)	For each domestic and agricultural supply well, a grab sample per the "Approved Sampling Procedures for Nutrient and Groundwater Monitoring at Existing Milk Cow Dairies" will be collected.	All domestic and agricultural irrigation wells	None required	General minerals, including: calcium, magnesium, sodium, bicarbonate, carbonate, sulfate, chloride Total dissolved solids
Annually	For each domestic and agricultural supply well, a grab sample per the "Approved Sampling Procedures for Nutrient and Groundwater Monitoring at Existing Milk Cow Dairies" will be collected.	All domestic and agricultural irrigation wells	Electrical conductivity and ammonion-nitrogen	Nitrate-nitrogen. If field measurement indicates the presence of ammonium-nitrogen, the Discharger shall collect a sample for laboratory analysis of ammonium-nitrogen.

NUTRIENT MANAGEMENT PLAN REVIEW

A. NUTRIENT MANAGEMENT PLAN REVIEW

Person who created the NMP:	Ramos, Joe	*See above for contact information.*
Date the NMP was drafted:	01/01/2015	
Person who approved the final NMP:	Ramos, Joe	*See above for contact information.*
Date of NMP implementation:	01/01/2015	

ATTACHED MAP AND DOCUMENTATION REFERENCES

The following list, based upon user selections and data entries, describes the minimum required attachments that must be submitted with the Nutrient Management Plan for the reporting schedule of 'July 1, 2009'.

A. PRELIMINARY DAIRY FACILITY ASSESSMENT

The NMP will include the initial Preliminary Dairy Facility Assessment (Attachment A) and the annual updates as required by Monitoring and Reporting Program No. R5-2007-0035. Copies of these assessments shall be maintained for 10 years.

B. LAND AREA MAP(S)

Identify each land application area (under the Discharger's control, whether it is owned, rented, or leased, to which manure or process wastewater from the production area is or may be applied for nutrient recycling) on a single published base map

1. A field identification system (Assessor's Parcel Number; land application area; crops grown); indication if each land application is owned, rented, or leased by the Discharger; indication of what type of waste is applied (solid manure only, wastewater only, or both solid manure and wastewater); drainage flow direction in each field, nearby surface waters, and storm water discharge points; tailwater and storm water drainage controls; subsurface (tile) drainage systems (including discharge points and lateral extent); irrigation supply wells and groundwater monitoring wells; sampling locations for discharges of storm water and tailwater to surface water from the field.

2. Process wastewater conveyance structures, discharge points and discharge mixing points with irrigation water supplies; pumping facilities; flow meter locations; drainage ditches and canals, culverts, draining controls (berms, levees, etc.), and drainage easements.

Application area map reference number: Figures 4-6

Identify each field under control of the Discharger and within five miles of the dairy where neither process wastewater nor manure is applied. Each field shall be identified on a single published base map at an appropriate scale by the following:

1. Assessor's Parcel Number.
2. Total acreage.
3. Information on who owns or leases the field

Non-application area map reference number: None

Setbacks, Buffers, and Other Alternatives to Protect Surface Water (see Technical Standard VII):

1. Identify all potential surface waters or conduits to surface water that are within 100 feet of any land application area.
2. For each land application area that is within 100 feet of a surface water or a conduit to surface water, identify the setback, vegetated buffer, or other alternative practice that will be implemented to protect surface water (Technical Standard VII).

Setbacks and buffers map reference number: Figures 4-6

C. PROCESS WASTEWATER WRITTEN AGREEMENTS

Provide copies of written agreements with third parties that receive process wastewater for their own use from the Discharger's dairy (Technical Standards V.A.1 and V.A.3).

Nutrient Management Plan Report
General Order No. R5-2007-0035, Attachment C
July 1, 2009 deadline

SAMPLING AND ANALYSIS PLAN CERTIFICATION

A. DAIRY FACILITY INFORMATION

Name of dairy or business operating the dairy: Trinkler Dairy Farms Inc.

Physical address of dairy:

7251 Crowslanding RD	Ceres	Stanislaus	95307
Physical Address Number and Street	City	County	Zip Code

Street and nearest cross street (if no address):

B. DOCUMENTATION OF QUALIFICATIONS AND PLAN DEVELOPMENT

I certify that I meet the requirements as a certified specialist in developing nutrient management plans as described in Attachment C of Waste Discharge Requirements General Order No. R5-2007-0035 and that I prepared the Sampling and Analysis plan.

Technical Service Provider
TITLE/QUALIFICATIONS OF CERTIFIED NUTRIENT MANAGEMENT SPECIALIST

SIGNATURE OF TRAINED PROFESSIONAL — DATE: 2/11/15

Joe Ramos
PRINT OR TYPE NAME

2857 Geer RD; Turlock, CA 95382
MAILING ADDRESS

(209) 250-2471
PHONE NUMBER

C. OWNER AND/OR OPERATOR CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

SIGNATURE OF OWNER OF FACILITY

Wendel Trinkler, Jr.
PRINT OR TYPE NAME

2/16/15
DATE

SIGNATURE OF OPERATOR OF FACILITY

PRINT OR TYPE NAME

DATE

Nutrient Management Plan Report
General Order No. R5-2007-0035, Attachment C
July 1, 2009 deadline

NUTRIENT BUDGET CERTIFICATION

A. DAIRY FACILITY INFORMATION

Name of dairy or business operating the dairy: Trinkler Dairy Farms Inc.

Physical address of dairy:

7251 Crowslanding RD	Ceres	Stanislaus	95307
Number and Street	City	County	Zip Code

Street and nearest cross street (if no address):

B. DOCUMENTATION OF QUALIFICATIONS AND PLAN DEVELOPMENT

I certify that I meet the requirements as a certified specialist in developing nutrient management plans as described in Attachment C of Waste Discharge Requirements General Order No. R5-2007-0035 and that I prepared the Nutrient Budget plan.

Technical Service Provider
TITLE/QUALIFICATIONS OF CERTIFIED NUTRIENT MANAGEMENT SPECIALIST

Joe Ramos — 2/11/15
SIGNATURE OF TRAINED PROFESSIONAL — DATE

Joe Ramos
PRINT OR TYPE NAME

2857 Geer RD; Turlock, CA 95382
MAILING ADDRESS

(209) 250-2471
PHONE NUMBER

C. OWNER AND/OR OPERATOR CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

SIGNATURE OF OWNER OF FACILITY	SIGNATURE OF OPERATOR OF FACILITY
Wendel Trinkler, Jr.	
PRINT OR TYPE NAME	PRINT OR TYPE NAME
2/16/15	
DATE	DATE

Nutrient Management Plan Report
General Order No. R5-2007-0035, Attachment C
July 1, 2009 deadline

STATEMENTS OF COMPLETION

Waste Discharge Requirements General Order No. R5-2007-0035 for Existing Milk Cow Dairies (General Order) requires owners and operators of existing milk cow dairies (Dischargers) to develop and implement a Nutrient Management Plan for their land application areas (land under control of the Discharger, whether it is owned, rented, or leased, to which manure or process wastewater from the production area is or may be applied for nutrient cycling). The Discharger is required to maintain the NMP at the dairy, make the NMP available to Central Valley Water Board staff during their inspections, and submit the NMP to the Executive Officer upon request.

The General Order requires the Discharger to submit two Statements of Completion during development of the NMP. The Discharger may use this form to comply with the General Order requirement to submit one or both of these Statements of Completion. Parts A and E must be completed for each Statement of Completion. Parts B, C and D are to be completed for the Statements of Completion due by 1 July 2008, 31 December 2008 and 1 July 2009, respectively. Both the owner and the operator of the dairy must sign this form in Part E below.

A. DAIRY FACILITY INFORMATION

Name of dairy or business operating the dairy: Trinkler Dairy Farms Inc.

7251 Crowslanding RD	Ceres	Stanislaus	95307
Number and Street	City	County	Zip Code

Street and nearest cross street (if no address):

Operator name: _____ Telephone no.: _____ (Landline) _____ (Cellular)

_____ _____ _____ _____
Mailing Address Number and Street | City | State | Zip Code

Legal owner name: Trinkler, Wendel Jr. Telephone no.: (209) 537-9883 (Landline) _____ (Cellular)

P.O. Box 10	Ceres	CA	95307
Mailing Address Number and Street	City	State	Zip Code

B. STATEMENT OF COMPLETION DUE 1 JULY 2008

I have completed the following items of the Nutrient Management Plan (check the boxes of completed sections), which are due 1 July 2008:

☐ **Item I.A.1 Land Application Information**
Identification of land used for manure application and needed information on a facility map.

☐ **Item I.B Land Application Information**
Information list for information provided on map above.

☐ **Item I.C Land Application Information**
Copies of written third-party process wastewater agreements.

☐ **Item I.D Land Application Information**
Identification of fields under control of the discharger within five miles of the dairy where neither process wastewater nor manure is applied.

☐ **Item II Sampling and Analysis Plan**

☐ **Item IV Setbacks, Buffers, and Other Alternatives to Protect Surface Water**
Identification of all potential surface waters or conduits to surface waters within 100 feet of land application areas and appropriate protection.

☐ **Item VI Record-Keeping Requirements**
Identification of monitoring records that will be maintained as required in the production and land application areas.

Has Item II (Sampling and Analysis Plan) of the Nutrient Management Plan been certified by a Certified Nutrient Management Specialist as required in the General Order?

☐ Yes ☐ No

C. STATEMENT OF COMPLETION DUE 31 DECEMBER 2008

I have completed the following items of the Nutrient Management Plan (check the boxes of completed sections), which are due 31 December 2008:

☐ **Item V Field Risk Assessment**
Evaluation of the effectiveness of management practices used to control the discharge of waste constituents from land application areas by assessing the water quality monitoring results of discharges of manure, process wastewater, tailwater, subsurface (tile) drainage, or storm water from the land application areas.

D. STATEMENT OF COMPLETION DUE 1 JULY 2009

I have completed the following items of the Nutrient Management Plan (check the boxes of completed sections), which are due 1 July 2009:

☐ **Item I.A.2 Land Application Area Information**
Identification of process wastewater conveyance, mixing and drainage information for each land application area on a facility map.

☐ **Item III Nutrient Budget**
Established planned rates of nutrient applications by crop based on nutrient monitoring results for each land application area.

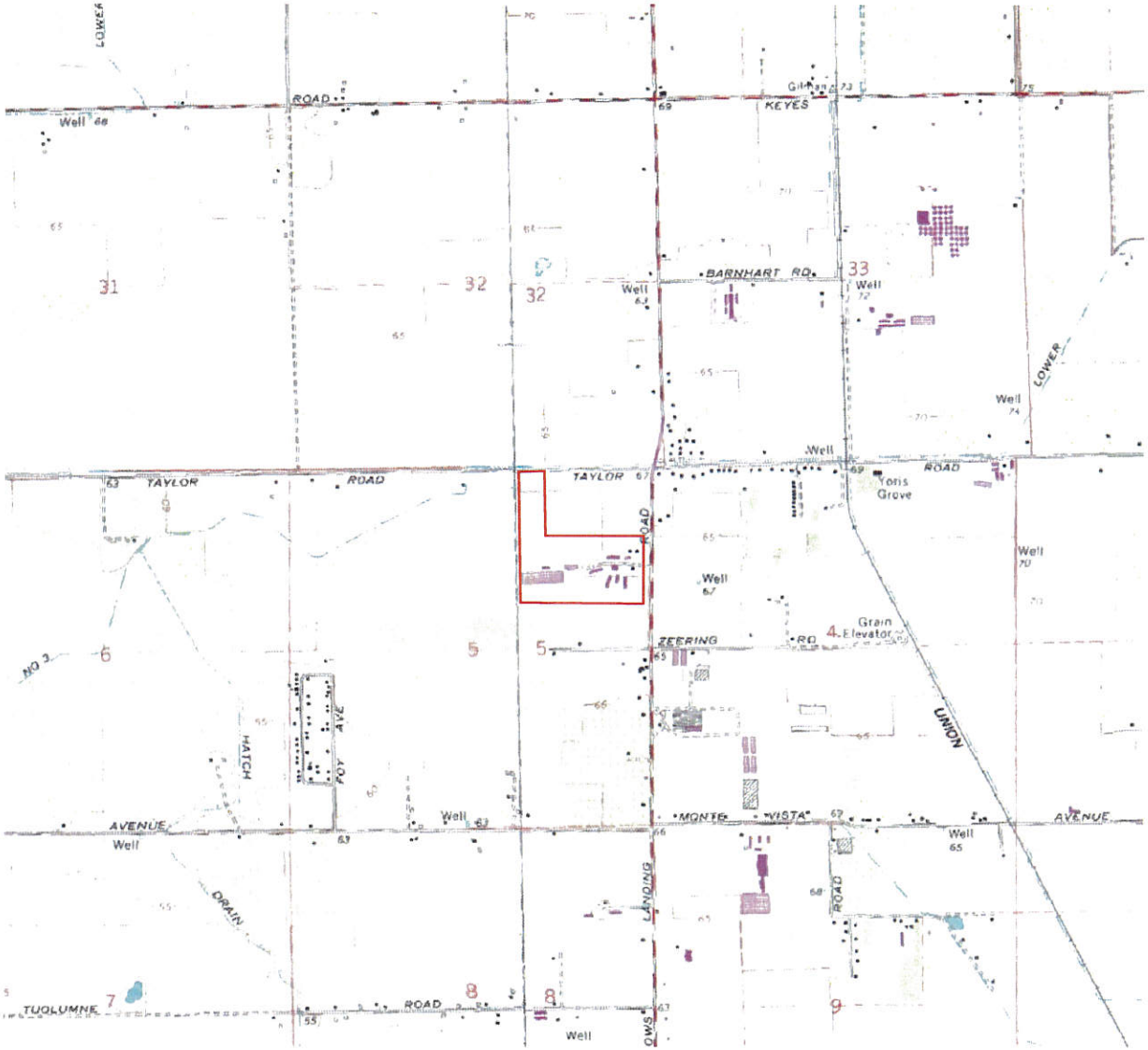
Has Item III (Nutrient Budget) of the Nutrient Management Plan been certified by a Certified Nutrient Management Specialist as required in the General Order?

☐ Yes ☐ No

E. CERTIFICATION STATEMENT

I certify under penalty of law that I have completed the items of the Nutrient Management Plan that are checked in Parts B, C and/or D above for the dairy identified in Part A above and that the appropriate certified nutrient management specialist has certified the items requiring such certification as noted in part B and/or D above and that I have personally examined and am familiar with the information submitted in Parts A, B, C and D of this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

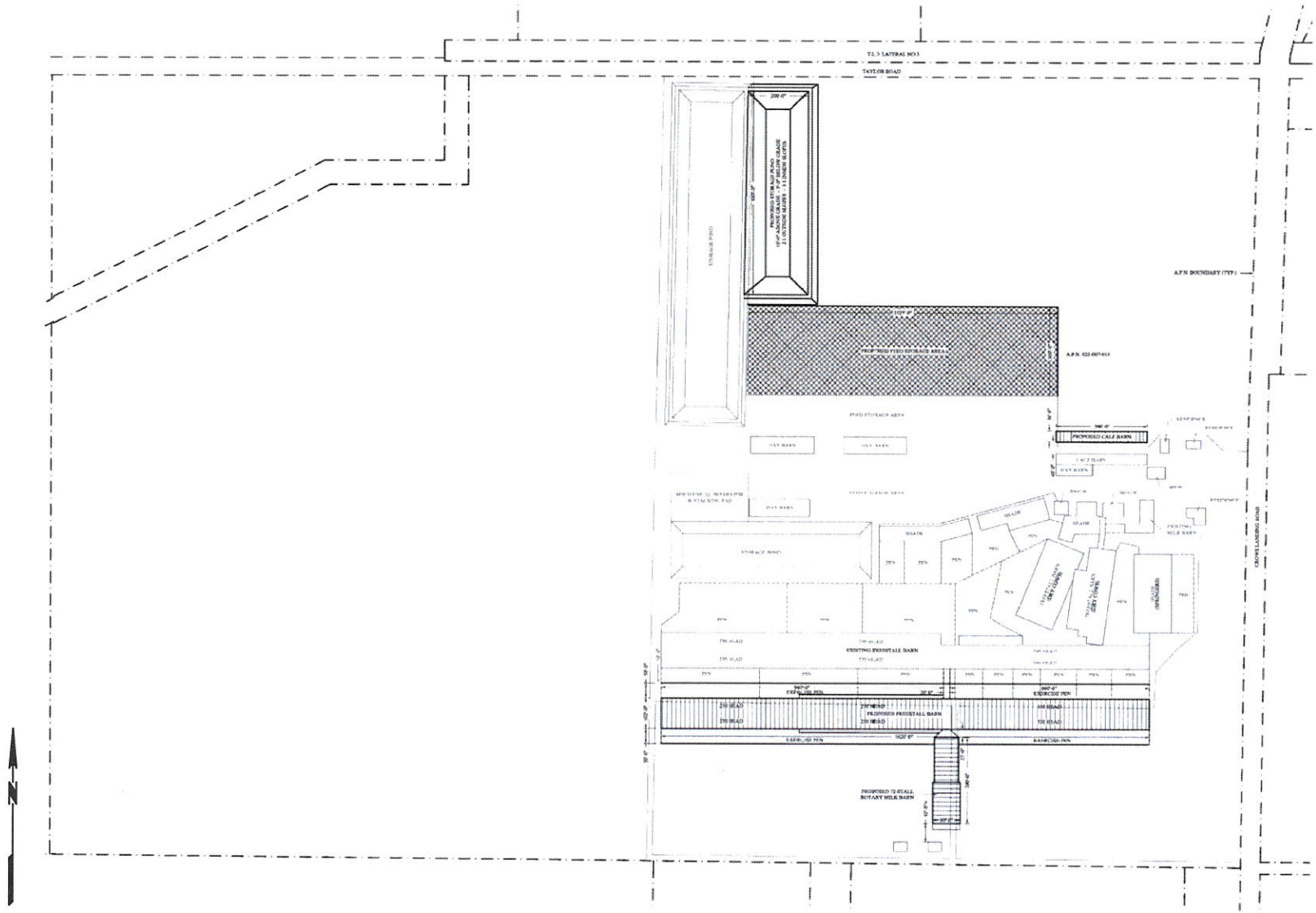
SIGNATURE OF OWNER OF FACILITY	SIGNATURE OF OPERATOR OF FACILITY
Wendel Trinkler, Jr.	
PRINT OR TYPE NAME	PRINT OR TYPE NAME
2/16/15	
DATE	DATE



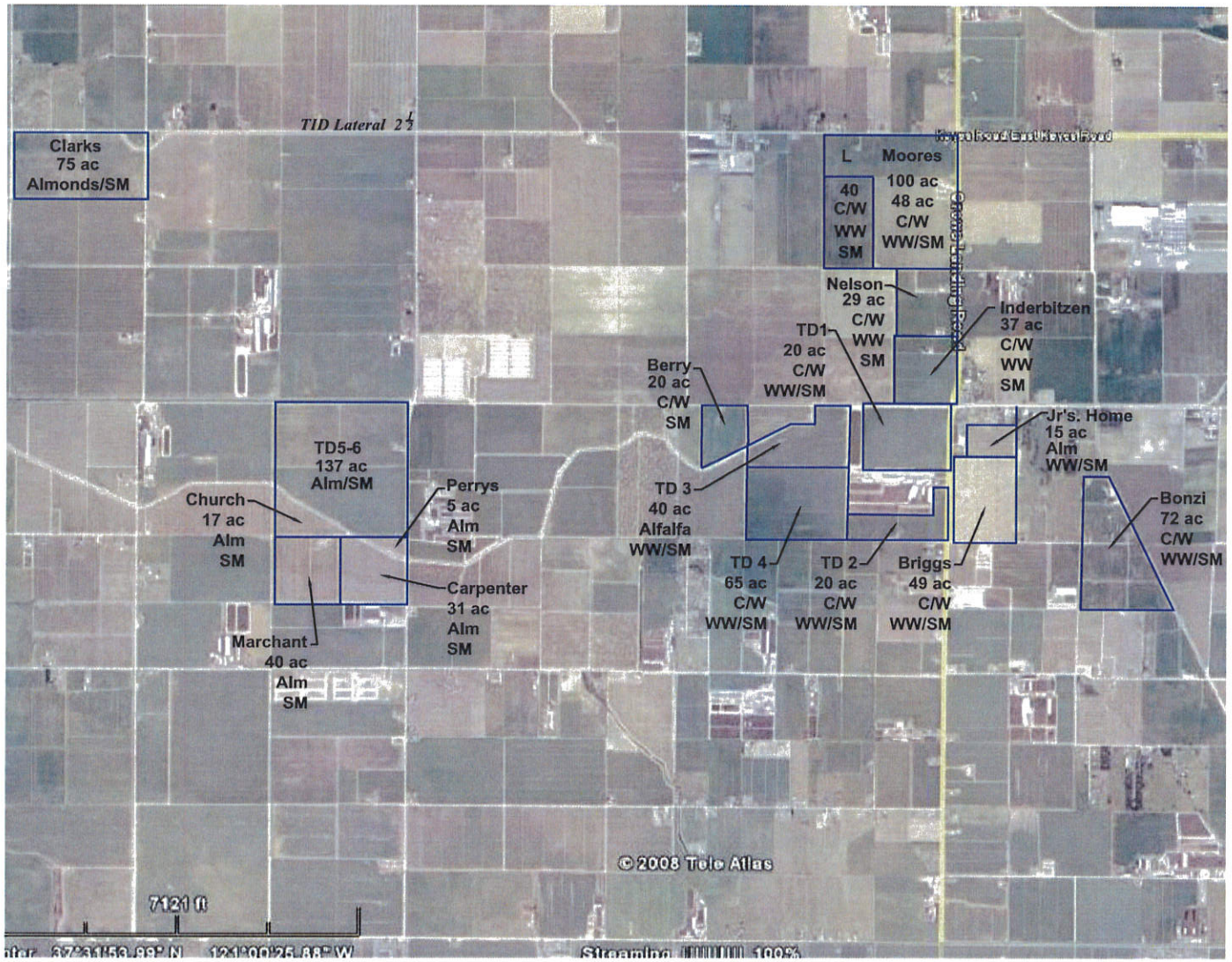
LEGEND

Facility Boundary

Ag Services, Inc.	SCALE: 0 4,000 8,000 APPROXIMATE SCALE IN FEET	TRINKLER DAIRY STANISLAUS COUNTY, CA			**FIGURE 1** TOPOGRAPHIC MAP
	PROJECT NO. FRA-00	DATE: 10/17/14	DRAWN BY: SB	APP. BY: JR	Trinkler Dairy



Ag Services, Inc.	SCALE: 0 — 500 — 1,000 APPROXIMATE SCALE IN FEET	TRINKLER DAIRY STANISLAUS COUNTY, CA			**FIGURE 2** CUP SITE PLAN
	PROJECT NO. FRA-00	DATE: 1/26/15	DRAWN BY: SB	APP. BY: JR	Trinkler Dairy



Owned-lagoon water	APN	Acres
TD 1-4	0022-0007-0013-0000	171
Inderbitzen	0041-0044-0006-0000	37
Nelson 1	0041-0045-0008-0000	16
Nelson 2	0041-0045-0009-0000	13
Berry	0022-0007-0004-0000	20
Briggs	0022-0024-0013-0000	49
Bonzi 1	0022-0010-0006-0000	24
Bonzi 2	0022-0010-0007-0000	48
Jr.'s Home	0022-0024-0012-0000	15
	Total	**393**

Rented-lagoon water	APN	Acres
Moores Home	0041-0044-0005-0000	148
	Total	**148**

Owned-dry manure	APN	Acres
T&R Jones 1	0058-0022-0007-0000	80
T&R Jones 2	0058-0022-0038-0000	75
TD 5&6 (trees)	0022-0002-0012-0000	137
Clarks (trees)	0017-0062-0006-0000	77
Carp. Trees	0022-0002-0014-0000	31
Perry (trees)	0022-0002-0013-0000	5
Church (trees)	0022-0002-0011-0000	17
Marchant (trees)	0022-0002-0015-0000	40
	Total	**462**
	total	1003

LEGEND

Fields	SM	Solid Manure	C	Corn	Alm	Almonds
	WW	Wastewater	W	Wheat	L	Leased

Ag Services, Inc.

SCALE:
0 3200 6400
APPROXIMATE SCALE IN FEET

TRINKLER DAIRY
STANISLAUS COUNTY, CA

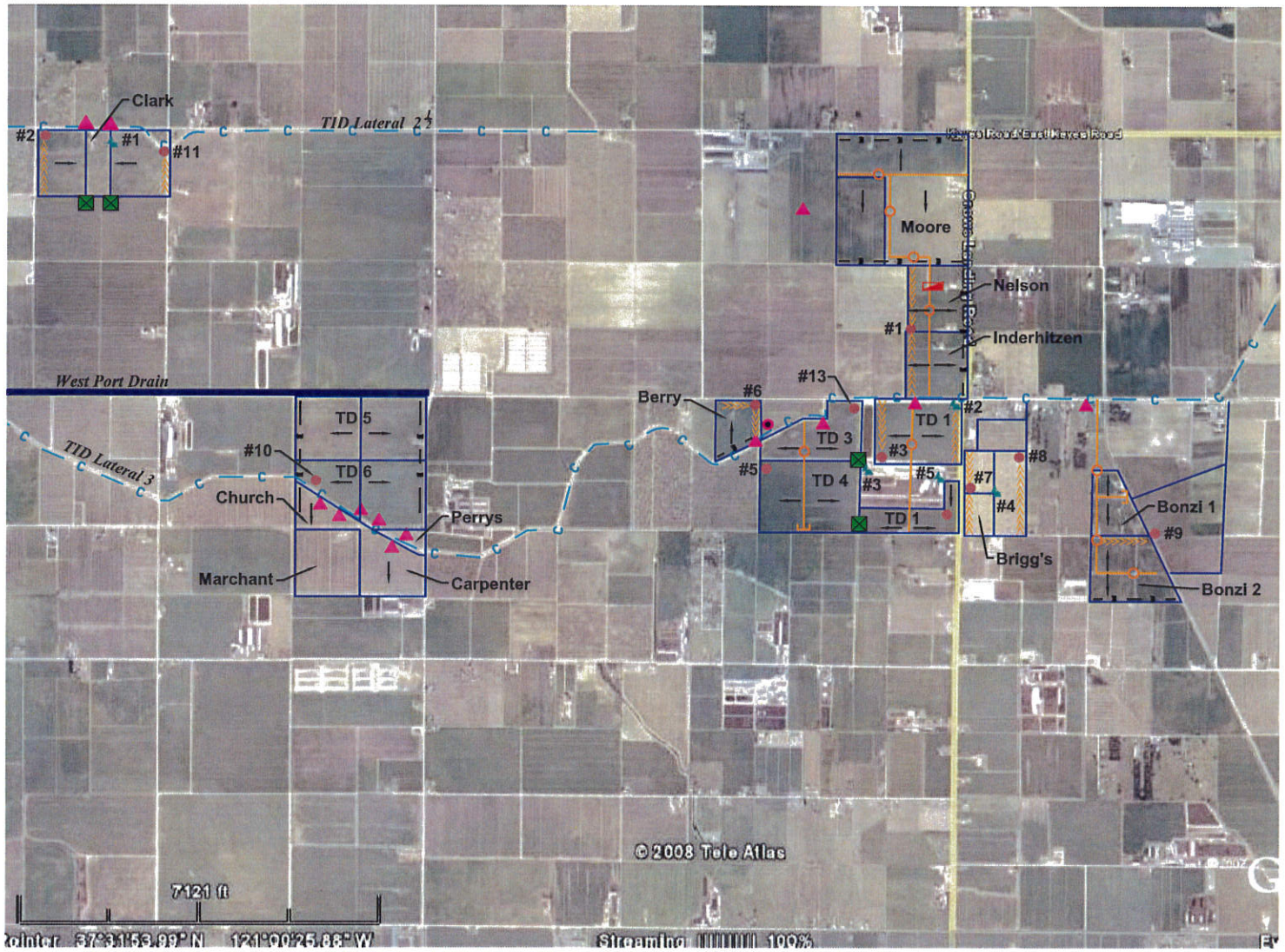
FIGURE 3
FIELD AND CROPPING MAP

PROJECT NO.	DATE:	DRAWN BY:	APP. BY:
FRA-00	2/9/15	SB	JR

Trinkler Dairy

LEGEND

- Fields
- Irrigation Well
- TID Inlet Valve
- Tailwater Pump
- Tailwater Drain Pump
- Drainage Ditches
- Irrigation Mixing Box
- Irrigation Flow
- Irrigation Pipeline
- Tailwater Recovery
- Canal
- Wastewater Lift Station
- Irrigation Control Box



100

Ag Services, Inc.	SCALE: 0 — 3200 — 6400 APPROXIMATE SCALE IN FEET	TRINKLER DAIRY STANISLAUS COUNTY, CA			**FIGURE 4** IRRIGATION SCHEMATIC
	PROJECT NO. FRA-00	DATE: 10/17/14	DRAWN BY: SB	APP. BY: JR	Trinkler Dairy

POND CONSTRUCTION WORK PLAN
TRINKLER DAIRY FARMS
CERES, CA

June 30, 2016

Prepared by:

EAC ENGINEERING
environmental
agricultural | civil

California Office
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Turlock, CA 95380
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Soda Springs, ID 83276
(208) 547-3548 (fax)

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1.0 Project Description

The facility is located at 37.53281667, -120.9969222 at 7251 Crows Landing Road, Ceres CA. The facility is proposing to construct a new wastewater storage pond that is to be lined to meet RWQCB requirements for the proposed expansion of the facility.

A site plan has been provided in Appendix A.

2.0 Project Summary

- Pond Dimensions
  - 375' w. x 500' l.
  - 15'-0" total depth – 10'-0" above grade – 5'-0" below grade
  - 3:1 inside embankment slope
  - 2:1 outside embankment slope
- Pond Lining Requirements
  - Soils compacted to 90% standard proctor density
  - 60-mil HDPE
  - Gas vent strips @ max. 50'-0" o.c.
  - Min. 18" w. x 18" dp. anchor trench
  - All pipe inlets/outlets to have HDPE boots
- Pre-construction meeting to be held before work begins
  - See section 6.0 of this report for those who must attend
- Construction
  - Procedures as specified in Appendix D
  - Compaction and liner testing as specified in Appendix D
- Post Construction
  - As-built survey and construction drawings
  - Testing result reports

3.0 Pond Design & Layout

The facility will be lining one earthen pond with 60-mil HDPE to meet RWQCB requirements.

The new storage pond on the facility will be 375' wide by 500' long by 15' deep with 3:1 embankment inside slopes. Of the 15'-0" depth, only 5'-0" will be below existing grade. Once the excavation and construction of the embankments have been completed, the embankments will be compaction tested and any areas not meeting 90% standard proctor density will be re-compacted. Gas vent strips will then be installed at a maximum spacing of 50' o.c. Then a 60-mil HDPE liner will be installed in accordance with the manufacturer's specifications and the requirements of the RWQCB.

Pond drawings and details have been provided in Appendix B.

4.0 Site Investigations

Soil data was obtained from the USDA-NRCS soil survey for the area. This data shows that the soils in the area of the pond are Dinuba sandy loam and Tujunga loamy sand. The Dinuba soil contains an average of 14% clay and is classified as a hydrologic group C. The Tujunga soil contains an average of 5% clay and is classified as a hydrologic group A. The soil information has been provided in Appendix C.

No geotechnical investigation has been conducted as this time.

5.0 Design Seepage & Specifications

The pond will be lined with a 60-mil HDPE liner that is UV protected and warranted for 15 years. The liner material will have a service life of at least 20 years. The liner and installation specifications have been fully explained in Appendix D. The liner manufacturer's specifications for the lining material, gas vent material, example warranty, recommended installation procedures, and example test methods shown in pages 4-9 of the manufacturer's Installation Quality Assurance Manual and quality assurance forms have all been provided in Appendix F.

Pond Seepage Estimate

The seepage rate of most geosynthetic liners ranges from $1x10^{-13}$ m/s to $1x10^{-15}$ m/s. Calculations are conducted in accordance with USBR Report DS-13(20)-13, Chapter 20.

Storage Pond Seepage

Seepage rate = $1x10^{-13}$ m/s = $3.28x10^{-13}$ ft/s
Maximum water depth = 13'
Time = 365 days = 31,536,000 s
Area = 183,259 sq.ft.
Seepage = 183,259 * 13 * 31,536,000 * $3.28x10^{-13}$ = 24.6 ft^3/yr

Liner Defect Seepage

Area of hole = 0.00001 m^2
Head = 3.96 m
k = $1x10^{-8}$ m/s
# of defects/acre = 1
Total # of defects = 4
Seepage = $0.21*(\text{area of hole})^{0.1}*(\text{head})^{0.9}*k^{0.74}$ = $2.76x10^{-8}$ m^3/s/defect * 4 defects = 123 ft^3/yr (for good contact)

The entire liner surface is in contact with the subgrade soil except in the areas of gas vents. However, the gas vents themselves are made of semi-impermeable material at the base and an impermeable material at the liner face (top) to allow gases to enter the venting system, but not pass through and be trapped under the liner. The venting system is in direct contact with the soil subgrade. The presence of a gas

venting system has no significant affect on the liner seepage rate even in areas of liner defects. If anything, there will actually be less seepage in the areas of gas vents then in areas without since it is one more layer of synthetic type material that effluent would have to pass through.

The total seepage for the liner system is estimated to be 147.6 ft^3/yr which is negligible considering the pond was designed to contain a total of 13,450,528 gallons of effluent each year including dead loss storage. This seepage rate does not take into account the additional reduction in seepage that will occur due to the soil subgrade itself and is an overestimate of seepage since the calculations assume the ponds are at maximum capacity for the entire year, which is not true in any dairy containment system.

Gas Venting

Gases emitted from organic materials and fluctuations in groundwater levels in the soil below the pond will be captured by 6 oz/yd^3 FabriNet Geocomposite strips located below the pond lining material. These strips will facilitate the movement of gases to 12" square vents that will be placed as shown in the pond design sheets located in Appendix B.

Anchor Trench

The anchor trench for the HDPE liner will be constructed in accordance with USDA-NRCS specifications for pond sealing and lining. Their criteria require a minimum of a 1.5'x1.5' anchor trench. This is what will be used by the facility.

Subgrade

The bottom and embankments of the ponds will be compacted using heavy equipment and moisture conditioning to a minimum of 90% maximum proctor density throughout. All organics, gravel, rock, and other material that would be potentially hazardous to the HDPE liner material have been removed. Above grade pond surfaces will be compaction tested at each 1 foot increment of embankment height during the construction process at a frequency of 1 test/300 lineal feet of length.

Pipe Inlets/Outlets

All pipeline inlets and outlets through the pond embankments & liner will be sealed using HDPE "boots" that are welded to the liner material. HDPE "boots" are to have stainless steel bands around the pipes. A pipe inlet detail has been provided in Appendix B.

Concrete

All concrete will be minimum 2500 psi with all joints sealed using PVC waterstop or volclay sealer and have sealed contraction joints at 15' o.c. Concrete to have a min. 1-1/2 lbs/yd^3 of fiber mesh reinforcement.

Soil Cover

A soil cover will not be required for the ponds. Liner material is UV protected and does not require protection and all cleaning will be done hydraulically. No equipment will be allowed inside the pond on the liner surface.

Maintenance

- Routine lubrication and maintenance of all mechanical components, including valves
- Repair of leaks, slope failures, embankment settling, eroded banks, and management of burrowing animals
- Routine pond inspections, at least once/week and after major storm events

6.0 Pre-Construction

Prior to the commencement of pond construction, a pre-construction meeting between EAC Engineering, the excavation company, D&E Construction (lining company), and the Trinkler family will be conducted. The purpose of the meeting is to insure that all parties have reviewed and understand requirements of the pond construction and the steps necessary to complete the project as designed.

Construction schedule

1. Begin construction upon RWQCB Pond Construction Work Plan approval
2. Earth work, compaction, & survey – approximately 12 weeks to complete
3. Pond liner installation – approximately 3 weeks to complete
4. Liner testing – approximately 2 weeks for testing and repairs
5. Final Pond Certification

Key Personnel

1. Property Owner
    a. Wendel Trinkler (209) 537-9883
2. Professional Engineer
    a. Michael C. Mitchell – EAC Engineering, Inc. (209) 664-1067
3. Excavation Company
    a. To be determined
4. Liner Installation
    a. D & E Construction, Inc (559) 732-1601
5. Liner Testing
    a. Leak Location Services, Inc. (210) 408-1241

7.0 Post-Construction

Upon the completion of the pond lining, a leak location survey conducted in accordance with ASTM D-7002 will be completed by Leak Location Services, Inc. out of San Antonio, TX under the direction of EAC Engineering, Inc. Any deficiencies encountered from the survey will be repaired prior to final certification by the engineer.

Once the construction of the ponds has been completed, a Quality Control and Assurance Report (Pond Certification) will be prepared, stamped, and signed by the Michael C. Mitchell of EAC Engineering, Inc. and submitted to the RWQCB. This report will include an as-built survey/drawing of the ponds.

8.0 Groundwater Levels

Hydrographs of near by wells that have been monitored and recorded by the California Department of Water Resources have been provided in Appendix E. Two wells in the area had data from sampling events within the last 20 years. CDWR well 05S09E04C001M is located approximately 3/4-mile to the east of the proposed pond location. This well has an approximate natural ground elevation of 65.0'. Information gathered from this well since 1987 shows that the average groundwater depth is 15.2'. CDWR well 05S09E09AC001M is located approximately 1.3-mile to the southeast of the proposed pond location. This well has an approximate natural ground elevation of 65.0'. Information gathered from this well since 1960 shows that the average groundwater depth is 10.7'.

In addition, a copy of the 2010 Lines of Equal Depth to Water (LEDW) map produced by CDWR shows that the facility is located between the 10' and 20' contour lines. This map also shows that the groundwater flows from east to west across the site towards the San Joaquin River.

Based on the sampled wells in the area, an on-site backhoe pit, and the analysis of the CDWR LEDW map, it is anticipated that the max. groundwater depth will be 10' below grade on the site. The groundwater surface in relation to the bottom of the pond has been shown on the pond drawings provided in Appendix B.

9.0 Flood Zone

The proposed storage pond will be located within a Zone X. A copy of the available FEMA map has been provided in Appendix G.

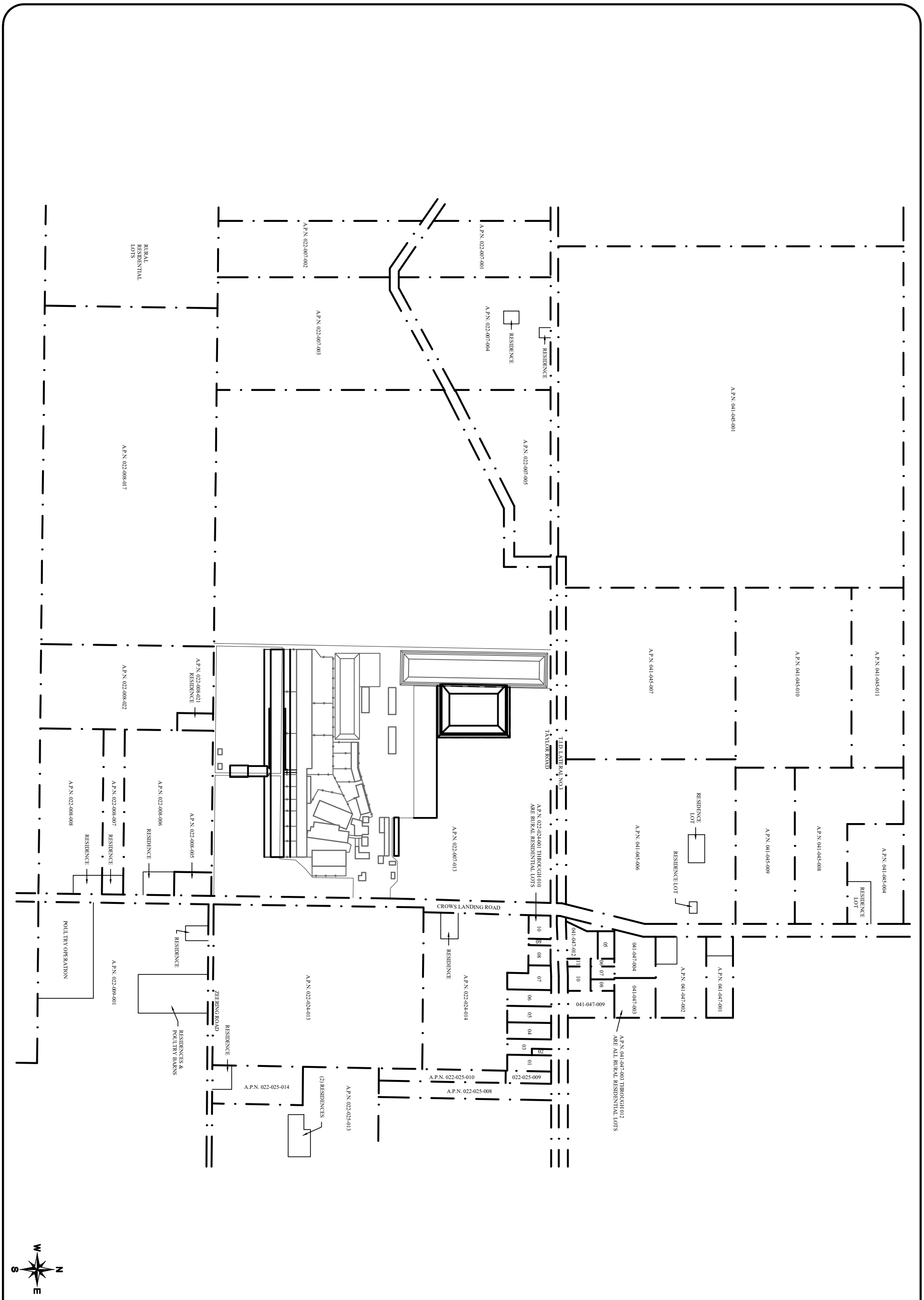
10.0Groundwater Contingency

As part of the project to protect groundwater, a tile drain around the perimeter will be installed at a depth of 2' below the bottom of the pond and liner. The tile drain will daylight into an 18" diameter standpipe in the northwest corner of the pond. The standpipe shall extend a minimum of 12" above the surrounding grade and project into the ground a minimum of 12" below the tile drain. This standpipe will serve two functions. First it will allow the groundwater depth in the area of the pond to be observed. Second, if groundwater is observed in the standpipe, it will act as a pump "pit" so that the groundwater can be pumped in order to maintain a level that is a minimum of 24" below the bottom of the pond and liner. Any water that is pumped will be pumped through a line that is connected to the cropland wastewater distribution system. This will allow the water to be distributed onto any of the fields owned by the operation.

Table of Appendices

Appendix A – Site Plan
Appendix B – Pond Design Details
Appendix C – Soil Information
Appendix D – Liner & Construction Specifications
Appendix E – CDWR Well Information
Appendix F – Pond Lining Materials Information
Appendix G – FEMA Map

Appendix A
Site Plan



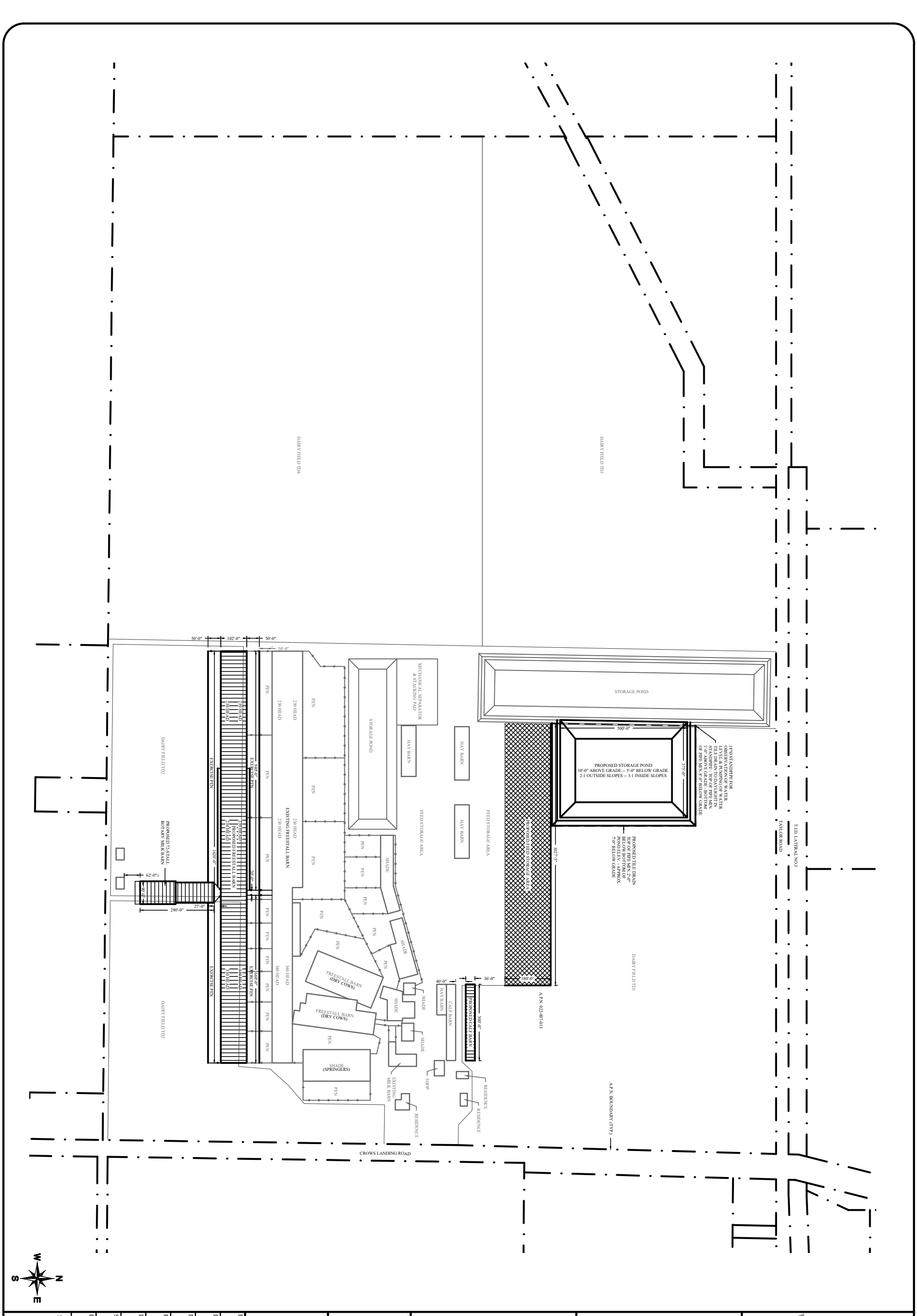
VICINITY PLAN

TRINKLER DAIRY
FARMS INC.
7251 CROWS LANDING RD.
CERES, CA 95307

EAC ENGINEERING
environmental agricultural civil

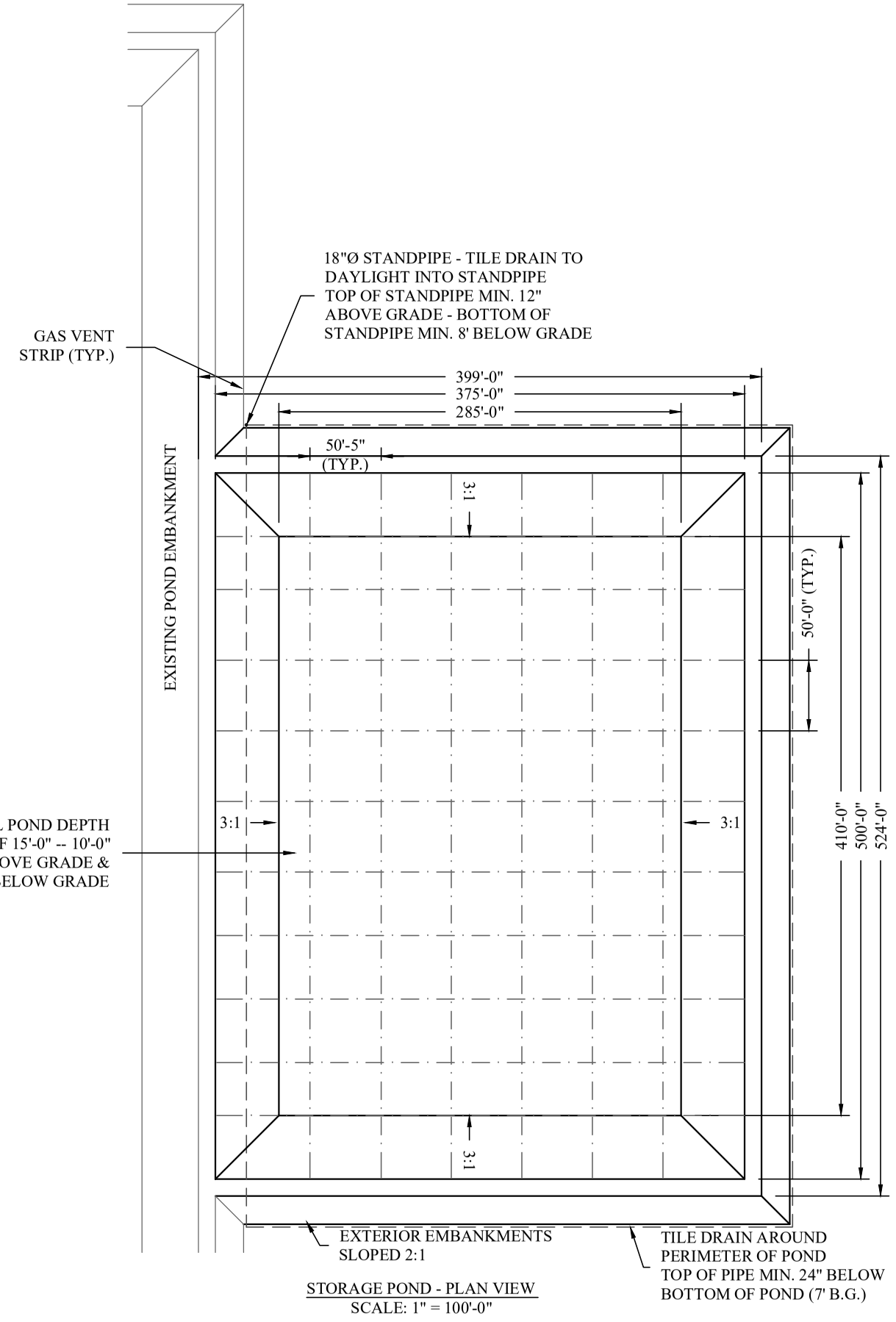
California Office
18836 E. Clausen -- Turlock, CA 95380
(209) 664-1067 -- (209) 664-0161 (fax)
Idaho Office
391 S. 1st E. -- Soda Springs, ID 83276
(208) 547-3722 -- (208) 547-3548 (fax)

PROJECT #: 12-009
DESIGN: TCK
DRAWN: TCK
REVIEW: MCM
DATE: 01/07/16
SCALE: 1" = 700'-0"
DWG NAME: CUP SITE PLAN
SHEET V
OF -- SHEETS

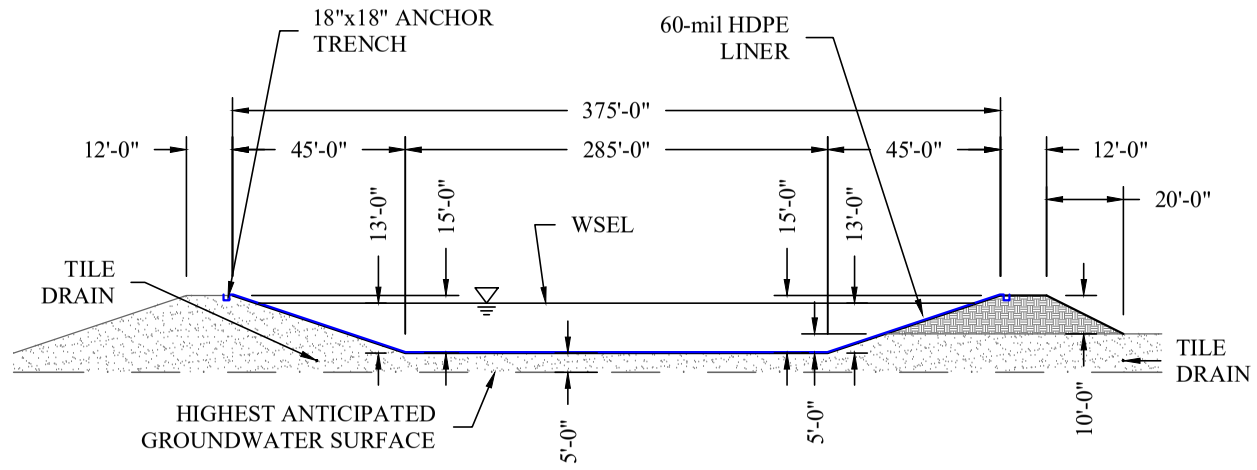


PROJECT #: 12-009			SITE PLAN	TRINKLER DAIRY FARMS INC. 7251 CROWS LANDING RD. CERES, CA 95307	EAC ENGINEERING environmental agricultural civil *California Office* 18836 E. Clausen -- Turlock, CA 95380 (209) 664-1067 -- (209) 664-0161 (fax) *Idaho Office* 391 S. 1st E. -- Soda Springs, ID 83276 (208) 547-3722 -- (208) 547-3548 (fax)
DESIGN: TCK					
DRAWN: TCK					
REVIEW: MCM					
DATE: 06/30/16					
SCALE: 1" = 350'-0"					
DWG NAME: CUP SITE PLAN					
SHEET S OF -- SHEETS					

Appendix B
Pond Design Details



STORAGE POND - PLAN VIEW
SCALE: 1" = 100'-0"



STORAGE POND - SECTION VIEW
AS NOTED

California Office
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Idaho Office
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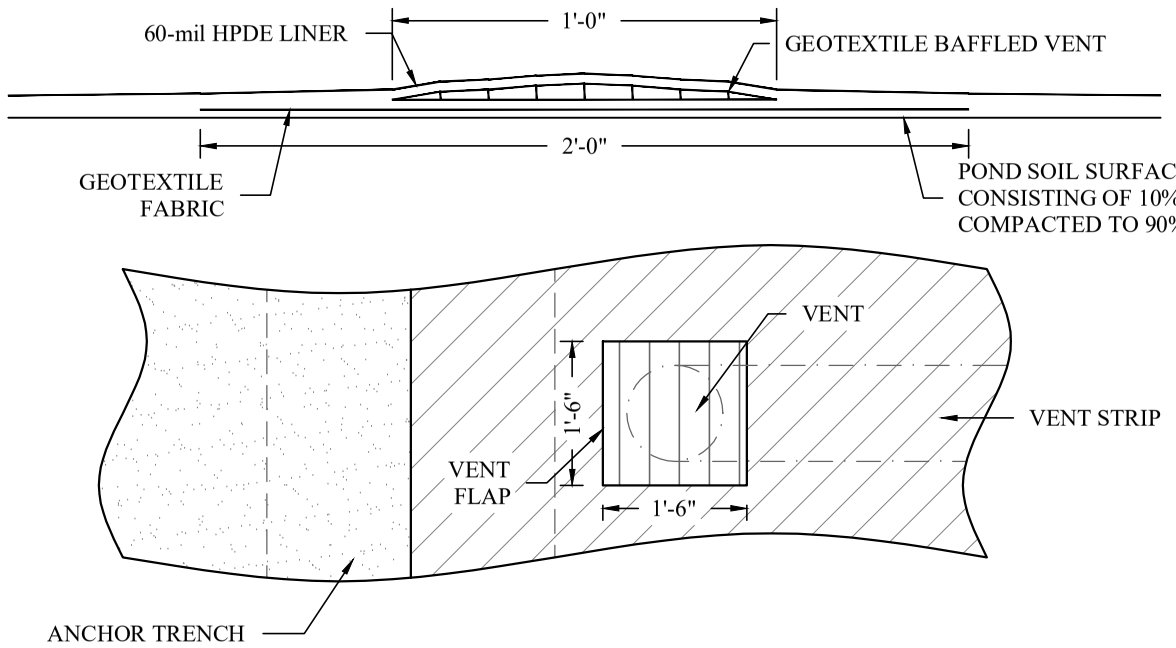
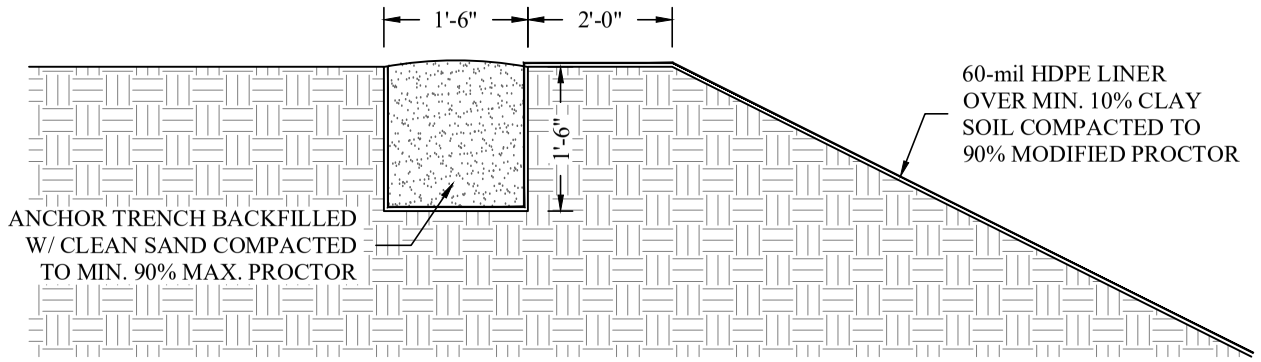
TRINKLER DAIRY FARMS
CROWS LANDING RD.
CERES, CA

STORAGE POND

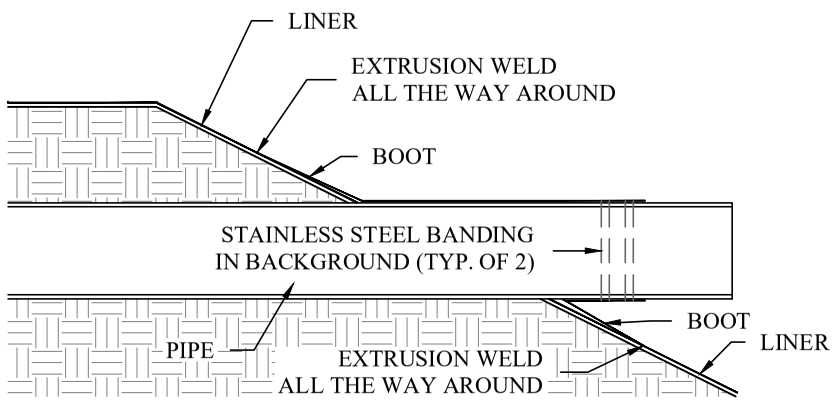
PROJECT #:	12-009
DESIGN:	TCK
DRAWN:	TCK
REVIEW:	MCM
DATE:	06/30/16
SCALE:	AS NOTED
DWG NAME:	POND
SHEET	1
	OF -- SHEETS



POND VENT DETAIL
NO SCALE



ANCHOR TRENCH DETAIL
NO SCALE



PIPE BOOT DETAIL
NO SCALE

California Office
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EAC
ENGINEERING AND ARCHITECTURAL CONSULTANTS

TRINKLER DAIRY
FARMS
CROWS LANDING RD.
CERES, CA

POND DETAILS

PROJECT #: 06-102
DESIGN: TCK
DRAWN: TCK
REVIEW: MCM
DATE: 03/04/15
SCALE: AS NOTED
DWG NAME: POND DETAILS
SHEET 2
OF -- SHEETS

Appendix C
USDA-NRCS Soils Information

Map Scale: 1:4,910 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Eastern Stanislaus Area, California
Survey Area Data: Version 9, Sep 18, 2014

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

Date(s) aerial images were photographed: May 12, 2010—Mar 11, 2011

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

Map Unit Legend

Eastern Stanislaus Area, California (CA644)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
DrA	Dinuba sandy loam, 0 to 1 percent slopes	31.7	30.4%
HfA	Hilmar loamy sand, 0 to 1 percent	16.1	15.4%
TuA	Tujunga loamy sand, 0 to 3 percent slopes	56.6	54.2%
Totals for Area of Interest		**104.5**	**100.0%**

Chemical Soil Properties

This table shows estimates of some chemical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Cation-exchange capacity is the total amount of extractable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. Soils having a low cation-exchange capacity hold fewer cations and may require more frequent applications of fertilizer than soils having a high cation-exchange capacity. The ability to retain cations reduces the hazard of ground-water pollution.

Effective cation-exchange capacity refers to the sum of extractable cations plus aluminum expressed in terms of milliequivalents per 100 grams of soil. It is determined for soils that have pH of less than 5.5.

Soil reaction is a measure of acidity or alkalinity. It is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Calcium carbonate equivalent is the percent of carbonates, by weight, in the fraction of the soil less than 2 millimeters in size. The availability of plant nutrients is influenced by the amount of carbonates in the soil.

Gypsum is expressed as a percent, by weight, of hydrated calcium sulfates in the fraction of the soil less than 20 millimeters in size. Gypsum is partially soluble in water. Soils that have a high content of gypsum may collapse if the gypsum is removed by percolating water.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Sodium adsorption ratio (SAR) is a measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. Soils that have SAR values of 13 or more may be characterized by an increased dispersion of organic matter and clay particles, reduced saturated hydraulic conductivity and aeration, and a general degradation of soil structure.

Report—Chemical Soil Properties

Chemical Soil Properties–Eastern Stanislaus Area, California								
Map symbol and soil name	**Depth**	**Cation-exchange capacity**	**Effective cation-exchange capacity**	**Soil reaction**	**Calcium carbonate**	**Gypsum**	**Salinity**	**Sodium adsorption ratio**
	In	*meq/100g*	*meq/100g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
DrA—Dinuba sandy loam, 0 to 1 percent slopes								
Dinuba	0-10	3.8-8.1	—	6.6-7.8	0	0	0	0
	10-30	5.1-9.6	—	6.6-7.8	0	0	0	0
	30-60	5.1-9.1	—	7.9-8.4	0	0	0.0-4.0	0
HfA—Hilmar loamy sand, 0 to 1 percent								
Hilmar	0-7	0.1-5.4	—	7.3-7.8	0	0	0	0
	7-21	0.1-5.4	—	7.3-7.8	0	0	0	0
	21-29	2.6-5.4	—	7.8-8.4	0-5	0	0.0-2.0	0
	29-60	4.1-7.6	—	8.4-9.6	0-5	0	2.0-8.0	0
TuA—Tujunga loamy sand, 0 to 3 percent slopes								
Tujunga	0-10	0.1-4.2	—	6.1-7.3	0	0	0	0
	10-60	0.1-4.0	—	6.1-7.8	0	0	0	0

Data Source Information

Soil Survey Area: Eastern Stanislaus Area, California
Survey Area Data: Version 9, Sep 18, 2014

Engineering Properties

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

Hydrologic soil group is a group of soils having similar runoff potential under similar storm and cover conditions. The criteria for determining Hydrologic soil group is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Listing HSGs by soil map unit component and not by soil series is a new concept for the engineers. Past engineering references contained lists of HSGs by soil series. Soil series are continually being defined and redefined, and the list of soil series names changes so frequently as to make the task of maintaining a single national list virtually impossible. Therefore, the criteria is now used to calculate the HSG using the component soil properties and no such national series lists will be maintained. All such references are obsolete and their use should be discontinued. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonal high water table, saturated hydraulic conductivity after prolonged wetting, and depth to a layer with a very slow water transmission rate. Changes in soil properties caused by land management or climate changes also cause the hydrologic soil group to change. The influence of ground cover is treated independently. There are four hydrologic soil groups, A, B, C, and D, and three dual groups, A/D, B/D, and C/D. In the dual groups, the first letter is for drained areas and the second letter is for undrained areas.

The four hydrologic soil groups are described in the following paragraphs:

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

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

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

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

Depth to the upper and lower boundaries of each layer is indicated.

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

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

References:

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Report—Engineering Properties

Absence of an entry indicates that the data were not estimated. The asterisk '*' denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba).

Engineering Properties–Eastern Stanislaus Area, California														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*Pct*	*Pct*					*Pct*	
DrA—Dinuba sandy loam, 0 to 1 percent slopes														
Dinuba	85	C	0-10	Sandy loam	SM	A-4	0	0	100	95-100	70-82	35-45	19-28	3-10
			10-30	Sandy loam, fine sandy loam	SM	A-4	0	0	100	95-100	69-81	33-43	20-30	6-12
			30-60	Very fine sand, silt loam	ML, SM	A-4	0	0	100	96-100	91-100	74-85	20-29	6-12
HfA—Hilmar loamy sand, 0 to 1 percent														
Hilmar	85	C	0-7	Loamy sand	SM	A-2	0	0	100	100	74-84	25-35	0-24	NP-6
			7-21	Sand, loamy sand	SM, SP-SM	A-2	0	0	100	100	72-82	5-15	0-23	NP-6
			21-29	Sandy loam, loamy sand	SM	A-2	0	0	100	100	74-79	35-40	16-23	2-6
			29-60	Very fine sandy loam, silt loam	ML	A-4	0	0	100	100	88-95	70-77	18-26	4-10

Engineering Properties–Eastern Stanislaus Area, California														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*Pct*	*Pct*					*Pct*	
TuA—Tujunga loamy sand, 0 to 3 percent slopes														
Tujunga	85	A	0-10	Loamy sand	SM, SP-SM, SW-SM	A-1, A-2, A-3	0	0-4	91-100	71-100	53-81	18-31	0-20	NP-2
			10-60	Loamy sand, fine sand, sand	SM, SP-SM, SW-SM	A-1, A-2, A-3	0	0-4	91-100	71-100	53-81	18-31	0-19	NP-2

Data Source Information

Soil Survey Area: Eastern Stanislaus Area, California
Survey Area Data: Version 9, Sep 18, 2014

Hydrologic Soil Group and Surface Runoff

This table gives estimates of various soil water features. The estimates are used in land use planning that involves engineering considerations.

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

The four hydrologic soil groups are:

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

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

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

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

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas.

Surface runoff refers to the loss of water from an area by flow over the land surface. Surface runoff classes are based on slope, climate, and vegetative cover. The concept indicates relative runoff for very specific conditions. It is assumed that the surface of the soil is bare and that the retention of surface water resulting from irregularities in the ground surface is minimal. The classes are negligible, very low, low, medium, high, and very high.

Report—Hydrologic Soil Group and Surface Runoff

Absence of an entry indicates that the data were not estimated. The dash indicates no documented presence.

Hydrologic Soil Group and Surface Runoff–Eastern Stanislaus Area, California			
Map symbol and soil name	**Pct. of map unit**	**Surface Runoff**	**Hydrologic Soil Group**
DrA—Dinuba sandy loam, 0 to 1 percent slopes			
Dinuba	85	Medium	C
HfA—Hilmar loamy sand, 0 to 1 percent			
Hilmar	85	Medium	C

Hydrologic Soil Group and Surface Runoff–Eastern Stanislaus Area, California			
Map symbol and soil name	**Pct. of map unit**	**Surface Runoff**	**Hydrologic Soil Group**
TuA—Tujunga loamy sand, 0 to 3 percent slopes			
Tujunga	85	Negligible	A

Data Source Information

Soil Survey Area: Eastern Stanislaus Area, California
Survey Area Data: Version 9, Sep 18, 2014

Particle Size and Coarse Fragments

This table shows estimates of particle size distribution and coarse fragment content of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Particle size is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller.

Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In this table, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Silt as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In this table, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Total fragments is the content of fragments of rock and other materials larger than 2 millimeters in diameter on volumetric basis of the whole soil.

Fragments 2-74 mm refers to the content of coarse fragments in the 2 to 74 millimeter size fraction.

Fragments 75-249 mm refers to the content of coarse fragments in teh 75 to 249 millimeter size fraction.

Fragments 250-599 mm refers to the content of coarse fragments in the 250 to 599 millimeter size fraction.

Fragments >=600 mm refers to the content of coarse fragments in the greater than or equal to 600 millimeter size fraction.

Reference:
United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. (http://soils.usda.gov)

Report—Particle Size and Coarse Fragments

Particle Size and Coarse Fragments–Eastern Stanislaus Area, California										
Map symbol and soil name	**Horizon**	**Depth**	**Sand**	**Silt**	**Clay**	**Total fragments**	**Fragments 2-74 mm**	**Fragments 75-249 mm**	**Fragments 250-599 mm**	**Fragments >=600 mm**
		In	*L-RV-H Pct*	*L-RV-H Pct*	*L-RV-H Pct*	*RV Pct*	*RV Pct*	*RV Pct*	*RV Pct*	*RV Pct*
DrA—Dinuba sandy loam, 0 to 1 percent slopes										
Dinuba	H1	0-10	-66-	-23-	7-11- 15	2	2	—	—	—
	H2	10-30	-67-	-19-	10-14- 18	2	2	—	—	—
	H3	30-60	-30-	-56-	10-14- 18	2	2	—	—	—
HfA—Hilmar loamy sand, 0 to 1 percent										
Hilmar	H1	0-7	-79-	-17-	0- 5- 10	—	—	—	—	—
	H2	7-21	-94-	- 1-	0- 5- 10	—	—	—	—	—
	H3	21-29	-69-	-24-	5- 8- 10	—	—	—	—	—
	H4	29-60	-32-	-56-	8-12- 15	—	—	—	—	—
TuA—Tujunga loamy sand, 0 to 3 percent slopes										
Tujunga	H1	0-10	-81-	-17-	0- 3- 5	12	10	2	—	—
	H2	10-60	-81-	-17-	0- 3- 5	12	10	2	—	—

Data Source Information

Soil Survey Area: Eastern Stanislaus Area, California
Survey Area Data: Version 9, Sep 18, 2014

Physical Soil Properties

This table shows estimates of some physical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Particle size is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller.

Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In this table, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Silt as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In this table, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3- or 1/10-bar (33kPa or 10kPa) moisture tension. Weight is determined after the soil is dried at 105 degrees C. In the table, the estimated moist bulk density of each soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute linear extensibility, shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. Depending on soil texture, a bulk density of more than 1.4 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates in the table are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity (Ksat) is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each soil layer. The capacity varies, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change between the water content of the clod at 1/3- or 1/10-bar tension (33kPa or 10kPa tension) and oven dryness. The volume change is reported in the table as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change.

Linear extensibility is used to determine the shrink-swell potential of soils. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In this table, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The content of organic matter in a soil can be maintained by returning crop residue to the soil.

Organic matter has a positive effect on available water capacity, water infiltration, soil organism activity, and tilth. It is a source of nitrogen and other nutrients for crops and soil organisms.

Erosion factors are shown in the table as the K factor (Kw and Kf) and the T factor. Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and Ksat. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor Kw indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind and/or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are described in the "National Soil Survey Handbook."

Wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Reference:
United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. (http://soils.usda.gov)

Report—Physical Soil Properties

Physical Soil Properties–Eastern Stanislaus Area, California														
Map symbol and soil name	**Depth**	**Sand**	**Silt**	**Clay**	**Moist bulk density**	**Saturated hydraulic conductivity**	**Available water capacity**	**Linear extensibility**	**Organic matter**	**Erosion factors**			**Wind erodibility group**	**Wind erodibility index**
										Kw	**Kf**	**T**		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
DrA—Dinuba sandy loam, 0 to 1 percent slopes														
Dinuba	0-10	-66-	-23-	7-11- 15	1.50-1.60	14.00-42.00	0.10-0.13	0.5-1.3	0.5-1.0	.20	.20	5	3	86
	10-30	-67-	-19-	10-14- 18	1.50-1.60	14.00-42.00	0.10-0.13	0.7-1.5	0.0-0.5	.24	.24			
	30-60	-30-	-56-	10-14- 18	1.70-1.80	0.42-1.40	0.10-0.13	0.7-1.5	0.0	.64	.64			
HfA—Hilmar loamy sand, 0 to 1 percent														
Hilmar	0-7	-79-	-17-	0- 5- 10	1.60-1.70	42.00-141.00	0.06-0.10	0.0-0.7	0.5-1.0	.24	.24	5	2	134
	7-21	-94-	- 1-	0- 5- 10	1.60-1.70	42.00-141.00	0.06-0.10	0.0-0.7	0.0-0.5	.05	.05			
	21-29	-69-	-24-	5- 8- 10	1.60-1.70	42.00-141.00	0.06-0.10	0.2-0.7	0.0-0.5	.37	.37			
	29-60	-32-	-56-	8-12- 15	1.60-1.70	0.42-1.40	0.14-0.17	0.2-0.9	0.0	.64	.64			
TuA—Tujunga loamy sand, 0 to 3 percent slopes														
Tujunga	0-10	-81-	-17-	0- 3- 5	1.60-1.70	42.00-141.00	0.05-0.10	0.0-0.5	0.5-1.0	.15	.15	5	2	134
	10-60	-81-	-17-	0- 3- 5	1.60-1.70	42.00-141.00	0.05-0.08	0.0-0.5	0.0-0.5	.15	.15			

Data Source Information

Soil Survey Area: Eastern Stanislaus Area, California
Survey Area Data: Version 9, Sep 18, 2014

Soil Features

This table gives estimates of various soil features. The estimates are used in land use planning that involves engineering considerations.

A *restrictive layer* is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly impede the movement of water and air through the soil or that restrict roots or otherwise provide an unfavorable root environment. Examples are bedrock, cemented layers, dense layers, and frozen layers. The table indicates the hardness and thickness of the restrictive layer, both of which significantly affect the ease of excavation. *Depth to top* is the vertical distance from the soil surface to the upper boundary of the restrictive layer.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage, or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. The table shows the expected initial subsidence, which usually is a result of drainage, and total subsidence, which results from a combination of factors.

Potential for frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, saturated hydraulic conductivity (Ksat), content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel or concrete in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel or concrete in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion also is expressed as *low*, *moderate*, or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Report—Soil Features

Soil Features–Eastern Stanislaus Area, California									
Map symbol and soil name	Restrictive Layer				Subsidence		Potential for frost action	Risk of corrosion	
	Kind	Depth to top	Thickness	Hardness	Initial	Total		Uncoated steel	Concrete
		In	*In*		*In*	*In*			
DrA—Dinuba sandy loam, 0 to 1 percent slopes									
Dinuba		—	—		—	—	None	High	Moderate
HfA—Hilmar loamy sand, 0 to 1 percent									
Hilmar		—	—		—	—	None	High	Moderate
TuA—Tujunga loamy sand, 0 to 3 percent slopes									
Tujunga		—	—		—	—	None	Low	Low

Data Source Information

Soil Survey Area: Eastern Stanislaus Area, California
Survey Area Data: Version 9, Sep 18, 2014

Water Features

This table gives estimates of various soil water features. The estimates are used in land use planning that involves engineering considerations.

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

The four hydrologic soil groups are:

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

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

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

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

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas.

Surface runoff refers to the loss of water from an area by flow over the land surface. Surface runoff classes are based on slope, climate, and vegetative cover. The concept indicates relative runoff for very specific conditions. It is assumed that the surface of the soil is bare and that the retention of surface water resulting from irregularities in the ground surface is minimal. The classes are negligible, very low, low, medium, high, and very high.

The *months* in the table indicate the portion of the year in which a water table, ponding, and/or flooding is most likely to be a concern.

Water table refers to a saturated zone in the soil. The water features table indicates, by month, depth to the top (*upper limit*) and base (*lower limit*) of the saturated zone in most years. Estimates of the upper and lower limits are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors or mottles (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

Ponding is standing water in a closed depression. Unless a drainage system is installed, the water is removed only by percolation, transpiration, or evaporation. The table indicates *surface water depth* and the *duration* and *frequency* of ponding. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 to 30 days, and *very long* if more than 30 days. Frequency is expressed as none, rare, occasional, and frequent. *None* means that ponding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of ponding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs, on the average, once or less in 2 years (the chance of ponding is 5 to 50 percent in any year); and *frequent* that it occurs, on the average, more than once in 2 years (the chance of ponding is more than 50 percent in any year).

Flooding is the temporary inundation of an area caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Duration and *frequency* are estimated. Duration is expressed as *extremely brief* if 0.1 hour to 4 hours, *very brief* if 4 hours to 2 days, *brief* if 2 to 7 days, *long* if 7 to 30 days, and *very long* if more than 30 days. Frequency is expressed as none, very rare, rare, occasional, frequent, and very frequent. *None* means that flooding is not probable; *very rare* that it is very unlikely but possible under extremely unusual weather conditions (the chance of flooding is less than 1 percent in any year); *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is 1 to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); *frequent* that it is likely to occur often under normal weather conditions (the chance of flooding is more than 50 percent in any year but is less than 50 percent in all months in any year); and *very frequent* that it is likely to occur very often under normal weather conditions (the chance of flooding is more than 50 percent in all months of any year).

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

Report—Water Features

Absence of an entry indicates that the data were not estimated. The dash indicates no documented presence.

Water Features–Eastern Stanislaus Area, California										
Map unit symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				Ft	*Ft*	*Ft*				
DrA—Dinuba sandy loam, 0 to 1 percent slopes										
Dinuba	C	Medium	January	—	—	—	—	None	—	None
			February	—	—	—	—	None	—	None
			March	—	—	—	—	None	—	None
			April	—	—	—	—	None	—	None
			May	—	—	—	—	None	—	None
			June	—	—	—	—	None	—	None
			July	—	—	—	—	None	—	None
			August	—	—	—	—	None	—	None
			September	—	—	—	—	None	—	None
			October	—	—	—	—	None	—	None
			November	—	—	—	—	None	—	None
			December	—	—	—	—	None	—	None

Water Features–Eastern Stanislaus Area, California										
Map unit symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				Ft	*Ft*	*Ft*				
HfA—Hilmar loamy sand, 0 to 1 percent										
Hilmar	C	Medium	January	—	—	—	—	None	—	None
			February	—	—	—	—	None	—	None
			March	—	—	—	—	None	—	None
			April	—	—	—	—	None	—	None
			May	—	—	—	—	None	—	None
			June	—	—	—	—	None	—	None
			July	—	—	—	—	None	—	None
			August	—	—	—	—	None	—	None
			September	—	—	—	—	None	—	None
			October	—	—	—	—	None	—	None
			November	—	—	—	—	None	—	None
			December	—	—	—	—	None	—	None

Water Features–Eastern Stanislaus Area, California										
Map unit symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				Ft	*Ft*	*Ft*				
TuA—Tujunga loamy sand, 0 to 3 percent slopes										
Tujunga	A	Negligible	January	—	—	—	—	None	—	None
			February	—	—	—	—	None	—	None
			March	—	—	—	—	None	—	None
			April	—	—	—	—	None	—	None
			May	—	—	—	—	None	—	None
			June	—	—	—	—	None	—	None
			July	—	—	—	—	None	—	None
			August	—	—	—	—	None	—	None
			September	—	—	—	—	None	—	None
			October	—	—	—	—	None	—	None
			November	—	—	—	—	None	—	None
			December	—	—	—	—	None	—	None

Data Source Information

Soil Survey Area: Eastern Stanislaus Area, California
Survey Area Data: Version 9, Sep 18, 2014

Appendix D
Liner & Construction Specifications

Earthwork

Subgrade Preparation

A. Subgrade shall be smooth and free of projections that can damage the lining. Stumps, roots, weeds, brush, rocks, hard clods, and other such materials are to be removed in order to provide a smooth soil surface.
B. Subgrade shall be placed in maximum 6" lifts and compacted to a minimum of 90% of the maximum dry density as determined by ASTM D-1557. Compaction shall be achieved using a sheepsfoot roller or other equivalent equipment that will provide the required compaction.
C. Compaction testing shall be conducted in accordance with ASTM D 2922. The portions of the embankments above grade will be tested at a frequency of 1 test per every foot of elevation gain every 300 lineal feet. Below grade portions of the embankments and pond bottoms will be tested at a frequency of 1 test per 20,000 ft^2. All compaction testing results shall be supplied to the engineer prior to the installation of the HDPE liner.
D. All subgrade that has been damaged during pond construction and deemed unsuitable by the engineer shall be repaired prior to HDPE liner installation.
E. HDPE liner shall not be allowed to "bridge" voids or low areas in the subgrade.
F. Subgrade areas that are weak or compressible that cannot meet the compaction requirements shall be removed and backfilled with satisfactory compacted fill.
G. The engineer shall approve the subgrade upon completion of the compaction of the pond bottom and embankments prior to liner installation. Once the subgrade has been approved by the engineer, the HDPE liner installation company shall approve the subgrade each day prior to commencement of installation. If unsatisfactory surfaces are encountered, the installer shall contact the engineer to inform them of the conditions. Unsatisfactory areas shall be fixed by the general contractor and approved by the engineer and liner installer prior to the commencement of liner installation.

Anchor Trench

A. An anchor trench that is a minimum of 1.5' wide by 1.5' deep shall be excavated around the entire area to be lined at the top of the embankment. The engineer and liner installer shall approve the anchor trench prior to liner installation. Any deficiencies shall be corrected by the excavation contractor to meet the approval of the engineer and liner installation company.
B. After liner installation and seam welding have been completed, the trench shall be backfilled to secure the liner material. The engineer and liner installation company shall approve the backfilled trench.
C. Trench backfill shall be placed in no more than 6" lifts and compacted to 90% maximum dry density of the backfill material used. If the liner material is damaged during backfilling that portion of the liner is to be repaired or replaced prior to backfilling commencing.

Finished Grade

A. Finished grading shall be within 0.2' of the design grades
B. Finished grades within the ponds shall have a smooth finish w/ no material larger than ½" in diameter. Exposed particles are to be classified as rounded or sub-rounded as defined under ASTM D2488

Moisture Control

A. Moisture shall be added to soils during compaction to maintain levels within ±5% of the optimal moisture content of the soil used.

GEOMEMBRANE LINER

Materials

A. Geomembrane liner shall be High-Density Polyethylene (HDPE), 60-mil, smooth on both sides and UV protected. The geomembrane shall meet or exceed the Geosynthetic Research Institute's (GRI) GM13 specifications.
B. Gasket material shall be neoprene, closed cell medium, ¼" thk., 2" wide with adhesive on one side or other equivalent materials.
C. Metal battens or banding and hardware shall be stainless steel.
D. Water cut-off mastic shall be Neoprene Flashing Cement or approved equivalent.
E. Sealant shall be General Electric Silicone, RTV 103 or equivalent.

Material Delivery

A. Upon delivery to the project site, the engineer shall conduct an inventor and inspection of the lining materials during and after unloading.
B. The inventory of delivered materials will be cross-referenced with bills of lading to ensure all necessary materials have been unloaded at the project site.
C. Any damaged materials shall be noted and clearly marked as damaged. The engineer and liner installation company will then determine if the materials may still be used on the project or if the materials are to be returned to the manufacturer.
D. The engineer shall obtain the manufacturer's construction quality assurance test results for the delivered materials and retain them for submittal with the pond certification document.

Liner Placement

A. Rolls shall be deployed using a spreader bar assembly attached to a loader bucket or other methods approved by the engineer
B. The liner installer shall be responsible for the following:
    a. Equipment and tools shall not damage the liner during handling, transportation, and deployment.
    b. Method used to unroll panels shall not cause scratches or crimps to the liner or damage the supporting subgrade.
    c. Liner panels shall be adequately "loaded" with sand bags or similar items to prevent uplift by wind.

d. No vehicular traffic will be allowed on the liner material.
e. Employees shall wear clean footwear and be prohibited from smoking on or near the liner panels.

C. Liner installation shall proceed between ambient temperatures of 32 and 104 degrees Fahrenheit.
D. Prior to installation, a liner panel numbering system shall be agreed upon between the engineer and liner installation company. The system will assist both parties in identifying each panel, seam, and the parent material used.
E. Panel numbers shall be written in large, white block letters at each end of the deployed panels. Panel numbers shall be logged with the liner roll number and gross length. All panels are to be field seamed.

Liner Seaming

A. Approved seaming processes are double fusion seams with air pressure testing for joining liner sections and extrusion welding for patches and boots. Seams shall be oriented in the direction of the embankment slope. All seaming equipment shall be calibrated in accordance with the manufacturer's specifications.
B. No base T-seam shall be closer than 5' from the toe of the embankment slope.
C. Seam Overlap
    a. Panels must have a minimum finished overlap of 4" for fusion welding and 6" for extrusion welding.
    b. Cleaning solvents may not be used unless approved by the liner manufacturer.
D. Seams shall be prepared prior to seaming to make sure that the seaming area is free of moisture, dirt, dust or debris.
E. Seam numbers shall be identified be the panels on each side of the seam. For example, the seam between panel number 11 and panel number 12 shall be identified as seam number 11-12. Seam numbers and lengths shall be seamed.
F. Technicians shall mark the end of each seam with the seam number, machine number, and date in white, block lettering.
G. Test Seams
    a. Field test seams shall be conducted on the liner to verify that seaming conditions are satisfactory. Seaming equipment shall be allowed to warm up a minimum of 15 minutes before conducting a field test. The test shall consist of placing two 10' long sections of the liner material on the pond embankment or bottom and seaming them together in the same method that will be used for the main liner panels. A visual inspection of the seam shall be conducted to verify that the seam has provided full fusion of the two liner pieces without causing either inadequate binding due to low equipment temperature and/or cool weather/soil conditions or melting of the two liner pieces caused by high equipment temperatures and/or hot weather/soil conditions. If improper seaming conditions exist, no liner panels shall be seamed within the pond until equipment and weather/soil conditions exist that will provide proper seaming. Test seams shall be conducted at the

beginning of each day's installation, after any power failure, and at least once every 4 hours throughout the day. All testing equipment shall be calibrated in accordance with the manufacturer's specifications.

b. All test seams shall be made in contact with the subgrade. Welding rod shall have the same properties as the resin used to manufacture the liner material. Test seam samples shall be 6' long for fusion welding and 3' long for extrusion welding.

c. Field conducted shear and peel tests shall result in Failure-To-Break (FTB). If a test seam breaks, the seaming equipment and/or seamer shall not be used until a successful test is achieved. Field shear and peel tests shall be conducted on-site throughout the liner installation process. Off-site laboratory shear test values (@ 2"/min.) shall meet or exceed 121 PPI. A fusion peel test value (@ 2"/min.) shall meet or exceed 98 PPI. An extrusion peel test value (@ 2"/min.) shall meet or exceed 78 PPI. The Off-site laboratory tests shall be conducted as the project is progressing.

H. Destructive Seam Testing (Off-site)

a. Destructive seam tests shall be performed at a frequency of one sample per 500' of seam length. Samples should be labeled for easy identification and logged for future reference. All testing equipment shall be calibrated in accordance with the manufacturer's specifications.

b. A minimum 12"x12" seam sample shall be taken by the engineer and shipped to Precision Geosynthetic Laboratories for testing

c. Seam samples shall be analyzed for shear and peel by the laboratory. Shear test values (@ 2"/min.) shall meet or exceed 121 PPI. A fusion peel test value (@ 2"/min.) shall meet or exceed 98 PPI. An extrusion peel test value (@ 2"/min.) shall meet or exceed 78 PPI. Results shall be delivered to the engineer for review and submittal with the pond certification.

I. Field Non-Destructive Seam Testing (On-site)

a. The liner installer shall non-destructively test <u>all field seams</u> over their full length. All testing equipment shall be calibrated in accordance with the manufacturer's specifications.

b. Vacuum Box Testing

i. Vacuum bas shall consist of a rigid housing, a transparent viewing window, a soft rubber gasket attached to the bottom, port hole or valve assembly, and a vacuum gauge.

ii. Soapy solution in a plastic bucket with a mop.

c. Installer procedures:

i. Excess panel overlap shall be trimmed away.

ii. Wet a strip of liner approximately 12" wide by the length of the box with a soapy solution.

iii. Place box over wetted area and compress.

iv. Create a 3-5 psi vacuum.

v. Ensure a leak tight seal is created.
vi. For approximately 15 seconds, examine the liner through the viewing window for the presence of animated bubbles.
vii. If no animated bubbles appear, release the vacuum pressure and move the box to the next adjoining area with a minimum 3" overlap and repeat process.
viii. All areas where animated bubbles were found shall be marked, repaired, and retested.

d. Air Pressure Testing (for double fusion seams only)
   i. Use an air pump capable of generating and sustaining 25 and 30 psi that is equipped with a pressure gauge.
   ii. Pressure gauge equipped with a sharp hollow needle.
e. Installer procedures:
   i. Seal one end of seam to be tested.
   ii. Insert needle through the sealed end of the channel.
   iii. Energize air pump to verify an unobstructed passage of air through the channel.
   iv. Seal other end of channel.
   v. Using air pump, create a pressure of 25 to 30 psi, close valve, wait 2 minutes, and then sustain the pressure for approximately 5 minutes.
f. If loss of pressure exceeds 2 psi or pressure does not stabilize, locate faulty area of seam, repair and retest.

Liner Defects & Repairs

A. All seams and non-seam areas of the liner shall be inspected by the engineer for defects, holes, blisters, undispersed raw materials, and any signs of contamination.
   a. Each suspect area of the liner and seams shall be non-destructively tested. Each location that fails testing shall be marked, repaired, and retested.
   b. Repair procedures:
      i. Defective seams shall be cap stripped or replaced.
      ii. Small holes shall be by extrusion welding unless the hole is larger than ¼", then it shall be patched.
      iii. Tears shall be repaired by patching.
      iv. Blisters, large cuts, and undispersed raw materials shall be repaired by patching.
      v. Patches shall be completed by extrusion welding. Patches shall be round or oval in shape and made of the same material as the liner. Patches shall extend a minimum of 6" past the edge of the defect.
      vi. Each repair shall be non-destructively tested until it passes the testing criteria.

Electrical Leak Location Testing

A. Within 1 week of completing the pond lining, the liner shall be tested using ASTM standard D-7002 or ASTM standard D-7007 by a third party, independent testing company. A longer time frame between liner completion and leak location testing may be allowed for scheduling purposes if approved by the engineer.
B. During leak location testing, the lining installation company will be present and available to make repairs that may be required.
C. All leak location testing results and resultant repairs shall be logged and provided to the engineer for submittal with the pond certification.

Depth Marker

A. Upon completion of the pond construction and prior to use, a steel rod depth gauge/marker must be installed in the pond. The marker is to identify each 0.5' of water depth starting with 0.0' at the bottom up to 13.0' at the top of the rod. The rod shall be heavily weighted at the bottom with a round steel ball welded to the rod to prevent overturning and anchored to the top of the pond embankments with guy wire. The bottom end of the rod shall be smooth with no sharp or rough edges that could potentially damage the liner surface. Any other type or method of identifying the pond depth must be approved by the engineer.

Concrete

Materials

A. Concrete shall have a minimum compressive strength of 2500 psi @ 28 days.
B. Concrete shall have a minimum 1-1/2 lb/yd^3 of fiber mesh reinforcement.
C. PVC water-stop to meet or exceed CRD-C572.

Material Delivery

A. Prior to delivery to the site, a concrete mix design must be provided to the project engineer for review and approval.
B. Truck load tickets are to be provided to the project engineer.
C. The inventory of delivered materials will be cross-referenced with bills of lading to ensure all necessary materials have been unloaded at the project site.
D. Any materials not meeting specifications will be rejected at the project site. The engineer and concrete contractor will determine if the materials may still be used elsewhere on the project or if the materials are to be returned to the concrete plant.
E. The engineer shall obtain the concrete plant's quality assurance test results for the delivered materials and retain them for submittal with the pond certification document.

Placement

A. Concrete is to be placed at a rate that can be managed by the contractor to ensure proper thickness, vibration, and finish.

B. The contractor shall be responsible for the following:
    a. Equipment and tools required for material handling, pouring, and finish.
    b. Method used to pour concrete shall not cause voids or thin areas in slabs or damage the supporting subgrade.
    c. Providing and installing waterstop materials that meet or exceed specifications of the engineer.
C. No traffic will be allowed on the slabs until concrete has reached minimum required compressive strength.
D. Waterstop materials are to be installed at all concrete joints.

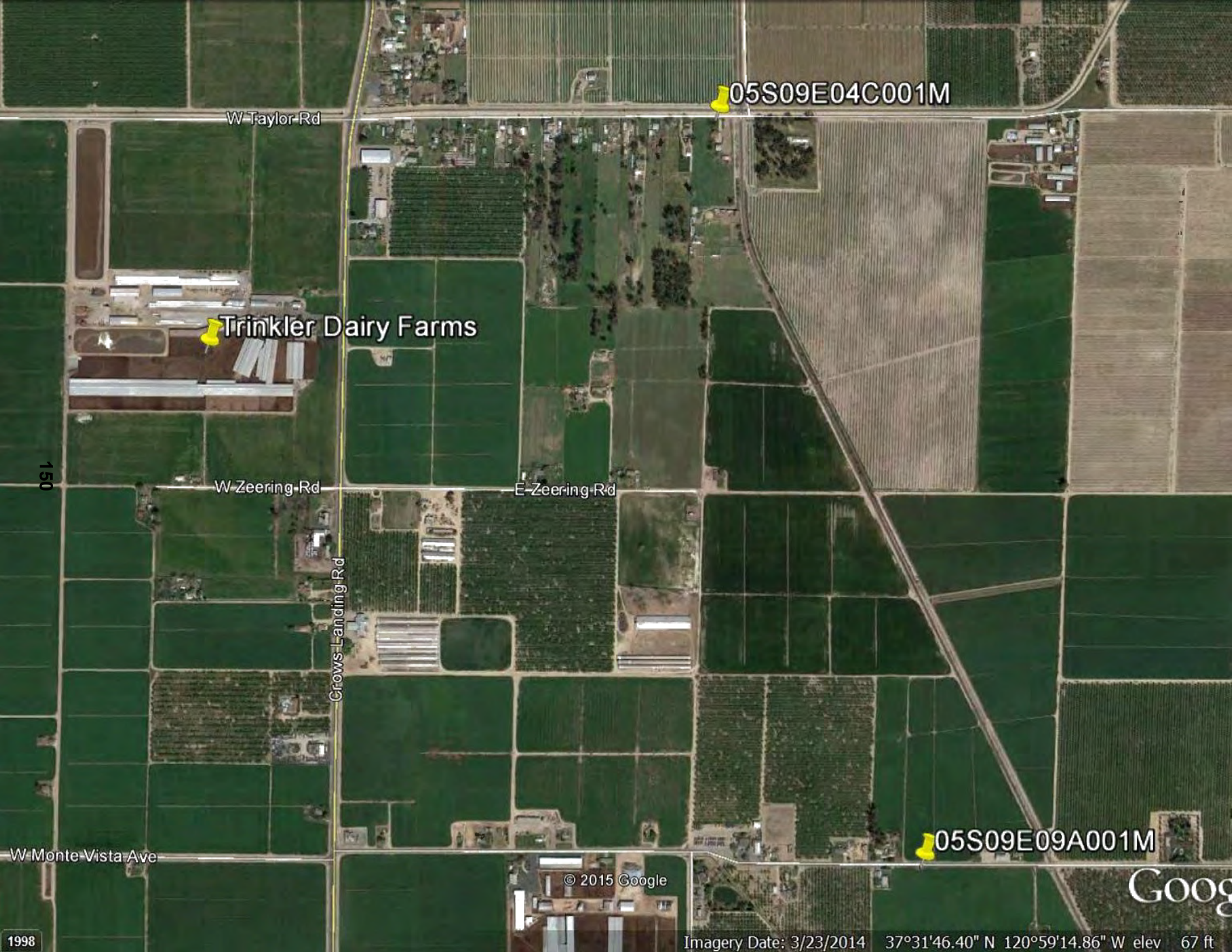
Control Joints

A. Control joints are to be provided a minimum of every 15' o.c.
B. All control joints are to be sealed using volclay or equivalent waterstop type sealer.
C. Any cracks that develop in the concrete during currying shall be sealed using volclay or equivalent waterstop type sealer.

Defects & Repairs

A. All concrete slabs and joints shall be inspected by the engineer for defects, gaps, cracking, undispersed raw materials, and any signs of contamination.
    a. Each suspect area of the concrete shall be inspected. Each location that fails inspection shall be marked, repaired, and re-inspected.
    b. Repair procedures:
        i. Defective areas shall be removed and re-poured/sealed.
        ii. Small cracks/gaps shall be by sealed with volclay or equivalent waterstop material.
B. Each repair shall be inspected until it passes the engineers requirements.

Appendix E
CDWR Well Information


05S09E04C001M
W Taylor Rd
Trinkler Dairy Farms
150
W Zeering Rd
E Zeering Rd
Crows Landing Rd
05S09E09A001M
W Monte Vista Ave
© 2015 Google
1998
Imagery Date: 3/23/2014 37°31'46.40" N 120°59'14.86" W elev 67 ft

State_Well_Number	Measurement_Date	RP_Elevation	GS_Elevation	RPWS	WSE	GSWS
05S09E04C001M	3/10/1987 0:00	65	65	13	52	13
05S09E04C001M	10/25/1988 0:00	65	65	23	42	23
05S09E04C001M	3/8/1989 0:00	65	65	21	44	21
05S09E04C001M	11/2/1989 0:00	65	65	22	43	22
05S09E04C001M	2/6/1990 0:00	65	65	22	43	22
05S09E04C001M	2/7/1991 0:00	65	65	18	47	18
05S09E04C001M	10/16/1991 0:00	65	65	23	42	23
05S09E04C001M	2/19/1992 0:00	65	65	20	45	20
05S09E04C001M	10/27/1992 0:00	65	65	23	42	23
05S09E04C001M	3/4/1993 0:00	65	65	20.1	44.9	20.1
05S09E04C001M	2/16/1994 0:00	65	65	12	53	12
05S09E04C001M	11/9/1994 0:00	65	65	13.6	51.4	13.6
05S09E04C001M	3/8/1995 0:00	65	65	9.7	55.3	9.7
05S09E04C001M	11/2/1995 0:00	65	65	13.2	51.8	13.2
05S09E04C001M	3/14/1996 0:00	65	65	9	56	9
05S09E04C001M	3/3/1999 0:00	65	65	8.6	56.4	8.6
05S09E04C001M	11/3/1999 0:00	65	65	14.4	50.6	14.4
05S09E04C001M	3/7/2000 0:00	65	65	8.6	56.4	8.6
05S09E04C001M	3/7/2001 0:00	65	65	10.9	54.1	10.9
05S09E04C001M	10/30/2001 0:00	65	65	14.1	50.9	14.1
05S09E04C001M	2/26/2003 0:00	65	65	10.5	54.5	10.5
05S09E04C001M	3/4/2004 0:00	65	65	13.5	51.5	13.5
05S09E04C001M	3/30/2005 0:00	65	65	11.1	53.9	11.1
05S09E04C001M	2/24/2006 0:00	65	65	10.8	54.2	10.8
05S09E04C001M	4/11/2007 0:00	65	65	12.9	52.1	12.9
05S09E04C001M	11/20/2008 0:00	65	65	17.8	47.2	17.8
05S09E04C001M	11/16/2009 0:00	65	65	18.2	46.8	18.2
05S09E04C001M	3/9/2010 0:00	65	65	15	50	15
05S09E04C001M	11/16/2010 0:00	65	65	15.2	49.8	15.2
05S09E04C001M	3/15/2011 0:00	65	65	12.3	52.7	12.3
05S09E04C001M	11/17/2011 0:00	65	65	13.3	51.7	13.3
					Average =	15.2

Well Coordinate Information

Projection	Datum	Easting	Northing	Units	Zone
UTM	NAD27	678103	4156118	metres	10
LL	NAD27	120.9842	37.5367	decimal degrees	
LL	NAD83	120.9852	37.5366	decimal degrees	

Well Use:Undetermined

State_Well_Number	Measurement_Date	RP_Elevation	GS_Elevation	RPWS	WSE	GSWS
05S09E09A001M	12/1/1960 0:00	65	65	6	59	6
05S09E09A001M	12/1/1961 0:00	65	65	9.7	55.3	9.7
05S09E09A001M	12/1/1962 0:00	65	65	3.1	61.9	3.1
05S09E09A001M	2/1/1964 0:00	65	65	4.8	60.2	4.8
05S09E09A001M	2/10/1965 0:00	65	65	4.5	60.5	4.5
05S09E09A001M	11/7/1984 0:00	65	65	14	51	14
05S09E09A001M	11/6/1985 0:00	65	65	8	57	8
05S09E09A001M	11/5/1986 0:00	65	65	7	58	7
05S09E09A001M	3/10/1987 0:00	65	65	6.5	58.5	6.5
05S09E09A001M	3/8/1988 0:00	65	65	18	47	18
05S09E09A001M	10/25/1988 0:00	65	65	23	42	23
05S09E09A001M	3/8/1989 0:00	65	65	18	47	18
05S09E09A001M	11/2/1989 0:00	65	65	17	48	17
05S09E09A001M	2/6/1990 0:00	65	65	16	49	16
05S09E09A001M	10/16/1990 0:00	65	65	21	44	21
05S09E09A001M	2/7/1991 0:00	65	65	17	48	17
05S09E09A001M	2/19/1992 0:00	65	65	16.7	48.3	16.7
05S09E09A001M	10/27/1992 0:00	65	65	15.5	49.5	15.5
05S09E09A001M	3/3/1993 0:00	65	65	13.5	51.5	13.5
05S09E09A001M	10/27/1993 0:00	65	65	6.5	58.5	6.5
05S09E09A001M	2/16/1994 0:00	65	65	7.5	57.5	7.5
05S09E09A001M	11/9/1994 0:00	65	65	8.5	56.5	8.5
05S09E09A001M	11/2/1995 0:00	65	65	7.6	57.4	7.6
05S09E09A001M	11/5/1996 0:00	65	65	6.1	58.9	6.1
05S09E09A001M	11/3/1998 0:00	65	65	6.9	58.1	6.9
05S09E09A001M	3/7/2000 0:00	65	65	3.6	61.4	3.6
05S09E09A001M	3/7/2001 0:00	65	65	5	60	5
05S09E09A001M	10/30/2001 0:00	65	65	10.9	54.1	10.9
05S09E09A001M	3/7/2002 0:00	65	65	6.2	58.8	6.2
05S09E09A001M	2/26/2003 0:00	65	65	7	58	7
05S09E09A001M	3/4/2004 0:00	65	65	7.8	57.2	7.8
05S09E09A001M	3/30/2005 0:00	65	65	5.1	59.9	5.1
05S09E09A001M	2/24/2006 0:00	65	65	6.8	58.2	6.8
05S09E09A001M	11/20/2008 0:00	65	65	13.7	51.3	13.7
05S09E09A001M	3/26/2009 0:00	65	65	17	48	17
05S09E09A001M	11/16/2009 0:00	65	65	12.2	52.8	12.2
05S09E09A001M	3/9/2010 0:00	65	65	10.8	54.2	10.8
05S09E09A001M	11/16/2010 0:00	65	65	10.5	54.5	10.5
05S09E09A001M	3/15/2011 0:00	65	65	9	56	9
05S09E09A001M	11/17/2011 0:00	65	65	18.8	46.2	18.8
					Average =	10.7

Well Coordinate Information

Projection	Datum	Easting	Northing	Units	Zone
UTM	NAD27	678559	4154489	metres	10

LL	NAD27	120.9794	37.5219	decimal degrees
LL	NAD83	120.9804	37.5218	decimal degrees

Well Use:Undetermined

Appendix F
Pond Lining Materials Information

GSE®

GSE STANDARD PRODUCTS

Product Data Sheet

GSE HD Geomembranes

GSE HD is a smooth, high quality, high density polyethylene (HDPE) geomembrane produced from specially formulated, virgin polyethylene resin. This polyethylene resin is designed specifically for flexible geomembrane applications. It contains approximately 97.5% polyethylene, 2.5% carbon black and trace amounts of antioxidants and heat stabilizers; no other additives, fillers or extenders are used. GSE HD has outstanding chemical resistance, mechanical properties, environmental stress crack resistance, dimensional stability and thermal aging characteristics. GSE HD has excellent resistance to UV radiation and is suitable for exposed conditions. *These product specifications meet or exceed GRI GM13.*

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE				
Product Code			HDE 030A000	HDE 040A000	HDE 060A000	HDE 080A000	HDE 100A000
Thickness, (minimum average) mil (mm)	ASTM D 5199	every roll	30 (0.75)	40 (1.00)	60 (1.50)	80 (2.00)	100 (2.50)
Lowest individual reading (-10%)			27 (0.69)	36 (0.91)	54 (1.40)	72 (1.80)	90 (2.30)
Density, g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb					
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		114 (20)	152 (27)	228 (40)	304 (53)	380 (67)
Strength at Yield, lb/in-width (N/mm)			63 (11)	84 (15)	126 (22)	168 (29)	210 (37)
Elongation at Break, %	G.L. 2.0 in (51 mm)		700	700	700	700	700
Elongation at Yield, %	G.L. 1.3 in (33 mm)		12	12	12	12	12
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	21 (93)	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	54 (240)	72 (320)	108 (480)	144 (640)	180 (800)
Carbon Black Content, %	ASTM D 1603*/4218	20,000 lb	2.0	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1	+Note 1
Notched Constant Tensile Load, hr	ASTM D 5397, Appendix	200,000 lb	300	300	300	300	300
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**				
Oxidative Induction Time, min	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100	>100
Roll Length[1] (approximate), ft (m)			1,120 (341)	870 (265)	560 (171)	430 (131)	340 (104)
Roll Width[1], ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			25,200 (2,341)	19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE HD is available in rolls weighing about 3,900 lb (1,769 kg)
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.
- [1]Roll lengths and widths have a tolerance of ± 1%.
- *Modified.

DS005 HD R01/07/08

North America	GSE Lining Technology, Inc.	Houston, Texas	800.435.2008	281.443.8564	Fax: 281.230.6739
South America	GSE Lining Technology Chile S.A.	Santiago, Chile		56.2.595.4200	Fax: 56.2.595.4290
Asia Pacific	GSE Lining Technology Company Limited	Bangkok, Thailand		66.2.937.0091	Fax: 66.2.937.0097
Europe & Africa	GSE Lining Technology GmbH	Hamburg, Germany		49.40.767420	Fax: 49.40.7674234
Middle East	GSE Lining Technology-Egypt	The 6th of October City, Egypt		20.2.828.8888	Fax: 20.2.828.8889

SAMPLE COPY

PRO RATA LIMITED MATERIAL WARRANTY
FOR GSE LINING TECHNOLOGY, INC.
Geomembrane Products
(U.S.A.)

Date:	_____	Warranty No.:	_____
Purchaser Name:	_____	Project No.:	_____
Address:	_____	Effective Date:	_____
City, State:	_____	Project Name:	_____
Product Type/Description:	_____	Project Address:	_____

GSE Lining Technology, Inc. ("GSE") warrants each GSE product described above to be free from material manufacturing defects (as described by the contract's material specifications) and to be able to withstand normal weathering for a period of **five (5) years** from the date of sale. This limited warranty does not include damages or defects in the GSE product resulting from acts of God, casualty or catastrophe, including but not limited to: earthquakes, floods, piercing hail, tornadoes or force majeure. The term "normal use" does not include, among other things, the exposure of GSE's product to harmful chemicals, abuse by machinery, equipment or people; improper site preparation or placement of cover materials; excessive pressures or stresses from any source. This warranty is intended for commercial use only and is not in effect for the consumer as defined in the Magnuson-Moss Warranty Act.

Should defects or premature loss of use within the scope of this warranty occur, GSE will, at its option, repair or replace the GSE product on a pro rata basis at the current price in such manner as to charge the Purchaser only for that portion of the warranted life which has elapsed since the purchase of the product. GSE shall have the right to inspect and determine the cause of the alleged defect in the product and to take appropriate steps to repair or replace the product if a defect exists that is covered under this warranty.

Any claim for any alleged breach of this warranty must be made in writing, by certified mail or courier, to GSE Lining Technology Co., 19103 Gundle Road, Houston, TX 77073, with the words "Warranty Claim" clearly marked on the face of the envelope, within ten (10) days of Purchaser becoming aware of the alleged defect. Should the required notice not be given, the defect and all warranties are waived by the Purchaser, and Purchaser shall not have rights under this warranty. GSE shall not be obligated to perform any inspection or obligated to perform any repair or replacement under this warranty until the area is made available free from all obstructions, water, dirt, sludge, residuals and liquids of any kind. If after inspection it is determined that there is no claim under this warranty, Purchaser shall reimburse GSE for its costs associated with the site inspection.

In the event the exclusive remedy provided herein fails in its essential purpose, and in that event only, the Purchaser shall be entitled to a return of the purchase price for so much of the product as GSE determines to have violated the warranty provided herein. GSE shall not be liable for direct, indirect, special, consequential or incidental damages resulting from a breach of this warranty including, but not limited to: damages for loss of production, lost profits, personal injury or property damage. GSE shall not be obligated to reimburse Purchaser for any repairs, replacement, modifications or alterations made by Purchaser to GSE's product, unless GSE specifically authorized, in writing, said repairs, replacements, modifications or alterations in advance. GSE liability under this warranty shall in no event exceed the replacement cost of the product sold to the Purchaser for the particular installation in which it failed.

GSE neither assumes nor authorizes any person other than an officer of GSE to assume for it any other or additional liability in connection with the GSE product made on the basis of the Limited Warranty. **GSE MAKES NO WARRANTY OF ANY KIND OTHER THAN THAT GIVEN HEREIN AND HEREBY DISCLAIMS ALL WARRANTIES, INCLUDING BOTH EXPRESS OR IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, AND BY ACCEPTING DELIVERY OF THE PRODUCT, PURCHASER WAIVES ALL OTHER POSSIBLE WARRANTIES. GSE's WARRANTY BECOMES AN OBLIGATION OF GSE TO PERFORM UNDER THE WARRANTY ONLY UPON RECEIPT OF FINAL PAYMENT.**

This warranty is extended to the Purchaser and is non-transferable and non-assignable, i.e. there are no third-party beneficiaries to this warranty.

GSE®

GSE STANDARD PRODUCTS

Product Data Sheet

GSE FabriNet Geocomposite (Double-Sided)

GSE FabriNet geocomposite consists of GSE HyperNet geonet heat-laminated on both sides with a GSE nonwoven needlepunched geotextile. GSE HyperNet is a 200 mil thick geonet manufactured from a premium grade high density polyethylene resin. For the purpose of lamination to geonets, GSE nonwoven needlepunched geotextiles are available in mass per unit area range of 6 oz/yd² (200 g/m²) to 16 oz/yd² (540 g/m²). GSE FabriNet geocomposites are designed and formulated to perform drainage function under a range of anticipated site loads, gradients and boundary conditions. Index properties for the product are provided in the table below. Please contact GSE for further information regarding performance under site-specific conditions.

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE ROLL VALUE[a]		
Geocomposite			6 oz/yd²	8 oz/yd²	10 oz/yd²
Product Code			F42060060S	F42080080S	F421001005
Transmissivity[b], gal/min/ft (m²/sec)	ASTM D 4716	1/540,000 ft²	0.48 (1 x 10^{-4})	0.48 (1 x 10^{-4})	0.43 (9 x 10^{-5})
Ply Adhesion, lb/in (g/cm)	ASTM D 7005	1/50,000 ft²	1.0 (178)	1.0 (178)	1.0 (178)
Roll Width[c], ft (m)			14.5 (4.4)	14.5 (4.4)	14.5 (4.4)
Roll Length[c], ft (m)			230 (70.1)	200 (60.9)	190 (58.0)
Roll Area, ft² (m²)			3,335 (310)	2,900 (269)	2,755 (256)
Geonet core[d]					
Transmissivity,[b] gal/min/ft (m²/sec)	ASTM D 4716		9.66 (2 x 10^{-3})	9.66 (2 x 10^{-3})	9.66 (2 x 10^{-3})
Thickness, mil (mm)	ASTM D 5199	1/50,000 ft²	200 (5)	200 (5)	200 (5)
Density, g/cm³	ASTM D 1505	1/50,000 ft²	0.94	0.94	0.94
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035	1/50,000 ft²	45 (7.9)	45 (7.9)	45 (7.9)
Carbon Black Content, %	ASTM D 1603	1/50,000 ft²	2.0	2.0	2.0
Geotextile (prior to lamination)[d,e]					
Mass per Unit Area, oz/yd² (g/m²)	ASTM D 5261	1/90,000 ft²	6 (200)	8 (270)	10 (335)
Grab Tensile, lb (N)	ASTM D 4632	1/90,000 ft²	170 (755)	220 (975)	260 (1,155)
Puncture Strength, lb (N)	ASTM D 4833	1/90,000 ft²	90 (395)	120 (525)	165 (725)
AOS, US sieve (mm)	ASTM D 4751	1/540,000 ft²	70 (0.212)	80 (0.180)	100 (0.150)
Permittivity, (sec⁻¹)	ASTM D 4491	1/540,000 ft²	1.5	1.5	1.2
Flow Rate, gpm/ft² (lpm/m²)	ASTM D 4491	1/540,000 ft²	110 (4,480)	110 (4,480)	85 (3,460)
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	once per formulation	70	70	70

NOTES:

- [a] These are MARV values that are based on the cumulative results of specimens tested and determined by GSE. AOS is a maximum average roll value.
- [b] Gradient of 0.1, normal load of 10,000 psf, water at 70° F between steel plates for 15 minutes.
- [c] Roll widths and lengths have a tolerance of ±1%.
- [d] Component properties prior to lamination.
- [e] Refer to geotextile product data sheet for additional specifications.

DS018 Fabrinet R01/13/06

North America	GSE Lining Technology, Inc.	Houston, Texas	800 435 2008	281 443 8564	Fax: 281 230 8650
South America	GSE Lining Technology Chile S.A.	Santiago, Chile		56 2 595 4200	Fax: 56 2 595 4290
Asia Pacific	GSE Lining Technology Company Limited	Bangkok, Thailand		66 2 937 0091	Fax: 66 2 937 0097
Europe & Africa	GSE Lining Technology GmbH	Hamburg, Germany		49 40 767420	Fax: 49 40 7674234
Middle East	GSE Lining Technology-Egypt	The 6th of October City, Egypt		202 2 828 8888	Fax: 202 2 828 8889

Geomembranes

GSE HD • GSE HD Textured • GSE White • GSE White Textured • GSE Conductive • GSE Conductive Textured • GSE Conductive White
GSE Green Textured • GSE HD Weld Edge Textured • GSE UltraFlex • GSE UltraFlex Textured • GSE UltraFlex White • GSE Ultraflex White Textured

Installation Quality Assurance Manual

www.gseworld.com

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1.0 Overview

This manual is a guide of the duties and responsibilities for a GSE QA technician.

ASTM Practices that this guide lists include the following and are included separately:

ASTM D-6392 Standard Test Methods For Determining The Integrity Of NonReinforced Geomembrane Seams Produced Using Thermo Fusion Methods

ASTM D-5820 Standard Practice For Pressurized Air Channel Evaluation of Dual Seamed Geomembranes

ASTM D-5641 Standard Practice For Geomembrane Seam Evaluation By Vacuum Chamber

ASTM D-6497 Standard Guide For Mechanical Attachment of Geomembrane to Penetrations or Structures

GRI Standard GM13 Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes

GRI Standard GM14 Selecting Variable Intervals for Taking Geomembrane Destructive Seam Samples Using the Method of Attributes

GRI Standard GM17 Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes

GRI Standard GM19 Standard Specification for Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes

2.0 Material Delivery

2.01 Upon arrival on site, the GSE QA will do an inventory of materials on the job site.

2.02 Roll numbers of liner, textile, geonet and composite will be logged on the Inventory Check List and cross-referenced with bills of lading (Materials Supplied by GSE).

2.03 Copies of the Inventory Check List and signed Bill of Ladings should be sent to the home office with the QA retaining the originals.

2.04 Any visible damage to roll materials should be noted on the roll and Inventory Check List.

3.0 Earthwork

3.01 The General Contractor is responsible for preparing and maintaining the subgrade. The subgrade should be prepared and maintained per the individual job specifications.

3.02 Subgrade Surface Acceptance Certificate - The GSE Site Manager shall be responsible for assuring that the subgrade surface has been properly prepared for deployment of geosynthetics. If GSE is required to sign a Subgrade Surface Acceptance Certificate, please use the form provided by GSE. Under no circumstances sign off on subgrade that is not suitable for deployment of geosynthetics. Sign the Subgrade Acceptance Certificate only on areas to be covered in one day, preferably after deployment.

3.03 If the subgrade is unacceptable and the GC/Owner directs GSE to deploy over, the GSE Site Manager must have the Owner's representative sign the Deployment by Owner's Direction Over Unsuitable Subgrade Certificate which will take the place of the Subgrade acceptance Certificate for the particular area being covered.

3.04 Prior to material installation, whenever possible, the QA should measure the area to be covered and compare it to the area used for the bid. An outline of the area including anchor trenches, top of slopes and toe of slopes will be provided by GSE's Drafting department. Use this outline to log actual on-site conditions, i.e....distances between anchor trenches, length of anchor trenches, top of berms, length of slopes and/or any other relevant distances.

Note: Whenever possible distances will be included on the blank outlines. If actual field dimensions have changed or do not match the GSE outline the QA should notify their Supervisor and then the Project Manager, so that quantities can be reassessed to determine the proper amount of material needed for installation. It is important to establish the limits of deployment with all parties. Any changes must be noted and signed off by the Customer's Representative.

4.0 Panel Placement

4.01 Each panel will be assigned a number as detailed below.

4.01a When there is only one layer, panels may be designated with a number only, i.e.... 1, 2, 3, 4 etc.

4.01b When two or more layers are required use a letter and number, i.e....
Secondary Liner S1, S2, S3, S4 etc...
Primary Liner P1, P2, P3, P4 etc...
Tertiary Liner T1, T2, T3, T4 etc...

4.02 This numbering system should be used whenever possible. Agreement to a panel numbering system should be made at the pre-construction meeting if possible. However, it is essential that GSE's system and the Owner's Representative/Third Party QA agree. Do not use different systems.

4.03 Panel numbers shall be written in large block letters in the center of each deployed panel. The roll number, date of deployment and length (gross) should be noted below the panel number. All noting should be made so that they are easily visible from a distance. On long panels it is beneficial to write information at both ends.

4.04 Panel Numbers shall be logged on the GSE Panel Placement Log along with the roll number and gross length.

4.05 If there is a partial roll left after deployment it is important to write the last four digits of the roll number several times for future identification, along with the estimated length.

4.06 Deployment of geomembrane panels shall be performed in a manner that will comply with the following guidelines:

4.06a Unroll geomembrane using methods that will not damage geomembrane and will protect underlying surface from damage (spreader bar, protected equipment bucket).

4.06b Place ballast (commonly sandbags) on geomembrane which will not damage geomembrane to prevent wind uplift.

4.06c Personnel walking on geomembrane shall not engage in activities or wear shoes that could damage it. Smoking will not be permitted on the geomembrane.

4.06d Do not allow heavy vehicular traffic directly on geomembrane. Rubber tired/tracked ATV's and trucks are acceptable if wheel contact is less than 8 psi.

4.06e Protect geomembrane in areas of heavy traffic by placing protective cover over the geomembrane.

4.06f Driver shall check for sharp edges, embedded rocks, or other foreign material stuck into or protruding out from tires/tracks prior to driving on any geosynthetic layer.

4.06g Path driven on geosynthetics shall be as straight as possible with no sharp turns, sudden stops, or quick starts.

4.06h Areas where driving occurs shall be continuously and thoroughly inspected throughout the deployment process by the contractor and the third party CQA.

5.0 Trial Welds

5.01 Seaming apparatus shall be allowed to warm up a minimum of 15 minutes before performing trial welds.

5.02 Each seaming apparatus along with GSE Welding Tech will pass a trial weld prior to use. Trial welds to be performed in the morning and afternoon, as a minimum, as well as whenever there is a power shutdown.

5.03 Fusion or wedge welds will always be performed or conducted on samples at least 6' long. Extrusion welds will be done on samples at least 3' long.

Note: Always perform trial welds in the same conditions that exist on the job. Run the trial welds on the ground, not the installed liner. Do not use a wind break unless you are using one on the job.

5.04 Sampling Procedure

5.04a Cut 4 - 1" wide specimens from the trial weld sample. Operating temperatures should be monitored while welding.

5.04b Specimens will always be cut using a 1" die cutter so the peel values may be used for qualitative analysis.

5.04c When cutting coupons from the trial weld samples, the inside and outside tracks on the coupon should be identified to assist in troubleshooting problems in case the weld fails. The outside track will be defined as the track which would be peeled if pulling the overlap exposed in a typical installation, or the seam which is closest to the edge of the top sheet. The inside track is the seam closest to the edge of the bottom sheet.

5.04d Place a small mark on the exposed (Top) overlap to denote the outside track prior to testing trial welds.

5.05 Die Cutter

5.05a Only cut one sample at a time to avoid damaging the die cutter.

5.05b Samples should be free of sand and grit prior to cutting sample.

5.05c Inspect the die edge weekly for nicks, dents or signs of dullness. Dullness of the cutting edge may damage the units.

5.05d Remove die when edge has been dulled and lightly reshape it with a medium hand file. When wear is excessive return it for a replacement die.

5.05e When the cutting board becomes deeply scored and/or interferes with coupon cutting it should be replaced.

5.05d To adjust the depth of the die cut into the cutting board, after replacing the cutting board or sharpening the die, 0.015" washer shims can be added or removed between the cutting ram and the ram extension. Only add shims when cutting is difficult due to lack of depth of cut.

5.06 Trial Weld Testing

5.06a Allow coupons to cool prior to testing. Avoid separating the coupons while hot as failure of the sheet may be initiated and false readings indicated.

5.06b In extreme heat the coupons may need to be cooled, using water or an insulated cooler prior to peel testing. Lab conditions specify 70 degrees (plus or minus 4 degrees) Fahrenheit. Coupon temperatures greater than 70 degrees may result in lowered strengths.

5.06c Visually inspect the coupons for squeeze-out, footprint, pressure and general appearance.

5.06d Each of the 4 coupons will be tested in peel on the field tensiometer at a separation rate of 2" per minute (for HDPE). Shear tests, in addition to the peel tests, will be performed if required by a site-specific QA. Plan.

5.07 Pass/Fail Criteria

5.07a Criteria for passing trial welds will be as follows:

1) Seam must exhibit film tear bond (FTB). Trial welds should have no incursion into the weld.
2) Peel and shear values shall meet or exceed the values listed below for HDPE smooth or textured sheet (@ 2"/min.):

Material (Mil)	Shear Strength (PPI)	Fusion Peel (PPI)	Extrusion Peel (PPI)
40	81	65	52
60	121	98	78
80	162	130	104
100	203	162	130

3) Peel and shear values shall meet or exceed the values listed below for LLDPE smooth or textured sheet (@ 20"/min.):

Material (Mil)	Shear Strength (PPI)	Fusion Peel (PPI)	Extrusion Peel (PPI)
40	60	50	48
60	90	75	72
80	120	100	96
100	150	125	120

5.07b Both tracks of fusion welded samples must pass for the trial weld to be considered acceptable. If any of the four coupons fail either due to seam incursion (no FTB) or low strength values, the trial weld must be re-done.

5.07c The GSE QA will give approval to proceed with welding after observing and recording all trial welds.

5.08 Trial Weld Documentation

5.08a All trial weld data will be logged on the GSE Trial Weld log

5.08b When logging fusion welded peel values on the GSE Trial Weld log indicate the values for the outside track first, followed by the inside track

5.08c Speed and temperature settings will be recorded for each machine's trial weld

6.0 Geomembrane Field Seaming

6.01 The seam number takes the identity of the panels on each side. The seam between panels 1 & 2 becomes Seam 1/2. These lengths and seam numbers shall be recorded in the GSE Seam Log.

6.02 Welding Technicians will mark their initials/employee number, machine number, date and time at the start of every seam. Technician should also periodically mark temperatures along the seam and at the end of the seam.

6.03 Approved processes for field seaming and repairing are extrusion welding and fusion welding. All welding equipment shall have accurate temperature monitoring devices installed and working to ensure proper measurement.

6.04 Extrusion welding shall be used primarily for repairs, patching and special detail fabricating and may be used for seaming. The GSE Site Manager shall verify that:

1) equipment in use is functioning properly
2) welding personnel are purging the machine of heat degraded extrudate prior to actual use
3) all work is performed on clean surfaces and done in a professional manner
4) no seaming will be performed in adverse weather conditions

6.05 Fusion welding, shall be used for seaming panels together and is not used for patching or detail work. The GSE Site Manager shall verify that:

1) the equipment used is functioning properly
2) seaming personnel are working in a professional manner and are attentive to their duties
3) no seaming will be performed in adverse weather conditions

6.06 Seam preparation, the welding technician shall verify that:

1) prior to seaming, the seaming area is free of moisture, dust, dirt, sand or debris of any nature
2) the seam is overlapped properly for fusion welding
3) the seam is overlapped or extended beyond damaged areas at least 4" when extrusion welding
4) the seam is properly heat tacked and abraded when extrusion welding
5) seams are welded with fewest number of unmatched wrinkles or "fishmouths"

6.07 No seaming will be performed in ambient air temperatures or adverse weather conditions that would jeopardize the integrity of the liner installation.

7.0 Field Destructive Testing

7.01 Destructive seam tests shall be performed to evaluate bonded seam strength. The frequency of sample removal shall be one sample per 500' of seam, unless specific site specifications differ. Location of the destructive samples will be selected and marked by the QA Technician or third party QA. Field testing should take place as soon as possible after seam is completed.

7.02 Samples should be labeled in numerical order, I.e. DS-1, DS-2 etc....This should carry thru any layers and or multiple ponds, do not start numbering from 1 again. (This is the preferred method)

7.03 The size of samples and distribution should be approximately 12" x 39"(size may vary dependent on Job requirements) and distributed as follows:

7.03a 12" x 12" piece given to QA Technician for field testing.

7.03b 12" x 12" piece sent to Home Office for testing, if required.
7.03c 12" x 12" piece given to third party for independent testing, or archiving.

NOTE: All samples will be labeled showing test number, seam number, machine number, job number, date welded and welding tech number.

7.04 The sample given to the QA Technician in the field shall have ten coupons cut and be tested with a tensiometer adjusted to a pull rate as shown below. The strength of four out of five specimens should meet or exceed the values below, and the fifth specimen must meet or exceed 80% of the value below.

1) Seam must exhibit film tear bond (FTB). Welds should have ≤25% incursion into the weld.
2) Peel and shear values shall meet or exceed the values listed below for HDPE smooth or textured sheet (@ 2"/min.):

Material (Mil)	Shear Strength (PPI)	Fusion Peel (PPI)	Extrusion Peel (PPI)
40	81	65	52
60	121	98	78
80	162	130	104
100	203	162	130

3) Peel and shear values shall meet or exceed the values listed below for LLDPE smooth or textured sheet (@ 20"/min.):

Material (Mil)	Shear Strength (PPI)	Fusion Peel (PPI)	Extrusion Peel (PPI)
40	60	50	48
60	90	75	72
80	120	100	96
100	150	125	120

7.05 All weld destructive test data will be logged on the GSE Destructive test log.

7.06 When logging fusion welded peel values on the GSE Destructive Test Log, indicate the values for the outside track first, followed by the inside track.

7.08 Test results will be noted in the GSE Destructive Test Log as P (pass) or F (fail).

7.09 If test fails, additional samples will be cut, approximately 10' on each side of the failed test, and retested. These will be labeled A (after) & B (before). This procedure will repeat itself until a sample passes. Then the area of failed seam between the two tests that pass will be capped or reconstructed.

7.10 In lieu of taking an excessive number of samples, the GSE Site Manager may opt to extrusion weld the flap or cap the entire seam and then non-destructively test according to Section 8.0.

8.0 Non-Destructive Testing

8.01 GSE shall non-destructively test all seams their full length using an air pressure or vacuum test. The purpose of this test is to check the continuity of the seam.

8.02 Air testing; the following procedures are applicable to those seams welded with a double-seam fusion welder.

8.02a The equipment used shall consist of an air tank or pump capable of producing a minimum 35 psi and a sharp needle with a pressure gauge attached to insert into the air chamber.

8.02b Seal both ends of the seam by heating and then squeezing together. Insert the needle with the gauge into the air channel, it may be necessary to heat the liner to make this easier. Pressurize the air channel to 30psi. Note time test starts and wait a minimum of 5 minutes to check. If pressure after five minutes has dropped less than 2 psi then the test is successful (Thickness of material may cause variance).

8.02c Cut opposite seam end and listen for pressure release to verify full seam has been tested.

8.02d If the test fails, follow these procedures.

a) While channel is under pressure walk the length of the seam listening for a leak.
b) While channel is under pressure apply a soapy solution to the seam edge and look for bubbles formed by air escaping.
c) Re-test the seam in smaller increments until the leak is found.

8.02e Once the leak is found using one of the proceedures above, cut out the leak area and retest the portions of the seams between the leak areas as per 8.02a to 8.02c above. Continue this proceedure until all sections of the seam pass the pressure test.

8.02f Repair the leak with a patch and vacuum test again.

8.02g All non-destructive tests will be noted in the GSE Non-Destructive Test/Repair log.

8.03 Vacuum testing; the following procedures are applicable to those seams welded with a extrusion welder.

8.03a The equipment used shall consist of an vacuum pumping device, a vacuum box and a foaming agent in solution.

8.03b Wet a section with the foaming agent, place vacuum box over wetted area. Evacuate air from the vacuum box to a pressure suitable to affect a seal between the box and geomembrane. Observe the seam through the viewing window for the presence of soap bubbles emitting from the seam.

8.03c If no bubbles are observed, move box to the next area for testing. If bubbles are observed, mark the area of the leak for repair as per Section 10.0 and retest as

per Section 8.03.

Note: If vacuum testing fusion welded seams, the overlap flap must be cut off to perform the tests.

9.0 Defects and Repairs

9.01 Identification; all seams and non-seam areas of the geomembrane lining system shall be examined for defects in the seam and sheet.

9.02 Identification of the defect should be made using the following procedures:

9.02a For any defect in the seam or sheet that is an actual breach (hole) in the liner, installation personnel shall circle the defect and mark with the letter "P" along side the circle. The letter "P" indicates a patch is required.

9.02b For any defect that is not an actual hole, installation personnel shall only circle the defect indicating that the repair method may be only an extruded bead and that a patch is not required.

9.02c Each suspect area that has been identified as needing repair shall be repaired in accordance with this section and Non-Destructively tested as per Section 8.0. After all work is complete, the GSE Site Manager will conduct a final walk-through to confirm all repairs have been completed and debris removed. Only after this final evaluation by GSE's Site Manager and Owner/Agent shall any material be placed over the installed liner.

10.0 Repair Procedures

10.01 Any Portion of the Geomembrane liner system exhibiting a defect which has been marked for repair may be repaired with any one or combination of the following procedures:

1) Patching - used to repair holes, tears, undispersed raw materials in the sheet and dented areas.
2) Grind and Reweld - used to repair small sections of extruded seams.
3) Spot Welding - Used to repair small minor, localized flaws.
4) Flap Welding - Used to extrusion weld the flap of a fusion weld in lieu of a full cap.
5) Capping - Used to repair failed seams.
6) Topping - Application of extrudate bead directly to existing seams.

10.02 The following conditions shall apply to the above methods:

1) surfaces of the geomembrane which are to be repaired shall be roughened
2) all surfaces must be clean and dry at the time of the repair
3) all seaming equipment used in repairing procedures shall be qualified
4) all patches and caps shall extend at least 4" beyond the edge of the defect, and all patches must have rounded corners
5) all cut out holes in liner must have rounded corners, 3" min. radius

11.0 As-Built Drawing Procedures

11.01 Liner Layout

11.01a Submitted As-built Drawings should always be on blank outlines supplied by GSE's Drafting Department. (Phone 281-230-2518 Don Sharkey). When outlines are not available plain paper may be used, but only after permission from GSE's Drafting Department.

11.01b Accuracy to the way seams fit or join.

11.01c Using different colors makes information easier to see. Drawings may be done in ink or pencil, but writing must be neat.

11.01d Do not write so small that it is hard to read.

11.01e Suggested scale is 1" = 40' (Other scales may be used if required).

11.02 Anchor Trenches

11.02a The amount of liner actually in the trench should be noted on the drawing. If amount differs, show all differences and approximate locations.

11.02b If anchor trench is larger than shown on GSE's construction drawings then a written approval should be obtained from the Owner/Agent representative. This should be included in the as-built package.

11.03 Panel & Roll Numbers

11.03a Each panel will be assigned a number as detailed below. When there is only one layer panels may be designate with a number only, i.e.... 1, 2, 3, 4 etc.

11.03b When two or more layers are required use a letter and number, i.e....

Secondary Liner S1, S2, S3, S4 etc...
Primary Liner P1, P2, P3, P4 etc...
Tertiary Liner T1, T2, T3, T4 etc...

11.03c This numbering system should be used whenever possible. Agreement to a panel numbering system should be made at the pre-construction meeting if possible. However, it is essential that GSE's system and the Owner's Representative/Third Party QA agree. Do not use different systems.

11.03d Panel numbers shall be written in large block letters in the center of each deployed panel. The roll number, date of deployment and gross length should be noted below the panel number. All notations should be made so that they are easily visible from a distance. On long panels it is beneficial to write information at both ends.

11.03e Panel Numbers shall be logged on the Daily Report Forms along with the roll number and gross length.

11.03f Whenever possible, roll numbers should be placed next to panel numbers on the field copies of the as-built drawing.

11.04 Seam Lengths

11.04a Every seam length that is not a cross-seam must be noted. This includes rectangles, squares, pies and any other shape (See Fig. A).

11.04b GSE assumes that all regular cross-seams are either 22' or 34' wide, unless they are not full width panels they do not have to be noted on the drawing. Panel widths are measured perpendicularly across the panels.

11.04c All dimensions should be called out in tenths of a foot.

11.05 Tests

11.05a All test markings should conform to the "Legend" on the blank outline.

11.05b It can be assumed that all seam junctions will have a patch, therefore, it is only necessary to note if they don't.

11.06 Seam Numbers

11.06a Since the seam number is drawn from the adjoining panels (I.e. 1/2, 10/11 etc.) there is no need to call out seam numbers on the drawings.

11.06b Each seam must be logged in the Daily Report.

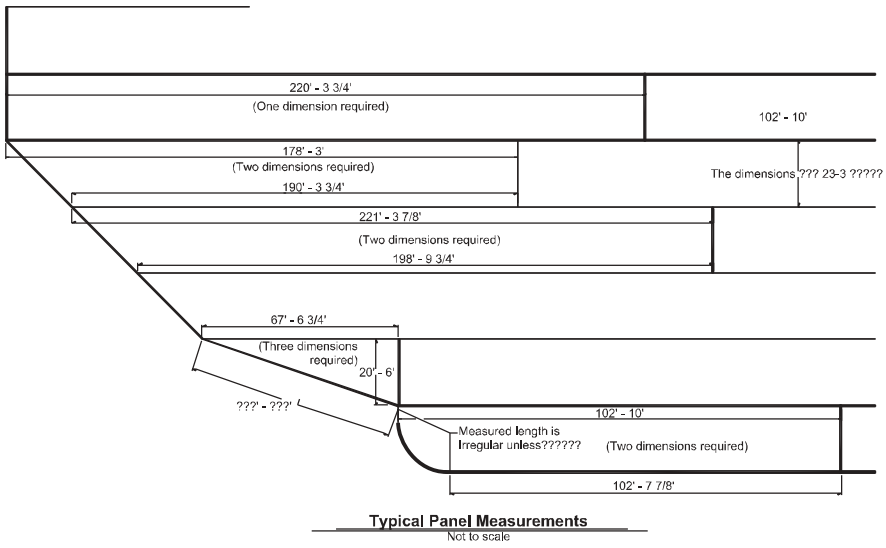


Fig A

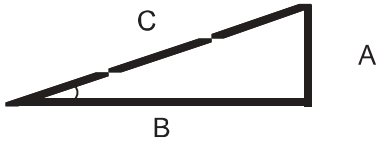
11.07 Miscellaneous

11.07a QA's name should be on all drawings and paperwork.

11.07b Any questions arising in the field about reporting issues may be handled by calling Don Sharkey at 800-435-2008, ext 2518 or 281-230-2518.

12.0 Formulas

12.01 Here are some procedures using trig formulas to enable you to deal with slope corrections concerning seam lengths on as-built drawings in order to do these calculations you will need a calculator that performs trigonomic functions.



A = Rise
B = Base
C = Slope

12.02 Useful Formulas

12.02a rise divided by base = Tangent of the angle

12.02b base divided by cosign of the angle = slope

12.02c slope multiplied by cosign of the angle = base

12.02d rise divided by Tangent of the angle = base

12.03 Slope factors

12.03a Slope factors can be used as a quick method of calculating seam lengths in a flat plan, such as an as-built drawing. Most of the time when field drawings do not fit the outline provided by the Drafting Department it is because actual seam lengths were used instead of lengths calculated with a slope factor. Once you determine the slope factor (a percentage of the actual length) it will probably make field drawings fit the outlines better. As usual, there are always exceptions to this theory.

12.03b To determine a slope factor simply divide the base length by the slope length. Lets use a 3:1 slope as an example. With a base of 100' and a rise of 33.34' the angle of the slope becomes 18.435 degrees. 100' divided by the cosign of 18.435 degrees equals 105.41'. Thus, if you divide 100' by 105.41' you get a slope factor of .9487 or rounded to the nearest one hundredth 0.95.

Now, if you multiply your slope lengths by .95 you will get the actual plan view or paper view length of a seam.

12.04 Typical Slope factors

Slope	Slope Factor	Degrees
2 to 1	0.895	26.565
3 to 1	0.949	18.435
4 to 1	0.970	14.036
5 to1	0.981	11.310
2.5 to 1	0.928	21.802

GSE Panel Placement Log

Project Name: ____________________ Site Manager: ____________________

Location: ____________________ Material: ____________________

Job Number: ____________________ Sheet Thickness: ____________________

Q.A. Technician: ____________________ Smooth: ________ Textured: ________

Panel Number	Roll Number	Deployment Date	Width (Feet)	Length (Feet)	Square Feet Smooth	Square Feet Textured

GSE Seam Log

Project Name: ______________________ Site Manager: ______________________

Location: ______________________ Material: ______________________

Job Number: ______________________ Sheet Thickness: ______________________

Q.A. Techncian: ______________________ Smooth: ________ Textured: ________

Seam Number	Time of Weld	Date of Weld	Type of Weld	Length of Seam	Machine Number	Technician ID Number

GSE Destructive Test Log

Project Name:	Site Manager:	Fusion (ppi)	Extrusion (ppi)
Location:	Material:	Min. Peel	Min. Peel
Job Number:	Sheet Thickness:	Min. Shear	Min. Shear
Q.A. Technician:	Smooth: Textured:		

Sample No.	Date Welded	Seam Number	Technician ID Number	Machine Type & No.	Location	Peel ppi	Peel ppi	Peel ppi	Peel ppi	Peel ppi	Peel ppi	Shear ppi	Shear ppi	Shear ppi	Shear ppi	Shear ppi	Shear ppi	FTB Y / N	Pass/ Fail

GSE Non-Destuctive Test / Repair Log

Project Name: _____ Site Manager: _____

Location: _____ Material: _____

Job Number: _____ Sheet Thickness: _____

Q.A. Technician: _____

Seam Number	Test Date	Technician ID Number	Test Type (A or V)	Air Pressure Test psi start	Air Pressure Test psi finish	Test Result (P or F)	Repair Locations

GSE Trial Weld Log

Project Name: _____ Site Manager: _____

Location: _____ Material: _____

Job Number: _____ Sheet Thickness: _____

Q.A. Technician: _____ Smooth: _____ Textured: _____

Trial No.	Date of Trial	Time of Trial	Technicians ID Number	Machine Number	Ambient Temp.	Wedge Mass	Speed Preheat	Peel ppi	Peel ppi	Peel ppi	Peel ppi	Shear ppi	Shear ppi	Shear ppi	Shear ppi	FTB Y / N	Pass Fail

Subgrade Surface Acceptance

Date: _____

Project: _____ **Site Manager:** _____

Project #: _____

Location: _____ **Partial:** _____ **Final:** _____

This document only applies to the acceptability of surface conditions for installation of geosynthetic products. GSE does not accept responsibility for compaction, elevation or moisture content, nor for the surface maintenance during deployment. Structural integrity of the subgrade and maintenance of these conditions are the responsibility of the owner or earthwork contrator.

_____

_____

_____

_____

_____

For GSE Lining Technology, Inc.: For Owner / Contractor:

_____ _____

_____ _____

Acceptance Number: _____ Area Accepted: _____ s.f. Total Area Accepted to date: _____ s.f.

Spark Test Log

Project Name: _____ Site Manager: _____

Location: _____ Material: _____

Job Number: _____ Sheet Thickness: _____

Q.A. Technician: _____

Seam or Panel No.	Time of Test	Date of Test	Technician ID Number	Location of Repairs

GSE Lining Technology, Inc.
19103 Gundle Road
Houston, Texas 77073-3598
800-435-2008
281-443-8564
281-875-6010 Fax

Job No.: _____
Project: _____
Client: _____
Bill To: _____
_____
_____
Job Description: _____
% Complete of Total Job: _____

Certificate of Acceptance

Material	Estimated Square feet	Final Quantity/Description

I, the undersigned, duly representative of:
Do hereby take over and accept the work described above from the date hereof and confirm to the best of my knowledge the work has been completed in accordance with the specifications and the terms and conditions of the contract.

Name	Signature	Title	Date

Certificate accepted by GSE Lining Technology, Inc Representative.

Name	Signature	Title	Date

GSE Inventory Check List

Date: _____

Project: _____ **Site Manager:** _____

Project #: _____ **QA Technician:** _____ **Page:** _____ of _____

Material	Roll #	Date Used	Material	Roll #	Date Used	Material	Roll #	Date Used	Material	Roll #	Date Used	Material	Roll #	Date Used

GRI Standard GM 13*

STANDARD SPECIFICATION FOR TEST PROPERTIES, TESTING FREQUENCY AND RECOMMENDED WARRANTY FOR HIGH DENSITY POLYETHYLENE (HDPE) SMOOTH AND TEXTURED GEOMEMBRANES

This specification was developed by the Geosynthetic Research Institute (GRI), with the cooperation of the member organizations for general use by the public. It is completely optional in this regard and can be superseded by other existing or new specifications on the subject matter in whole or in part. Neither GRI, the Geosynthetic Institute, nor any of its related institutes, warrant or indemnifies any materials produced according to this specification either at this time or in the future.

1.0 Scope

1.1 This specification covers high density polyethylene (HDPE) geomembranes with a formulated sheet density of 0.940 g/ml, or higher, in the thickness range of 0.75 mm (30 mils) to 3.0 mm (120 mils). Both smooth and textured geomembrane surfaces are included.

1.2 This specification sets forth a set of minimum, physical, mechanical and chemical properties that must be met, or exceeded by the geomembrane being manufactured. In a few cases a range is specified.

1.3 In the context of quality systems and management, this specification represents manufacturing quality control (MQC).

Note 1: Manufacturing quality control represents those actions taken by a manufacturer to ensure that the product represents the stated objective and properties set forth in this specification.

1.4 This standard specification is intended to ensure good quality and performance of HDPE geomembranes in general applications, but is possibly not adequate for the complete specification in a specific situation. Additional tests, or more restrictive values for test indicated, may be necessary under conditions of a particular application.

1.5 This specification also presents a recommended warrant which is focused on the geomembrane material itself.

1.6 The recommended warrant attached to this specification does not cover installation considerations which is independent of the manufacturing of the geomembrane.

Note 2: For information on installation techniques, users of this standard are referred to the geosynthetics literature, which is abundant on the subject.

*This GRI standard is developed by the Geosynthetic Research Institute through consultation and review by the member organizations. This specification will be reviewed at least every 2-years, or on an as-required basis. In this regard it is subject to change at any time. The most recent revision date is the effective version.

2. Referenced Documents

2.1 ASTM Standards:

D 638 Test Method for Tensile Properties of Plastics

D 792 Specific Gravity (Relative Density) and Density of Plastics by Displacement

D 1004 Test Method for Initial Tear Resistance of Plastics Film and Sheeting

D 1238 Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer

D 1505 Test Method for Density of Plastics by the Density-Gradient Technique

D 1603 Test Method for Carbon Black in Olefm Plastics

D 3895 Test Method for Oxidative Induction Time of Polyolefms by Thermal Analysis

D 4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique

D 4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products

D5199 Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes

D 5397 Procedure to Perform a Single Point Notched Constant Tensile Load -(SP-NCTL) Test: Appendix

D 5596 Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefm Geosynthetics

D 5721 Practice for Air-Oven Aging of Polyolefin Geomembranes

D 5885 Test method for Oxidative Induction Time of Polyolefm Geosynthetics by High Pressure Differential Scanning Calorimetry

D 5994 Test Method for Measuring the Core Thickness of Textured Geomembranes

2.2 GRI Standards:

GM10 Specification for the Stress Crack Resistance of Geomembrane Sheet

GM 11 Accelerated Weathering of Geomembranes using a Fluorescent UVA-Condensation Exposure Device

GM 12 Measurement of the Asperity Height ofTextured Geomembranes Using a Depth Gage

2.3 U. S. Environmental Protection Agency Technical Guidance Document "Quality Control Assurance and Quality Control for Waste Containment Facilities," EPA/600/R-93/182, September 1993, 305 pgs.

3.0 Definitions

Manufacturing Quality Control (MQC) – A planned system of inspections that is used to directly monitor and control the manufacture of a material which is factory originated. MQC is normally performed by the manufacturer of geosynthetic materials and is necessary to ensure minimum (or maximum) specified values in the manufactured product. MQC

refers to measures taken by the manufacturer to determine compliance with the requirements for materials and workmanship as stated in certification documents and contract specifications. ret. EPA/600/R-93/182

Manufacturing Quality Assurance (MQA) – A planned system of activities that provides assurance that the materials were constructed as specified in the certification documents and contract specifications. MQA includes manufacturing facility inspections, verifications, audits and evaluation of the raw materials (resins and additives) and geosynthetic products to assess the quality of the manufactured materials. MQA refers to measures taken by the MQA organization to determine if the manufacturer is in compliance with the product certification and contract specifications for the project. ref. EPA/600/R-93/182

Formulation, n – The mixture of a unique combination of ingredients identified by type, properties and quantity. For HDPE polyethylene geomembranes, a formulation is defined as the exact percentages and types ofresin(s), additives and carbon black.

4.0 Material Classification and Formulation

4.1 This specification covers high density polyethylene geomembranes with a formulated sheet density of 0.940 g/ml, or higher. Density can be measured by ASTM D1505 or ASTM D792. If the latter. Method B is recommended.

4.2 The polyethylene resin from which the geomembrane is made will generally be in the density range of 0.932 g/ml or higher, and have a melt index value per ASTM D1238 of less than 1.0 g/10 min.

4.3 The resin shall be virgin material with no more than 10% rework. If rework is used, it must be a similar HDPE as the parent material.

4.4 No post consumer resin (PCR) of any type shall be added to the formulation.

5.0 Physical, Mechanical and Chemical Property Requirements

5.1 The geomembrane shall conform to the test property requirements prescribed in Tables 1 and 2. Table 1 is for smooth HOPE geomembranes and Table 2 is for single and double sided textured HDPE geomembranes. Each of the tables are given in English and SI (metric) units. The conversion from English to SI (metric) is soft.

Note 3: There are several tests often included in other HDPE specifications which are omitted from this standard because they are outdated, irrelevant or generate information that is not necessary to evaluate on a routine MQC basis. The following tests have been purposely omitted:

- Volatile Loss
- Dimensional Stability
- Coeff. of Linear Expansion
- Resistance to Soil Burial
- Low Temperature Impact
- ESCR Test (D 1693)
- Wide Width Tensile
- Water Vapor Transmission
- Water Absorption
- Ozone Resistance
- Modulus of Elasticity
- Hydrostatic Resistance
- Tensile Impact
- Field Seam Strength
- Multi-Axial Burst
- Various Toxicity Tests

Note 4: There are several tests which are included in this standard (that are not customarily required in other HDPE specifications) because they are relevant and important in the context of current manufacturing processes. The following tests have been purposely added:

- Oxidative Induction Time
- Oven Aging
- Ultraviolet Resistance
- Asperity Height ofTextured Sheet

Note 5: There are other tests in this standard, focused on a particular property, which are updated to current standards. The following are in this category:

- Thickness of Textured Sheet
- Puncture Resistance
- Stress Crack Resistance
- Carbon Black Dispersion (In the viewing and subsequent quantitative interpretation of ASTM D 5596 only near spherical agglomerates shall be included in the assessment).

Note 6: There are several GRI tests currently included in this standard. Since these topics are not covered in ASTM standards, this is necessary. They are the following:

- UV Fluorescent Light Exposure
- Asperity Height Measurement

5.2 The values listed in the tables of this specification are to be interpreted according to the designated test method. In this respect they are neither minimum average roll values (MARV) nor maximum average roll values (MaxARV).

5.3 The properties of the HDPE geomembrane shall be tested at the minimum frequencies shown in Tables 1 and 2. If the specific manufacturer's quality control guide is more stringent and is certified accordingly, it must be followed in like manner.

Note 7: This specification is focused on manufacturing quality control (MQC). Conformance testing and manufacturing quality assurance (MQA) testing are at the discretion of the purchaser and/or quality assurance engineer, respectively.

6. Workmanship and Appearance

6.1 Smooth geomembrane shall have good appearance qualities. It shall be free from such defects that would affect the specified properties of the geomembrane.

6.2 Textured geomembrane shall generally have uniform texturing appearance. It shall be free from agglomerated texturing material and such defects that would affect the specified properties of the geomembrane.

6.3 General manufacturing procedures shall be performed in accordance with the manufacturer's internal quality control guide and/or documents.

7. MQC Sampling

7.1 Sampling shall be in accordance with the specific test methods listed in Tables 1 and 2. If no sampling protocol is stipulated in the particular test method, then test specimens shall be taken evenly spaced across the entire roll width.

7.2 The number of tests shall be in accordance with the appropriate test methods listed in Tables 1 and 2.

7.3 The average of the test results should be calculated per the particular standard cited and compared to the minimum value listed in these tables, hence the values listed are the minimum average values and are designated as "min. ave."

8. MQC Retest and Rejection

8.1 If the results of any test do not conform to the requirements of this specification, retesting to determine conformance or rejection should be done in accordance with the manufacturing protocol as set forth in the manufacturer's quality manual.

9. Packaging and Marketing

9.1 The geomembrane shall be rolled onto a substantial core or core segments and held firm by dedicated straps/slings, or other suitable means. The rolls must be adequate for safe transportation to the point of delivery, unless otherwise specified in the contract or order.

10. Certification

10.1 Upon request of the purchaser in the contract or order, a manufacturer's certification that the material was manufactured and tested in accordance with this specification, together with a report of the test results, shall be furnished at the time of shipment.

11. Warranty

11.1 Upon request of the purchaser in the contract or order, a manufacturer's warrant of the quality of the material shall be furnished at the completion of the terms of the contract.

11.2 A recommended warranty for smooth and textured HDPE geomembranes manufactured and tested in accordance with this specification is given in Appendix A.

11.3 The warranty in Appendix A is for the geomembrane itself. It does not cover subgrade preparation, installation, seaming, or backfilling. These are separate operations that are often beyond the control, or sphere of influence, of the geomembrane manufacturer.

Note 8: If a warrant is required for installation, it is to be developed between the installation contractor and the party requesting such a document.

ENGLISH UNITS

Table 1(a) – High Density Polyethylene (HDPE) Geomembrane -Smooth

Properties	Test Method	Test Value						Testing Frequency (minimum)
		30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	
Thickness (min. ave.)	D5199	nom.	Nom.	Nom.	Nom.	Nom.	Nom.	Nom.	Per roll
• lowest individual of 10 values		-10%	-10%	-10%	-10%	-10%	-10%	-10%	
Density mg/l (min.)	D 1505/D 792	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	200,00 lb
Tensile Properties *(1)* (min. ave.)	D 6693 Type IV								20,000 lb
• yield strength		63 lb/in.	84 lb/in.	105 lb/in.	126 lb/in.	168 lb/in.	210 lb/in.	252 lb/in.	
• break strength		114 lb/in.	152 lb/in.	190 lb/in.	228 lb/in.	304 lb/in.	380 lb/in.	456 lb/in.	
• yield elongation		12%	12%	12%	12%	12%	12%	12%	
• break elongation		700%	700%	700%	700%	700%	700%	700%	
Tear Resistance (min. ave.)	D 1004	21 lb	28 lb	35 lb	42 lb	56 lb	70 lb	84 lb	45,000 lb
Puncture Resistance (min. ave.)	D 4833	54 lb	72 lb	90 lb	108 lb	144 lb	180 lb	216 lb	45,000 lb
Stress Crack Resistance *(2)*	D5397 (App.)	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	per GRI-GM10
Carbon Black Content (range)	D 1603 *(3)*	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	20,000 lb
Carbon Black Dispersion	D 5596	note *(4)*	note *(4)*	note *(4)*	note *(4)*	note *(4)*	note *(4)*	note *(4)*	45,000 lb
Oxidative Induction Time (OIT) (min. ave.) *(5)*									200,000 lb
(a) Standard OIT	D 3895	100 min.	100 min.	100 min.	100 min.	100 min.	100 min.	100 min.	
— or —									
(b) High Pressure OIT	D 5885	400 min.	400 min.	400 min.	400 min.	400 min.	400 min.	400 min.	
Oven Aging at 85°C *(5), (6)*	D 5721								per each formulation
(a) Standard OIT (min. ave.) - % retained after 90 days	D 3895	55%	55%	55%	55%	55%	55%	55%	
— or —									
(b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5885	80%	80%	80%	80%	80%	80%	80%	
UV Resistance *(7)*	GM 11								per each formulation
(a) Standard OIT (min. ave.)	D 3895	N.R. *(8)*	N.R. *(8)*	N.R. *(8)*	N.R. *(8)*	N.R. *(8)*	N.R. *(8)*	N.R. *(8)*	
— or —									
(b) High Pressure OIT (min. ave.) - % retained after 1600 hrs *(9)*	D 5885	50%	50%	50%	50%	50%	50%	50%	

(1) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
Yield elongation is calculated using a gage length of 1.3 inches
Break elongation is calculated using a gage length of 2.0 in.
(2) The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.
(3) Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.
(4) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
9 in Categories 1 or 2 and 1 in Category 3
(5) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
(6) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.
(7) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
(8) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
(9) UV resistance is based on percent retained value regardless of the original HP-OIT value.

SI (METRIC) UNITS

Table 1(b) – High Density Polyethylene (HPDE) Geomembrane - Smooth

Properties	Test Method	Test Value							Testing Frequency (minimum)
		0.75 mm	1.00 mm	1.25 mm	1.50 mm	2.00 mm	2.50 mm	3.00 mm	
Thickness - mils (min. ave.) • lowest individual of 10 values	D5199	nom. (mil) -10%	nom. (mil) -10%	nom. (mil) -10%	nom. (mil) -10%	nom. (mil) -10%	nom. (mil) -10%	nom. (mil) -10%	per roll
Density (min.)	D 1505/D 792	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	90,000 kg
Tensile Properties *(1)* (min. ave.) • yield strength • break strength • yield elongation • break elongation	D 6693 Type IV	11 kN/m 20kN/m 12% 700%	15 kN/m 27 kN/m 12% 700%	18 kN/m 33 kN/m 12% 700%	22 kN/m 40 kN/m 12% 700%	29 kN/m 53 kN/m 12% 700%	37 kN/m 67 kN/m 12% 700%	44 kN/m 80 kN/m 12% 700%	9,000 kg
Tear Resistance (min. ave.)	D 1004	93 N	125 N	156 N	187 N	249 N	311 N	374 N	20,000 kg
Puncture Resistance (min. ave.)	D 4833	240 N	320 N	400 N	480 N	640 N	800 N	960 N	20,000 kg
Stress Crack Resistance *(2)*	D 5397 (App.)	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	per GRI GM-10
Carbon Black Content - %	D 1603 *(3)*	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	9,000 kg
Carbon Black Dispersion	D 5596	note *(4)*	note *(4)*	note *(4)*	note *(4)*	note *(4)*	note *(4)*	note *(4)*	20,000 kg
Oxidative Induction Time (OIT) (min. ave.) *(5)* (a) Standard OIT — or — (b) High Pressure OIT	D 3895 D 5885	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	90,000 kg
Oven Aging at 85°C *(5), (6)* (a) Standard OIT (min. ave.) - % retained after 90 days — or — (b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5721 D 3895 D 5885	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	per each formulation
UV Resistance *(7)* (a) Standard OIT (min. ave.) — or — (b) High Pressure OIT (min. ave.) - % retained after 1600 hrs *(9)*	D 3895 D 5885	N. R. *(8)* 50%	N.R. *(8)* 50%	N.R. *(8)* 50%	N.R. *(8)* 50%	N.R. *(8)* 50%	N.R. *(8)* 50%	N.R. *(8)* 50%	per each formulation

(1) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction
Yield elongation is calculated using a gage length of 33 mm
Break elongation is calculated using a gage length of 50 mm

(2) The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.

(3) Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.

(4) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
9 in Categories 1 or 2 and 1 in Category 3

(5) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(6) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

(7) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.

(8) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

(9) UV resistance is based on percent retained value regardless of the original HP-OIT value.

ENGLISH UNITS

Table 2(a) – High Density Polyethylene (HDPE) Geomembrane - Textured

Properties	Test Method	Test Value						Testing Frequency (minimum)
		30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	
Thickness mils (min. avc.) • lowest individual for 8 out of 10 values • lowest individual for any of the 10 values	D 5994	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	per roll
Asperity Height mils (min. ave.) *(1)*	GM 12	10 mil	10 mil	10 mil	10 mil	10 mil	10 mil	10 mil	every 2nd roll *(2)*
Density (min. ave.)	D 1505/D 792	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	200,000 lb
Tensile Properties (min. ave.) *(3)* • yield strength • break strength • yield elongation • break elongation	D 6693 Type IV	63 lb/in. 45 lb/in. 12% 100%	84 lb/in. 60 lb/in. 12% 100%	105 lb/in. 75 lb/in. 12% 100%	126 lb/in. 90 lb/in. 12% 100%	168 lb/in. 120 lb/in. 12% 100%	210 lb/in. 150 lb/in. 12% 100%	252 lb/in. 180 lb/in. 12% 100%	20,000 lb
Tear Resistance (min. ave.)	D 1004	21 lb	28 lb	35 lb	42 lb	56 lb	70 lb	84 lb	45,000 lb
Puncture Resistance (min. ave.)	D 4833	45 lb	60 lb	75 lb	90 lb	120 lb	150 lb	180 lb	45,000 lb
Stress Crack Resistance *(4)*	D 5397 (App.)	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	per GRI GM10
Carbon Black Content (range)	D 1603 *(5)*	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	20,000 lb
Carbon Black Dispersion	D 5596	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	45,000 lb
Oxidative Induction Time (OIT) (min. ave.) *(7)* (a) Standard OIT — or — (b) High Pressure OIT	D 3895 D 5885	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	200,000 lb
Oven Aging at 85°C *(7), (8)* (a) Standard OIT (min. ave.) - % retained after 90 days — or — (b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5721 D 3895 D 5885	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	per each formulation
UV Resistance *(9)* (a) Standard OIT (min. ave.) — or — (b) High Pressure OIT (min. ave.) - % retained after 1600 hrs *(11)*	GM11 D 3895 D 5885	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	per each formulation

(1) Of 10 readings; 8 out of 10 must be ≥ 7 mils, and lowest individual reading must be ≥ 5 mils

(2) Alternate the measurement side for double sided textured sheet

(3) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
Yield elongation is calculated using a gage length of 1.3 inches
Break elongation is calculated using a gage length of 2.0 inches

(4) P-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials.
The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.

(5) Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.

(6) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
9 in Categories 1 or 2 and 1 in Category 3

(7) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(8) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

(9) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.

(10) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

(11) UV resistance is based on percent retained value regardless of the original HP-OIT value.

SI (METRIC UNITS)

Table 2(b) – High Density Polyethylene (HDPE) Geomembrane - Textured

Properties	Test Method	Test Value							Testing Frequency (minimum)
		0.75 mm	1.00 mm	1.25 mm	1.50 mm	2.00 mm	2.50 mm	3.00 mm	
Thickness mils (min. ave.) • lowest individual for 8 out of 10 values • lowest individual for any of the 10 values	D 5994	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	per roll
Asperity Height mils (min. ave.) *(1)*	GM 12	0.25 mm	0.25 mm	0.25 mm	0.25 mm	0.25 mm	0.25 mm	0.25 mm	every 2nd roll *(2)*
Density (min. ave.)	D 1505/D 792	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	90,000 kg
Tensile Properties (min. ave.) *(3)* • yield strength • break strength • yield elongation • break elongation	D 6693 Type IV	11 kN/m 8 kN/m 12% 100%	15 kN/m 10 kN/m 12% 100%	18 kN/m 13 kN/m 12% 100%	22 kN/m 16 kN/m 12% 100%	29 kN/m 21 kN/m 12% 100%	37 kN/m 26 kN/m 12% 100%	44 kN/m 32 kN/m 12% 100%	9,000 kg
Tear Resistance (min. ave.)	D 1004	93 N	125 N	156 N	187 N	249 N	311 N	374 N	20,000 kg
Puncture Resistance (min. ave.)	D 4833	200N	267 N	333 N	400 N	534 N	667 N	800 N	20,000 kg
Stress Crack Resistance *(4)*	D 5397 (App.)	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	per GRI GM10
Carbon Black Content (range)	D 1603 *(5)*	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	9,000 kg
Carbon Black Dispersion	D 5596	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	20,000 kg
Oxidative Induction Time (OIT) (min. ave.) *(7)* (a) Standard OIT — or — (b) High Pressure OIT	D 3895 D 5885	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	90,000 kg
Oven Aging at 85°C *(7), (8)* (a) Standard OIT (min. ave.) - % retained after 90 days — or — (b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5721 D 3895 D 5885	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	per each formulation
UV Resistance *(9)* (a) Standard OIT (min. ave.) — or — (b) High Pressure OIT (min. ave.) - % retained after 1600 hrs *(11)*	GM11 D 3895 D 5885	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	per each formulation

(1) Of 10 readings, 8 out of 10 must be ≥ 0.18 mm, and lowest individual reading must be ≥ 0.13 mm

(2) Alternate the measurement side for double sided textured sheet

(3) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
Yield elongation is calculated using a gage length of 33 mm
Break elongation is calculated using a gage length of 50 mm

(4) The SP-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials.
The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.

(5) Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.

(6) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
9 in Categories 1 or 2 and 1 in Category 3

(7) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(8) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

(9) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.

(10) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

(11) UV resistance is based on percent retained value regardless of the original HP-OIT value.

APPENDIX "A"

TYPICAL HDPE GEOMEMBRANE WARRANTY

ADOPTION AND REVISION SCHEDULE FOR HDPE SPECIFICATION PER GRI-GM13

"Test Properties, Testing Frequency and Recommended Warrant for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes"

Adopted: June 17, 1997

Revision 1: November 20, 1998; changed CB dispersion from allowing 2 views to be in Category 3 to requiring all 10 views to be in Category 1 or 2. Also reduced UV percent retained from 60% to 50%.

Revision 2: April 29, 1999: added to Note 5 after the listing of Carbon Black Dispersion the following: "(In the viewing and subsequent quantitative interpretation of ASTM D5596 only near spherical agglomerates shall be included in the assessment)" and to Note (4) in the property tables.

Revision 3: June 28, 2000: added a new Section 5.2 that the numeric table values are neither MARV or MaxARV. They are to be interpreted per the the designated test method.

Revision 4: December 13, 2000: added one Category 3 is allowed for carbon black dispersion. Also, unified terminology to "strength" and "elongation".

Revision 5: May 15, 2003: Increased minimum acceptable stress crack resistance time from 200 hrs to 300 hrs.

Revision 6: June 23, 2003: Adopted ASTM D 6693, in place of ASTM D 638, for tensile strength testing. Also, added Note 2.

GRI Standard GM14

SELECTING VARIABLE INTERVALS FOR TAKING GEOMEMBRANE DESTRUCTIVE SEAM SAMPLES

1. Scope

1.1 This guide is focused on selecting the spacing interval for taking destructive seam samples of field deployed geomembranes as a particular job progresses based on an installers ongoing record of pass - or - fail testing.

Note 1 - While subjective at this time, the guide is most applicable to large geomembrane seaming projects, which require more than 100 destructive seam samples based upon the typical sampling strategy of 1 destructive sample per 150 m (500 ft).

1.2 This guide is essentially applicable to production seams. Caution should be exercised in using the guide for projects that involve complex geometries, multiple penetrations, or extreme weather conditions.

1.3 The primary target audiences for this guide are construction quality assurance (CQA) organizations, construction quality control (CQC) organizations, facility owner/operators and agency regulators having permitting authority.

1.4 The outcome of using the guide rewards good seaming performance resulting from a record of passing destructive seam tests. It also penalizes poor seaming performance resulting from a record of excessively failing seam tests.

1.5 This guide does not address the actual seam testing procedures that are used for acceptance or failure of the geomembrane seam test specimens themselves. Depending on the type of geomembrane being deployed one should use ASTM D4437, D3083, D751 and D413 for testing details in this regard. The project-specific CQA plan should define the particular criteria used in acceptance or failure.

1.6 An appendix is offered using control charts, which is intended to be of assistance to geomembrane installers, i.e., construction quality control (CQC) organizations, to identify salient aspects of good and poor seaming performance.

2. Referenced Documents

2.1 ASTM Standards:

D4437 Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes

D3083 Specification for Flexible Poly (Vinyl Chloride) Plastic Sheeting for Pond, Canal, and Reservoir Lining

D751 Method of Testing Coated Fabrics

D413 Test Methods for Rubber Property - Adhesion to Flexible Substrate

2.2 Other Standards:

ANSI/ASQC Z1.4 [1993]

Sampling Procedures and Tables for Inspection by Attributes

3. Summary of Guide

3.1 Use of this guide requires the establishment of an anticipated geomembrane seam failure percentage (ranging from 1 to 8%) and an initial, or start-up, sampling interval.

Note 2 - The value of anticipated failure percentage is an important consideration. It dictates each decision as to a possible increase or decrease in interval spacing from the preceding value. The percentage itself comes from historical data of the construction quality assurance (CQA) organization or regulatory agency. It is related to a number of factors including criticality of installation, type of geomembrane, type of seaming method and local ambient conditions.

The actual value is admittedly subjective and should be made known in advance to the geomembrane installer before bidding the project. Use of an unrealistically low value of anticipated failure percentage, e.g., < 1.0%, will likely result in field difficulties insofar as decreased sampling intervals are concerned. Conversely, use of an unrealistically high value of anticipated failure percentage, e.g., > 8.0%, will likely result in very large sampling intervals and quite possibly sacrifice the overall quality of the seaming effort.

3.2 The guide then gives the procedure for establishing the initial number of samples needed for a possible modification to the start-up sampling interval. This is called the initial batch. Based upon the number of failed samples in the initial batch, the spacing is increased (for good seaming), kept the same, or decreased (for poor seaming).

3.3 A second batch size is then determined and the process is continued. Depending on the project size, i.e., the total length of seaming, a number of decision cycles can occur until the project is finished.

3.4 It is seen that the number of samples required for the entire project is either fewer than the start-up frequency (for good seaming); the same as the start-up frequency (for matching the initial anticipated failure percentage); or more than the start-up frequency (for poor seaming).

4. Significance and Use

4.1 Construction quality assurance (CQA) and construction quality control (CQC) organizations, as well as owner/operators and agency regulators can use this guide to vary the sampling interval of geomembrane seam samples (i.e., the taking of field samples for destructive shear and peel testing) from an initial, or start-up, interval. This initial interval is often 1 destructive seam sample in every 150 m (500 ft) of seam length.

4.2 The guide leads to increasing the sampling interval for good seaming practice (hence fewer destructive samples) and to decreasing the sampling interval for poor seaming practice (hence additional destructive samples).

4.3 Use of the guide should provide an incentive for geomembrane installers to upgrade the quality and performance of their field seaming activities. In so doing, the cutting of fewer destructive sam-

ples will lead to overall better quality of the entire liner project, since the patching of previously taken destructive samples is invariably of poorer quality than the original seam itself.

Note 3 - It is generally accepted that field patching of areas where destructive samples had been taken using extrusion fillet seaming is less desirable than the original seam, which was made by hot wedge welding.

4.4 Control charts are illustrated in Appendix A, which can be used by geomembrane installers and their construction quality control (CQC) personnel for improvement in overall job quality and identification of poorly performing seaming personnel and/or equipment.

5. Suggested Methodology

Using the concepts embodied in the method of attributes, the following procedure is based on adjustments to sequential sampling.

5.1 Typical Field Situation - In order to begin the process, a project-specific total seam length must be obtained from the installers panel (roll) layout plan. Also, an initial, or start-up, sampling interval must be decided upon. From this information the total number of samples that are required based on the start-up sampling interval can be obtained.

Example 1 - A given project has 54,000 m (180,000 ft) of field seaming. The start-up sampling frequency is 1 sample per 150 m (500 ft). Therefore, the total number of samples required if the start-up interval is kept constant will be:

$$\frac{54{,}000}{150} = 360 \text{ Samples}$$

5.2 Determination of Initial Batch Size - Using the table shown below, the initial batch size from which to possibly modify the start-up sampling interval is obtained.

TABLE 1. BATCH SIZE DETERMINATION, AFTER ANSI/ASQC Z1.4 [1993]

No. Of Required Samples Based on Initial Or Modified Sampling Interval	No. Of samples Needed (Batch Size) To Determine Subsequent Sampling Interval
2-8	2
9-15	3
16-25	5
26-50	8
51-90	13
91-150	20
151-280	32
281-500	50
501-1200	80
1201-3200	125

Example 1 (cont.) - For 360 samples, a batch size of 50 is necessary. As production seaming progresses, these 50 samples are tested (either as they are taken or in a batch) and the number of failures is determined.

5.3 Verification of Start-Up Sampling Interval - A sampling table is now used which separates the number of failures within this initial batch size into three categories: a relatively low number of failures (where the sampling interval can be increased), the anticipated number of failures (where the sampling interval is maintained), or a relatively high number of failures (where the sampling interval should be decreased). Table 2 provides this information that is based upon the operation characteristic (OC) curves of Appendix B.

Example 1 (cont.) - Assuming an anticipated failure percentage of 2% (recall Note - 2), Table 2 results in the three categories shown below:

- 0 or 1 failure out of 50; the sampling interval can be increased
- 2 or 3 failures out of 50; the sampling frequency should remain at 1 sample per 150 m (500 ft)
- 4 or more failures out of 50; the sampling interval should be decreased

TABLE 2. SAMPLING TABLE CONTAINING THE NUMBER OF FAILED SAMPLES TO BE USED FOR INTERVAL

Sampling Interval Modification, see Appendix B for details

No. Of Required Samples Based on Initial or Modified Sampling Interval	No. Of Samples Needed (Batch Size) to Determine Subsequent Sampling Interval	Anticipated Failure Percentage*							
		1%		2%		3%		4%	
		I	D	I	D	I	D	I	D
2-8	2	0	1	0	1	0	1	0	1
9-15	3	0	1	0	1	0	2	0	2
16-25	5	0	1	0	1	0	2	0	2
26-50	8	0	1	0	1	0	2	0	2
51-90	13	0	1	0	2	0	2	0	3
91-150	20	0	2	0	3	1	3	1	4
151-280	32	0	2	1	3	1	4	2	5
281-500	50	0	3	1	4	2	5	3	6
504-1200	80	1	4	2	6	3	7	5	9
1201-3200	125	2	5	4	7	5	9	7	11

No. Of Required Samples Based on Initial or Modified Sampling Interval	No. Of Samples Needed (Batch Size) to Determine Subsequent Sampling Interval	Anticipated Failure Percentage*							
		5%		6%		7%		8%	
		I	D	I	D	I	D	I	D
2-8	2	0	1	0	1	0	2	0	2
9-15	3	0	2	0	1	0	2	0	2
16-25	5	0	2	0	1	0	3	0	3
26-50	8	0	3	0	1	1	3	1	4
51-90	13	1	4	1	2	1	4	1	5
91-150	20	1	5	2	3	2	5	2	6
151-280	32	2	6	3	3	3	7	4	7
281-500	50	4	7	4	4	5	9	6	10
504-1200	80	6	10	7	6	8	12	9	14
1201-3200	125	9	13	10	7	12	17	13	19

No: *To be selected by CQA, owner or regulatory organizations
I = Increase the sampling interval if the number of failed samples found in the batch does not exceed the tabulated value.
D = Decrease the sampling interval if the number of failed samples found in the batch equals or exceeds the tabulated value.

5.4 Modification of Start-Up Sampling Interval - Depending upon the outcome of the previous section, the start-up sampling interval may be modified to a new value which will then require a new batch

size to verify the modification. The process is then continued until the project is finished. Two examples will be provided using the above sampling tables both with anticipated failure percentages of 2.0%: Example 2 illustrates good seaming, and Example 3 illustrates poor seaming.

Example 2 - Using the same project seam length and start-up sampling frequency as in the previous example assume that the start-up batch of 50 samples in the previous example had 2-failures. The decision is then to continue at a 1 destructive sample in 150 m (500 ft) sampling interval. Thus the second batch size from Table 1 is again 50 samples, see Table 3. Table 3(a) is in S.I. units and Table 3(b) is in English units. Now assume in the second batch there are no failures. This allows the sampling interval to be increased, e.g., to 1 sample in 180 m (600 ft). From Table 1, the third batch size is then decreased to 32 samples. The process is continued in this manner until the project is concluded. For this hypothetical situation Table 3(a) illustrates that 265 samples (or 266 samples when using the English units in Table 3(b)) are necessary. Note that by using a constant interval of 1 sample in 150 m (500 ft), 360 samples would have been necessary. Also note that the maximum sampling interval was fixed at 310 m (1000 ft).

Note 4 - This example, and the following one, use a changing sampling interval of +/- 20% from the previous value. That is, when good seaming allows for an increase in sampling interval; the progression being from 150, 180, 215, 260 to 310 m (500, 600, 720, 850 to 1000 ft), respectively. A maximum interval of 310 m (1000 ft) is recommended, but clearly this value is at the discretion of the organizations involved. Conversely, poor seaming requires a decrease in sampling interval, the progression being from 150, 120, 100, 80 to 65 m (500, 400, 320, 250 to 200 ft), respectively. A minimum interval of 65 m (200 ft) is recommended, but clearly this decision is also at the discretion of the organizations involved

Table 3(a) - Results of Example 2 (in S.I. Units) Illustrating the Variation of the Sampling Interval Based on a 2.0% Anticipated Failure Percentage With a "Good" Quality Installer

Batch Number	Sampling Interval (m)	No. Of Remaining Samples Required	Batch Size	Cumulative Distance (m)	Number of Failures	Decision Made
1	150	360	50	7500	2	Stay
2	150	310	50	15000	0	Increase
3	180	217	32	20760	0	Increase
4	215	155	32	27640	2	Stay
5	215	123	20	31940	1	Stay
6	215	103	20	36240	0	Increase
7	260	68	13	39620	1	Stay
8	260	55	13	43000	0	Increase
9	310	35	8	45480	0	Stay
10	310	27	8	47960	0	Stay
11	310	19	5	49510	0	Stay
12	310	14	3	50440	0	Stay
13	310	11	3	51370	0	Stay
14	310	8	2	51990	0	Stay
15	310	6	2	52610	0	Stay
16	310	4	2	53230	0	Stay
17	310	2	2	53850	0	Done

Total Number of tests per 54,000 m of seam project = 265

Table 3(a) - Results of Example 2 (in English Units) Illustrating the Variation of the Sampling Interval Based on a 2.0% Anticipated Failure Percentage With a "Good" Quality Installer

Batch Number	Sampling Interval (Ft)	No. Of Remaining Samples Required	Batch Size	Cumulative Distance (Ft)	Number of Failures	Decision Made
1	500	360	50	25000	2	Stay
2	500	310	50	50000	0	Increase
3	600	217	32	69200	0	Increase
4	720	155	32	92240	2	Stay
5	720	123	20	106640	1	Stay
6	720	103	20	121040	0	Increase
7	850	68	13	132090	1	Stay
8	850	55	13	143140	0	Increase
9	1000	35	8	151140	0	Stay
10	1000	27	8	159140	0	Stay
11	1000	19	5	164140	0	Stay
12	1000	14	3	169140	0	Stay
13	1000	11	3	172140	0	Stay
14	1000	8	2	174140	0	Stay
15	1000	6	2	176140	0	Stay
16	1000	4	2	178140	0	Stay
17	1000	2	2	179140	0	Done

Total Number of tests per 180,000 ft of seam project = 266

Example 3 - Using the same project seam length and start-up sampling frequency as Example 1, assume that the start-up batch of 50 samples had 3- failures. The decision is then to continue at a 1 destructive sample in 150 m (500 ft) sampling interval. Thus the second batch size is again 50 samples as it was with Example 2, see Table 4. Table 4(a) is in S.I. units and Table 4(b) is in English units. Now assume in the second batch there are 2-failures. The decision is to again continue at a 1 destructive sample in 150 m (500 ft) sampling interval. From Table 1, the third batch size is then decreased to 32 samples. The process is continued in this manner until the project is concluded. For this hypothetical situation Table 4 illustrates that 412 samples are necessary. Note that by a constant interval of 1 sample in 150 m (500 ft), 360 samples would have been necessary. Furthermore, a good seamer (as illustrated in Example 2) would only have had to take 265 samples.

Table 4(a) - 150Results of Example 3 (in S.I. Units) Illustrating the Variation of the Sampling Interval Based on a 2.0% Anticipated Failure Percentage With a "Poor" Quality Installer

Batch Number	Sampling Interval (m)	No. Of Remaining Samples Required	Batch Size	Cumulative Distance (m)	Number of Failures	Decision Made
1	150	360	50	7500	3	Stay
2	150	310	50	15000	2	Stay
3	150	260	32	19800	2	Stay
4	150	228	32	24600	3	Decrease
5	150	245	32	28440	3	Decrease
6	150	256	32	31640	1	Increase
7	150	186	32	35480	1	Increase
8	150	123	20	38480	2	Stay
9	150	103	20	41480	1	Stay
10	150	83	13	43430	2	Decrease
11	150	88	13	44990	2	Decrease
12	150	90	13	46290	1	Stay
13	150	77	13	47590	1	Stay
14	150	64	13	48890	1	Stay
15	150	51	13	50490	0	Increase
16	150	32	8	51150	1	Stay
17	150	24	5	51750	1	Decrease
18	150	23	5	52250	0	Increase
19	150	15	3	52610	0	Increase
20	150	9	2	52910	1	Decrease
21	150	9	2	53150	1	Decrease
22	150	11	3	53210	0	Increase
23	150	7	2	53390	0	Increase
24	150	5	2	53510	0	Increase
25	150	3	2	53750	0	Done

Total Number of tests per 54,000 m of seam project = 412

Table 4(b) - Results of Example 3 (in English Units) Illustrating the Variation of the Sampling Interval Based on a 2.0% Anticipated Failure Percentage With a "Poor" Quality Installer

Batch Number	Sampling Interval (Ft)	No. Of Remaining Samples Required	Batch Size	Cumulative Distance (Ft)	Number of Failures	Decision Made
1	500	360	50	25000	3	Stay
2	500	310	50	50000	2	Stay
3	500	260	32	66000	2	Stay
4	500	228	32	82000	3	Decrease
5	400	245	32	94800	3	Decrease
6	320	266	32	105040	1	Increase
7	400	187	32	117840	1	Increase
8	500	124	20	127840	2	Stay
9	500	104	20	137840	1	Stay
10	500	84	13	144340	2	Decrease
11	400	89	13	149540	2	Decrease
12	320	95	13	153700	1	Stay
13	320	82	13	157860	1	Stay
14	320	69	13	162020	1	Stay
15	320	56	13	166180	0	Increase
16	400	35	8	169380	1	Stay
17	400	27	5	171380	1	Decrease
18	320	27	5	172980	0	Increase
19	400	18	3	174180	0	Increase
20	500	12	2	175180	1	Decrease
21	400	12	2	175980	1	Decrease
22	320	13	3	176140	0	Increase
23	400	10	2	176780	0	Increase
24	500	6	2	177140	0	Increase
25	600	5	2	177980	0	Done

Total Number of tests per 54,000 m of seam project = 412

5.5 Summary

This guide illustrates by means of hypothetical examples how a CQA and/or CQC organization can modify the sampling interval for taking destructive samples from a geomembrane-seaming project. It is based on the method of attributes that are common to statistical control methods. The methodology uses sequential sampling to proceed from one decision to the next until the project is complete.

The result in using this guide for the above purpose is to reward good seaming performance by taking fewer destructive samples, and to penalize poor seaming performance by taking additional destructive samples. In the example illustrations, good seaming resulted in taking 265 samples (versus 360), or a decrease of 26% from the originally set constant interval of 1 sample per 150 m (500 ft). Conversely, poor seaming resulted in taking 412 samples (versus 360), or a 14% increase in the originally set constant interval of 1 sample per 150 m (500 ft.) of seam length.

Appendix A - General Principles of Control Charts

In order to control a production process, like the field seaming of geomembranes, it is necessary to identify and quantify characteristics that reflect the quality of the product. Such quality characteristics can be either discrete or continuous variables. For example, the number of pinholes in a sheet of geomembrane is a discrete variable. Variation in the thickness of a sheet of geomembrane, however, is considered to be a continuous variable.

Whether quality characteristics are discrete or continuous, variability in the observed values is unavoidable. In the theory of control charts, this variation is considered due to either random (common) or assignable (special) causes, Wadsworth (1989) and Deming (1982). Random causes are generally smaller, uncontrollable influences that cannot be removed from the process without fundamental changes in the process itself. An assignable cause, however, is an influence considered to be significant, unusual, and capable of being removed form the process. Such causes may be due to human error, variation in raw materials, or the need for machine adjustment.

An important tool used to reduce process variation is the use of control charts. When using control charts, control limits are used to determine whether the variability of the statistic over time appears to be due to random variation only, or if an assignable cause is present. In other words, the purpose of control charts is to establish a "statistical control" of the assignable causes of variation within of a process.

The control chart generally used to monitor conforming or non-conforming data, called attributes, is the p-chart, where "p" stands for the proportion of non-conforming items in the entire population. In the case of inspecting the quality of the seams of field-deployed geomembranes, the p-value would be the historic failure percentage of the installer.

Suppose we have m subgroups (e.g., m different operators, or m different welding machines, or m working days, etc.) of varying sample sizes n_1, n_2, ..., nm. The number of non-conforming (failed) samples in the ith subgroup is Di, i =1, 2, ..., m, so the proportion of non-conforming items (failure rate) in the ith subgroup is as follows:

$$\hat{P}_i = \frac{D_i}{n_i} \quad 1 = 1,2,...,m \tag{A1}$$

For the p-chart, the values of pi are plotted against the subgroup number with a control limit, CL, set at the following:

$$CL = p + 3\left[\frac{p(1-p)}{n}\right]^{1/2} \tag{A2}$$

Where $\bar{n} = \frac{1}{m}\sum_{i=1}^{m} n_i$ = average sample size.

Two examples follow:

Example A1 - Assume that a seaming project is expected to take 25-days for completion, i.e., m=25. The installer has a historic data indicating that the company's average failure percentage is 2.0%. As the work progresses, the number of destructive seam samples and the respective numbers of failures are listed in tabular form as shown in the following table. Note that the daily failure rates, i.e., , are also shown in the table. The control chart of this project can now be developed.

Subgroup No. (days)	No. Of destructive samples	No. Of failures in subgroup	Failure Percentage P
1	12	0	0.000
2	14	0	0.000
3	9	0	0.000
4	7	0	0.000
5	13	1	0.077
6	15	0	0.000
7	19	1	0.053
8	13	0	0.000
9	14	1	0.071
10	9	0	0.000
11	17	1	0.059
12	16	0	0.000
13	7	0	0.000
14	22	1	0.045
15	18	0	0.000
16	16	0	0.000
17	15	0	0.000
18	16	0	0.000
19	14	0	0.000
20	16	0	0.000
21	22	1	0.045
22	18	0	0.000
23	16	0	0.000
24	9	0	0.000
25	13	1	0.077

Solution: From Equation (B2), the control limit is calculated as follows:

$$CL=0.02+3\left[\frac{0.02(1-0.02)}{360/25}\right]^{1/2}=0.13$$

The control chart can now be obtained by plotting the subgroup failure rate against the subgroup number (i.e., days) along with the control limit, CL = 0.13. The results are shown in the following figure, note that the 2.0% historic failure rate is also shown.

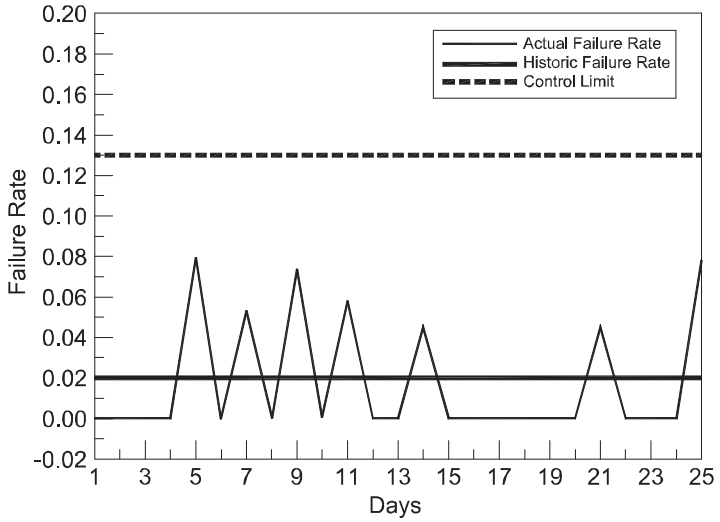


Figure A1 – The Resulted Control Chart of Example A-1.

As seen in the above control chart, the entire 25-day record of the failure rate of this project falls below the control limit set on the basis of the installer's 2.0% historic failure rate. That is to say, the variations in the daily failure record were due to random causes only and no assignable cause was identified. The above control chart indicates that no corrective action is necessary. This is an example of good seaming control.

Example A2 - For a similar size seaming project and historic record (i.e., 2% failure rate) as presented in Example A-1, a second installer has a poorer destructive seam record as shown in the following table. The control chart of this particular situation can also be developed.

Subgroup No. (days)	No. Of destructive samples	No. Of failures in subgroup	Failure Percentage
1	12	1	0.083
2	14	0	0.000
3	9	1	0.111
4	7	0	0.000
5	13	1	0.077
6	15	1	0.067
7	19	3	0.158
8	13	2	0.154
9	14	1	0.071
10	9	0	0.000
11	17	0	0.000
12	16	1	0.063
13	7	1	0.143
14	22	2	0.091
15	18	1	0.056
16	16	2	0.125
17	15	0	0.000
18	16	1	0.063
19	14	0	0.000
20	16	1	0.063
21	22	2	0.091
22	18	1	0.056
23	16	3	0.188
24	9	0	0.000
25	13	1	0.077

Solution: Since the historic failure rate is the same as shown in Example A-1.A new control chart can now be obtained by plotting the subgroup failure rate against the subgroup number (i.e., days) along with the control limit, CL = 0.13. The results are shown in the following figure. Again, the 2.0% historic failure rate is also shown.

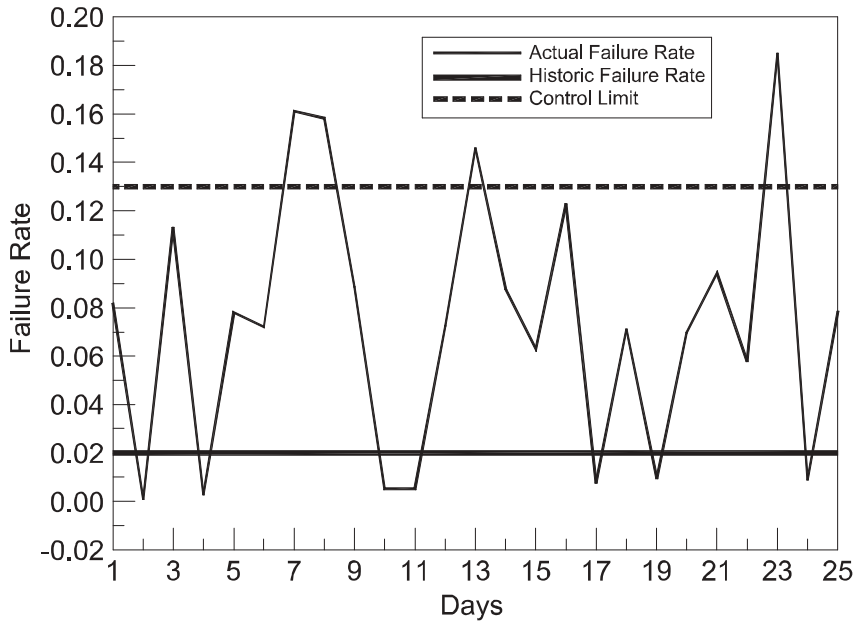


Figure A2 - The Resulted Control Chart of Example A-2.

As seen in the above control chart, the daily failure rates at day 7, 8, 13 and 23 exceed the control limit set on the basis of the installer's 2.0% historic failure rate. That is to say, there are possible assignable causes on those days. From the standpoint of construction quality control, the installer should check the record on those days, identify the cause(s) of such variations, and take necessary corrective actions. This is an example of poor seaming.

GM 14 - Appendix B - The Selection of the "I" and "D" Values

In this appendix, the procedure used for selecting the "I" and "D" values listed in Table 2 is presented. The required background, e.g., the concept of sampling risk and the operating characteristics (OC) curves, are briefly discussed.

Sampling Risk

Sampling involves a degree of risk that the actual samples do not adequately reflect the conditions of the lot. For example, when using the sampling plan recommended in this guide, there are two common risks [see Juran and Gryna (1980) and Juran el. al (1974) for details]:

1. A good seaming practice might be penalized. This is generally referred as the installer's risk and denoted as the risk.
2. A poor seaming practice might go undetected. This is generally referred as an owner/regulators risk and denoted as the risk.

The effects (impacts) of the relative degree of these two risks are summarized in Table B1.

TABLE B1 - THE EFFECTS OF THE RELATIVE DEGREE OF AND RISKS.

Relative	Types of Risks	
Degree	Installers (α) Risk	Owner/Regulators (β) Risk
Low	Loose CQA control; low testing cost	Tight CQA control; high testing cost
High	Tight CQA control; high testing cost	Loose CQA control; low testing cost

Operating Characteristics (OC) Curves

Both of the risks can be quantified by sampling-plan-specific operating characteristics (OC) curves. The OC curve for a sampling plan is a graph that plots the probability that the sampling plan will accept a lot (i.e., the Pa value) versus the percent defective samples in that particular lot. Note that the term "sampling plan" used here corresponds to a batch of "n" destructive testing samples and the criteria for adjusting the sampling interval. Recall Table 2 in the main body of this guide. Figure B1 illustrates the concept of OC curves. In Figure B1, the dashed curve represents an "ideal" OC curve. Here it is desired to accept all lots having less or equal than 2% and reject all lots having greater than 2% failures. In reality, all sampling plans have risks that a "good" lot will be rejected or a "bad" lot will be accepted. This is illustrated by the solid S-shaped curve shown in Figure B1. It is seen that this particular sampling plan will have a 5% risk (100% - 95%) of rejecting a lot having only 1% defects (i.e., a "good" lot) and a 10% risk of accepting a lot having 5% defects (i.e., a "bad" lot).

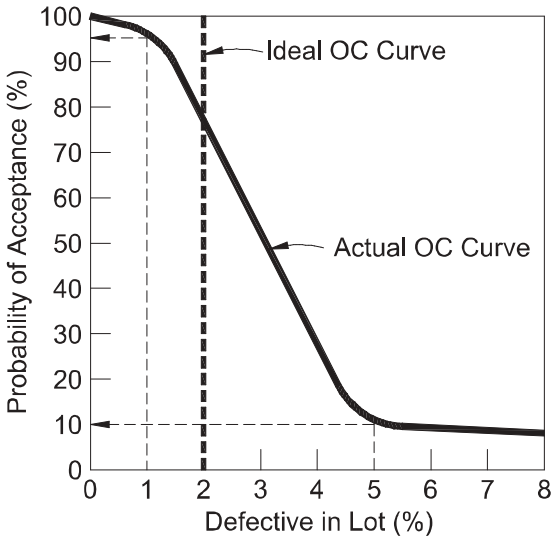


Figure B1 - Ideal and Actual Operating Characteristics Curves for a Sampling Plan

An OC curve can be developed by determining the probability of acceptance for several values of the percent defects. To do so, a statistical distribution of the acceptance probability has to be assumed first. There are three distributions that can be used: hypergeometric, binomial and Poisson distribution. The Poisson distribution is generally preferable due to the ease of calculation. It is used in this guide. The Poisson distribution function to be applied to an acceptance-sampling plan is as follows:

$$P\begin{pmatrix}\text{exactly "c" defects}\\ \text{in a batch of size "n"}\end{pmatrix} = \frac{e^{-np}(np)^c}{c!} \qquad \text{(B1)}$$

Most statistics books provide Poisson distribution tables that give the probability of "c" or fewer defects in a batch of size "n" from a lot having a fraction of defect "p".

The Selection of the "I" and "D" Values Listed in Table 2

As mentioned earlier, each of the sampling plans recommended in this guide consists of three variables: the batch size "n", the values of "I" and "D". Note that the values of "I" and "D" are specific values of "c" mentioned in Equation B1. The "I" value corresponds to the judgment criterion of rewarding good seaming practice, i.e., increasing the sampling interval if the number of failed samples does not exceed this particular value. The "D" value, on the other hand, corresponds to the judgment criterion of penalizing poor seaming practice, i.e., decreasing the sampling interval if the number of failed samples equals or exceeds this particular value.

The concept of the OC curves is used to determine the actual values of I's and D's for different sampling plans. The criteria used are as follows:

- For a batch of size "n", the "I" value should yield a 80~90% probability of rewarding good seaming practice, i.e., 80% < Pa < 90%.
- For a batch of size "n", the "D" value should yield a risk of 0.5% or less of penalizing

good seaming practice, i.e., Pa >99.5%. In other words, the probability for good seaming practice to be penalized is extremely small, i.e., less than 0.5%.

The above criteria are subjective. Nevertheless, it is felt to be adequate since the rights of both the installer and the owner/regulator are protected. Recognize that a sampling plan with tighter control (i.e., smaller values of "I" and "D") might seem to be more ideal at first glance, but it may result in a significant increase in the required number of destructive tests, i.e., it may be counter productive.

As an illustration, Figure B2 shows the graphic procedure of obtaining the "I" and "D" values for a batch of 50 samples (n=50) and an anticipated failure percentage of 4%. [In other words, it illustrates the procedure of obtaining one particular pair of numbers listed in Table 2, namely, "I" and "D" equal to 3 and 6, respectively.] Note that each OC curve shown in Figure B2 corresponds to a specific "c" value and is obtained via a Poisson distribution table.

Figure B2 can also used to determine the values of "I" and "D" for sampling plans with the same batch size (i.e., n = 50) but different anticipated failure percentage. The rest of the values listed in Table 2 can be verified in a similar manner using OC curves corresponding to different batch sizes.

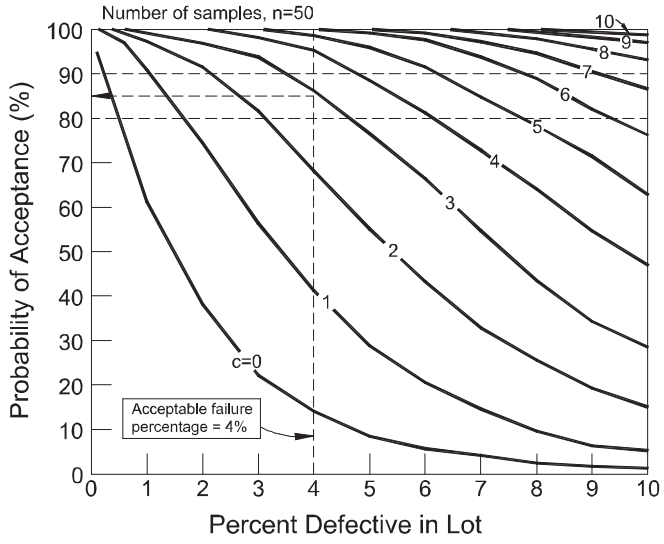


Figure B2 - The Determination of the Values of "I" and "D" for a Batch with 50 Samples and an Anticipated Failure Percentage of 4.0%.

Revision Schedule:

Adopted: March 27,1998

GRI Standard GM17

STANDARD SPECIFICATION FOR TEST PROPERTIES, TESTING FREQUENCY AND RECOMMENDED WARRANTY FOR LINEAR LOW DENSITY POLYETHYLENE (LLDPE) SMOOTH AND TEXTURED GEOMEMBRANES

This specification was developed by the Geosynthetic Research Institute (GRI), with the cooperation of the member organizations for general use by the public. It is completely optional in this regard and can be superseded by other existing or new specifications on the subject matter in whole or in part. Neither GRI, the Geosynthetic Institute, nor any of its related institutes, warrant or indemnifies any materials produced according to this specification either at this time or in the future.

1. Scope

1.1 This specification covers linear low density polyethylene (LLDPE) geomembranes with a formulated sheet density of 0.939 g/ml, or lower, in the thickness range of 0.50 mm (20 mils) to 3.0 mm (120 mils). Both smooth and textured geomembrane surfaces are included.

1.2 This specification sets forth a set of minimum, maximum, or range of physical, mechanical and endurance properties that must be met, or exceeded by the geomembrane being manufactured.

1.3 In the context of quality systems and management, this specification represents manufacturing quality control (MQC).

Note 1: Manufacturing quality control represents those actions taken by a manufacturer to ensure that the product represents the stated objective and properties set forth in this specification.

1.4 This standard specification is intended to ensure good uniform quality LLDPE geomembranes for use in general applications.

Note 2: Additional tests, or more restrictive values for the tests indicated, may be necessary under conditions of a particular application. In this situation, interactions with the manufacturers are required.

1.5 This specification also presents a recommended warranty which is focused on the geomembrane material itself.

1.6 The recommended warranty attached to this specification does not cover installation considerations which are independent of the manufacturing of the geomembrane.

Note 3: For information on installation techniques, users of this standard are referred to the geosynthetics literature, which is abundant on the subject.

*This GRI standard is developed by the Geosynthetic Research Institute through consultation and review by the member organizations. This specification will be reviewed at least every 2-years, or on an as-required basis. In this regard it is subject to change at any time. The most recent revision date is the effective version.

2. Referenced Documents

2.1 ASTM Standards:

D 638 Test Method for Tensile Properties of Plastics
D 792 Specific Gravity (Relative Density) and Density of Plastics by Displacement
D 1004 Test Method for Initial Tear Resistance of Plastics Film and Sheeting
D 1238 Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
D 1505 Test Method for Density of Plastics by the Density-Gradient Technique
D 1603 Test Method for Carbon Black in Olefin Plastics
D 3895 Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis
D 4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
D 4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
D 5199 Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
D 5323 Practice for Determination of 2% Secant Modulus for Polyethylene Geomembranes
D 5994 Test Method for Measuring the Core Thickness of Textured Geomembranes
D 5596 Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
D 5617 Test Method for Multi-Axial Tension Test for Geosynthetics
D 5721 Practice for Air-Oven Aging of Polyolefin Geomembranes GM17 - 3 of 14 rev. 2 - 12/13/00
D 5885 Test method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry

2.2 GRI Standards:

GM 11 Accelerated Weathering of Geomembranes using a Fluorescent UVA-Condensation Exposure Device
GM 12 Measurement of the Asperity Height of Textured Geomembranes Using a Depth Gage

2.3 U. S. Environmental Protection Agency Technical Guidance Document "Quality Control Assurance and Quality Control for Waste Containment Facilities," EPA/600/R-93/182, September 1993, 305 pages.

3. Definitions

Manufacturing Quality Control (MQC) - A planned system of inspections that is used to directly monitor and control the manufacture of a material which is factory originated. MQC is normally performed by the manufacturer of geosynthetic materials and is necessary to ensure minimum (or maximum) specified values in the manufactured product. MQC refers to measures taken by the manufacturer to determine compliance with the requirements for materials and workmanship as stated in certification documents and contract specifications ref. EPA/600/R-93/182.

Manufacturing Quality Assurance (MQA) - A planned system of activities that provides assurance that the materials were

constructed as specified in the certification documents and contract specifications. MQA includes manufacturing facility inspections, verifications, audits and evaluation of the raw materials (resins and additives) and geosynthetic products to assess the quality of the manufactured materials. MQA refers to measures taken by the MQA organization to determine if the manufacturer is in compliance with the product certification and contract specifications for the project ref. EPA/600/R-93/182.

Linear Low Density Polyethylene (LLDPE), n - A ethylene/ -olefin copolymer having a linear molecular structure. The comonomers used to produce the resin can include hexane, octane, or methyl pentene. LLDPE resins have a natural density in the range of 0.915 to 0.926 g/ml (ref. Pate, T. J. Chapter 29 in Handbook of Plastic Materials and Technology, I.I. Rubin Ed., Wiley,1990).

Formulation, n - The mixture of a unique combination of ingredients identified by type, properties and quantity. For linear low density polyethylene geomembranes, a formulation is defined as the exact percentages and types of resin(s), additives and carbon black.

4. Material Classification and Formulation

4.1 This specification covers linear low density polyethylene geomembranes with a formulated sheet density of 0.939 g/ml, or lower. Density can be measured by ASTM D1505 or ASTM D792. If the latter, Method B is recommended.

4.2 The polyethylene resin from which the geomembrane is made will generally be in the density range of 0.926 g/ml or lower, and have a melt index value per ASTM D1238 of less than 1.0 g/10 min. This refers to the natural, i.e., nonformulated, resin.

4.3 The resin shall be virgin material with no more than 10% rework. If rework is used, it must be of the same formulation (or other approved formulation) as the parent material.

4.4 No post consumer resin (PCR) of any type shall be added to the formulation.

5. Physical, Mechanical and Chemical Property Requirements

5.1 The geomembrane shall conform to the test property requirements prescribed in Tables 1 and 2. Table 1 is for smooth LLDPE geomembranes and Table 2 is for single and double sided textured LLDPE geomembranes. Each of the tables are given in English and SI (metric) units. The conversion from English to SI (metric) is "soft". It is to be understood that the tables refer to the latest revision of the referenced test methods and practices.

Note 4: There are several tests sometimes included in other LLDPE geomembrane specifications which are omitted from this standard because they are outdated, irrelevant or generate information that is not necessary to evaluate on a routine MQC basis. The following tests have been purposely omitted:

- Volatile Loss
- Dimensional Stability
- Coeff. of Linear Expansion
- Resistance to Soil Burial
- Low Temperature Impact
- ESCR Test (D 1693 and D 5397)
- Solvent Vapor Transmission
- Water Absorption
- Ozone Resistance
- Hydrostatic Resistance
- Tensile Impact
- Small Scale Burst

- Wide Width Tensile
- Water Vapor Transmission
- Various Toxicity Tests
- Field Seam Strength

Note 5: There are several tests which are included in this standard (that are not customarily required in other LLDPE geomembrane specifications) because they are relevant and important in the context of current manufacturing processes. The following tests have been purposely added:

- Oxidative Induction Time
- Oven Aging
- Ultraviolet Resistance
- Asperity Height of Textured Sheet

Note 6: There are other tests in this standard, focused on a particular property, which are updated to current standards. The following are in this category:

- Thickness of Textured Sheet
- Tensile Properties, incl. 2% Secant Modulus
- Puncture Resistance
- Axi-Symmetric Break Resistance Strain
- Carbon Black Dispersion (In the viewing and subsequent quantitative interpretation of ASTM D 5596 only near spherical agglomerates shall be included in the assessment).

Note 7: There are several GRI tests currently included in this standard. Since these topics are not covered in ASTM standards, this is necessary. They are the following:

- UV Fluorescent Light Exposure
- Asperity Height Measurement

5.2 The values listed in the tables of this specification are to be interpreted according to the designated test method. In this respect they are neither minimum average roll values (MARV) nor maximum average roll values (MaxARV).

5.3 The various properties of the LLDPE geomembrane shall be tested at the minimum frequencies shown in Tables 1 and 2. If the specific manufacturer's quality control guide is more stringent, it must be followed in like manner.

Note 8: This specification is focused on manufacturing quality control (MQC). Conformance testing and manufacturing quality assurance (MQA) testing are at the discretion of the purchaser and/or quality assurance engineer, respectively. Communication and interaction with the manufacturer is strongly suggested.

6. Workmanship and Appearance

6.1 Smooth geomembrane shall have good appearance qualities. It shall be free from such defects that would affect the specified properties and hydraulic integrity of the geomembrane.

6.2 Textured geomembrane shall generally have uniform texturing appearance. It shall be free from

such defects that would affect the specified properties and hydraulic integrity of the geomembrane.

6.3 General manufacturing procedures shall be performed in accordance with the manufacturer's internal quality control guide and/or documents.

7. MQC Sampling

7.1 Sampling shall be in accordance with the specific test methods listed in Tables 1 and 2. If no sampling protocol is stipulated in the particular test method, then test specimens shall be taken evenly spaced across the entire roll width.

7.2 The number of tests shall be in accordance with the appropriate test methods listed in Tables 1 and 2.

7.3 The average of the test results should be calculated per the particular standard cited and compared to the minimum value listed in these tables, hence the values listed are the minimum average values and are designated as "minimum average."

8. MQC Retest and Rejection

8.1 If the results of any test do not conform to the requirements of this specification, retesting to determine conformance or rejection should be done in accordance with the manufacturing protocol as set forth in the manufacturer's quality manual.

9. Packaging and Marketing

9.1 The geomembrane shall be rolled onto a substantial core or core segments and held firm by dedicated straps/slings, or other suitable means. The rolls must be adequate for safe transportation to the point of delivery, unless otherwise specified in the contract or order.

9.2 Marking of the geomembrane rolls shall be done in accordance with the manufacturers accepted procedure as set forth in their quality manual.

10. Certification

10.1 Upon request of the purchaser in the contract or order, a manufacturer's certification that the material was manufactured and tested in accordance with this specification, together with a report of the test results, shall be furnished at the time of shipment.

English Units

Table 1(a) – Linear Low Density Polyethylene (LLDPE) Geomembrane (SMOOTH)

Properties	Test Method	Test Value								Testing Frequenc (minimum)
		20 mils	30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	
Thickness - mils (min. ave.)	D5199	nom.	nom.	nom.	nom.	nom.	nom.	nom.	nom.	per roll
• lowest individual of 10 values		-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	
Density g/ml (max.)	D 1505/D 792	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	200,00 lb
Tensile Properties *(1)* (min. ave.) • break strength - lb/in. • break elongation - %	D 6693 Type IV	76 800	114 800	152 800	190 800	228 800	304 800	380 800	456 800	20,000 lb
2% Modulus – lb/in. (max.)	D 5323	1200	1800	2400	3000	3600	4800	6000	7200	per formulation
Tear Resistance - lb (min. ave.)	D 1004	11	16	22	27	33	44	55	66	45,000 lb
Puncture Resistance - lb (min. ave.)	D 4833	28	42	56	70	84	112	140	168	45,000 lb
Axi-Symmetric Break Resistance Strain - % (min.)	D 5617	30	30	30	30	30	30	30	30	per formulation
Carbon Black Content - %	D 1603 *(2)*	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	45,000 lb
Carbon Black Dispersion	D 5596	note *(3)*	note *(3)*	note *(3)*	note *(3)*	note *(3)*	note *(3)*	note *(3)*	note *(3)*	45,000 lb
Oxidative Induction Time (OIT) (min. ave.) *(4)* (a) Standard OIT — or — (b) High Pressure OIT	D 3895 D 5885	100 400	100 400	100 400	100 400	100 400	100 400	100 400	100 400	200,000 lb
Oven Aging at 85°C *(5)* (a) Standard OIT (min. ave.) - % retained after 90 days — or — (b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5721 D 3895 D 5885	35 60	35 60	35 60	35 60	35 60	35 60	35 60	35 60	per formulation
UV Resistance *(6)* (a) Standard OIT (min. ave.) — or — (b) High Pressure OIT (min. ave.) - % retained after 1600 hrs *(8)*	D 3895 D 5885	N. R. *(7)* 35	N.R. *(7)* 35	N.R. *(7)* 35	N.R. *(7)* 35	N.R. *(7)* 35	N.R. *(7)* 35	N.R. *(7)* 35	N.R. *(7)* 35	per formulation

(1) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
- Break elongation is calculated using a gage length of 2.0 in. at 2.0 in./min.

(2) Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.

(3) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
- 9 in Categories 1 or 2 and 1 in Category 3

(4) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(5) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

(6) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.

(7) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

(8) UV resistance is based on percent retained value regardless of the original HP-OIT value.

SI (Metric) Units

Table 1(b) – Linear Low Density Polyethylene (LLDPE) Geomembrane (SMOOTH)

Properties	Test Method	Test Value								Testing Frequency (minimum)
		0.50 mm	0.75 mm	1.0 mm	1.25 mm	1.50 mm	2.00 mm	2.5 mm	3.0 mm	
Thickness - mm (min. ave.)	D5199	nom.	nom.	nom.	nom.	nom.	nom.	nom.	nom.	per roll
• lowest individual of 10 values		-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	
Density g/ml (max.)	D 1505/D 792	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	90,000 kg
Tensile Properties *(1)* (min. ave.)	D 6693									9,000 kg
• break strength – N/mm	Type IV	13	20	27	33	40	53	66	80	
• break elongation - %		800	800	800	800	800	800	800	800	
2% Modulus – N/mm (max.)	D 5323	210	370	420	520	630	840	1050	1260	per formulation
Tear Resistance - N (min. ave.)	D 1004	50	70	100	120	150	200	250	300	20,000 kg
Puncture Resistance - N (min. ave.)	D 4833	120	190	250	310	370	500	620	750	20,000 kg
Axi-Symmetric Break Resistance Strain - % (min.)	D 5617	30	30	30	30	30	30	30	30	per formulation
Carbon Black Content - %	D 1603 *(3)*	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	20,000 kg
Carbon Black Dispersion	D 5596	note *(3)*	note *(3)*	note *(3)*	note *(3)*	note *(3)*	note *(3)*	note *(3)*	note *(3)*	20,000 kg
Oxidative Induction Time (OIT) (min. ave.) *(4)*										90,000 kg
(a) Standard OIT	D 3895	100	100	100	100	100	100	100	100	
— or —										
(b) High Pressure OIT	D 5885	400	400	400	400	400	400	400	400	
Oven Aging at 85°C *(5)*	D 5721									
(a) Standard OIT (min. ave.) - % retained after 90 days	D 3895	35	35	35	35	35	35	35	35	per formulation
— or —										
(b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5885	60	60	60	60	60	60	60	60	
UV Resistance *(6)*										
(a) Standard OIT (min. ave.)	D 3895	N. R. *(7)*	N.R. *(7)*	N.R. *(7)*	N.R. *(7)*	N.R. *(7)*	N.R. *(7)*	N.R. *(7)*	N.R. *(7)*	per formulation
— or —										
(b) High Pressure OIT (min. ave.) - % retained after 1600 hrs *(8)*	D 5885	35	35	35	35	35	35	35	35	

(1) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
- Break elongation is calculated using a gage length of 50 mm at 50 mm/min.

(2) Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.

(3) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
- 9 in Categories 1 or 2 and 1 in Category 3

(4) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(5) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

(6) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.

(7) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

(8) UV resistance is based on percent retained value regardless of the original HP-OIT value.

English Units

Table 2(a) – Linear Low Density Polyethylene (LLDPE) Geomembrane (TEXTURED)

Properties	Test Method	Test Value								Testing Frequency (minimum)
		20 mils	30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	
Thickness mils (min. ave.) • lowest individual for 8 out of 10 values • lowest individual for any of the 10 values	D 5994	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	per roll
Asperity Height mils (min. ave.) *(1)*	GM 12	10	10	10	10	10	10	10	10	Every 2nd rc *(2)*
Density g/ml (max.)	D 1505/D 792	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	200,000 lb
Tensile Properties *(3)* (min. ave.) • break strength – lb/in. • break elongation - %	D 6693 Type IV	30 250	45 250	60 250	75 250	90 250	120 250	150 250	180 250	20,000 lb
2% Modulus – lb/in. (max.)	D 5323	1200	1800	2400	3000	3600	4800	6000	7200	per formulation
Tear Resistance – lb (min. ave.)	D 1004	11	16	22	27	33	44	55	66	45,000 lb
Puncture Resistance – lb (min. ave.)	D 4833	22	33	44	55	66	88	110	132	45,000 lb
Axi-Symmetric Break Resistance Strain - % (min.)	D 5617	30	30	30	30	30	30	30	30	per formulation
Carbon Black Content - %	D 1603 *(4)*	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	45,000 lb
Carbon Black Dispersion	D 5596	note *(5)*	note *(5)*	note *(5)*	note *(5)*	note *(5)*	note *(5)*	note *(5)*	note *(5)*	45,000 lb
Oxidative Induction Time (OIT) (min. ave.) *(6)* (a) Standard OIT — or — (b) High Pressure OIT	D 3895 D 5885	100 400	100 400	100 400	100 400	100 400	100 400	100 400	100 400	200,000 lb
Oven Aging at 85°C *(7)* (a) Standard OIT (min. ave.) - % retained after 90 days — or — (b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5721 D 3895 D 5885	35 60	35 60	35 60	35 60	35 60	35 60	35 60	35 60	per formulation
UV Resistance *(8)* (a) Standard OIT (min. ave.) — or — (b) High Pressure OIT (min. ave.) - % retained after 1600 hrs *(10)*	D 3895 D 5885	N. R. *(9)* 35	N.R. *(9)* 35	N.R. *(9)* 35	N.R. *(9)* 35	N.R. *(9)* 35	N.R. *(9)* 35	N.R. *(9)* 35	N.R. *(9)* 35	per formulation

(1) Of 10 readings: 8 out of 10 must be 7 mils, and lowest individual reading must be 5 mils
(2) Alternate the measurement side for double sided textured sheet
(3) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
• Break elongation is calculated using a gage length of 2.0 in. at 2.0 in./min.
(4) Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.
(5) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
• 9 in Categories 1 or 2 and 1 in Category 3
(6) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
(7) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.
(8) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
(9) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
(10) UV resistance is based on percent retained value regardless of the original HP-OIT value.

SI (Metric) Units

Table 2(b) – Linear Low Density Polyethylene (LLDPE) Geomembrane (TEXTURED)

Properties	Test Method	Test Value								Testing Frequency (minimum)
		0.50 mm	0.75 mm	1.0 mm	1.25 mm	1.50 mm	2.00 mm	2.5 mm	3.0 mm	
Thickness mils (min. ave.) • lowest individual for 8 out of 10 values • lowest individual for any of the 10 values	D 5994	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	per roll
Asperity Height mm (min. ave.) *(1)*	GM 12	10	10	10	10	10	10	10	10	Every 2nd roll *(2)*
Density g/ml (max.)	D 1505/D 792	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	90,000 kg
Tensile Properties *(3)* (min. ave.) • break strength – N/mm • break elongation - %	D 6693 Type IV	5 250	9 250	11 250	13 250	16 250	21 250	26 250	31 250	9,000 kg
2% Modulus – N/mm (max.)	D 5323	210	370	420	520	630	840	1050	1260	per formulation
Tear Resistance – N (min. ave.)	D 1004	50	70	100	120	150	200	250	300	20,000 kg
Puncture Resistance – N (min. ave.)	D 4833	100	150	200	250	300	400	500	600	20,000 kg
Axi-Symmetric Break Resistance Strain - % (min.)	D 5617	30	30	30	30	30	30	30	30	per formulation
Carbon Black Content - %	D 1603 *(4)*	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	20,000 kg
Carbon Black Dispersion	D 5596	note *(5)*	note *(5)*	note *(5)*	note *(5)*	note *(5)*	note *(5)*	note *(5)*	note *(5)*	20,000 kg
Oxidative Induction Time (OIT) (min. ave.) *(6)* (a) Standard OIT — or — (b) High Pressure OIT	D 3895 D 5885	100 400	100 400	100 400	100 400	100 400	100 400	100 400	100 400	90,000 kg
Oven Aging at 85°C *(7)* (a) Standard OIT (min. ave.) - % retained after 90 days — or — (b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5721 D 3895 D 5885	35 60	35 60	35 60	35 60	35 60	35 60	35 60	35 60	per formulation
UV Resistance *(8)* (a) Standard OIT (min. ave.) — or — (b) High Pressure OIT (min. ave.) - % retained after 1600 hrs *(10)*	D 3895 D 5885	N. R. *(9)* 35	N.R. *(9)* 35	N.R. *(9)* 35	N.R. *(9)* 35	N.R. *(9)* 35	N.R. *(9)* 35	N.R. *(9)* 35	N.R. *(9)* 35	per formulation

(1) Of 10 readings; 8 out of 10 must be ≥ 0.18 mm, and lowest individual reading must be ≥ 0.13 mm
(2) Alternate the measurement side for double sided textured sheet
(3) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
• Break elongation is calculated using a gage length of 50 mm at 50 mm/min.
(4) Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.
(5) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
• 9 in Categories 1 or 2 and 1 in Category 3
(6) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
(7) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.
(8) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
(9) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
(10) UV resistance is based on percent retained value regardless of the original HP-OIT value.

11. Warranty

11.1 Upon request of the purchaser in the contract or order, a manufacturer's warranty of the quality of the material shall be furnished at the completion of the terms of the contract.

11.2 A recommended warranty for smooth and textured LLDPE geomembranes manufactured and tested in accordance with this specification is given in Appendix A.

11.3 The warranty in Appendix A is for the geomembrane itself. It does not cover subgrade preparation, installation, seaming, or backfilling. These are separate operations that are often beyond the control, or sphere of influence, of the geomembrane manufacturer.

Note 9: If a warranty is required for installation, it is to be developed between the installation contractor and the party requesting such a document.

Adoption and Revision Schedule for GRI Test Method GM17

"Test Properties, Testing Frequency and Recommended Warranted for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes"

Adopted: April 3, 2000

Revision 1: June 28, 2000: added a new Section 5.2 that the numeric tables values are neither MARV nor MaxARV. They are to be interpreted per the designated test method. Also, corrected typographical error of textured sheet thickness test method designation from D5199 to D5994.

Revision 2: December 13, 2000: added one Category 3 is allowed for carbon black dispersion. Also, unified terminology to "strength" and "elongation".

Revision 3: June 23, 2003: Adopted ASTM D 6693, in place of ASTM D 638, for tensile strength testing. Also, added Note 4.

GRI Test Method GM19*

STANDARD SPECIFICATION FOR SEAM STRENGTH AND RELATED PROPERTIES OF THERMALLY BONDED POLYOLEFIN GEOMEMBRANES

This specification was developed by the Geosynthetic Research Institute (GRI), with the cooperation of the member organizations for general use by the public. It is completely optional in this regard and can be superseded by other existing or new specifications on the subject matter in whole or in part. Neither GRI, the Geosynthetic Institute, nor any of its related institutes, warrant or indemnifies any materials produced according to this specification either at this time or in the future.

1. Scope

1.1 This specification addresses the required seam strength and related properties of thermally bonded polyolefin geomembranes; in particular, high density polyethylene (HDPE), linear low density polyethylene (LLDPE) and flexible polypropylene both nonreinforced (fPP) and scrim reinforced (fPP-R).

1.2 Numeric values of seam strength and related properties are specified in both shear and peel modes.

Note 1: This specification does not address the test method details or specific testing procedures. It refers to the relevant ASTM test methods where applicable.

1.3 The thermal bonding methods focused upon are hot wedge (single and dual track) and extrusion fillet.

Note 2: Other acceptable, but less frequently used, methods of seaming are hot air and ultrasonic methods. They are inferred as being a subcategory of hot wedge seaming.

1.4 This specification also suggests the distance between destructive seam samples to be taken in the field, i.e., the sampling interval. However, project-specific conditions will always prevail in this regard.

1.5 This specification is only applicable to laboratory testing.

1.6 This specification does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

2.1 ASTM Standards

D751 Standard Test Methods for Coated Fabrics

D6392 Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods

2.2 EPA Standards

EPA 600/2.88/052 (NTIS PB-89-129670)

Lining of Waste Containment and Other Containment Facilities

2.3 NSF Standards

NSF International Standard, Flexible Membrane Liners, NSF 54-1993 (depreciated)

2.4 GRI Standards

GM13 Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes

GM14 Selecting Variable Intervals for Taking Geomembrane Destructive Seam Samples Using the Method of Attributes

GM17 Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes

GM18 Test Properties, Testing Frequency and Recommended Warranty for Flexible Polypropylene (fPP and fPP-R) Geomembranes

3. Definition

3.1 Geomembrane, n – An essentially impermeable geosynthetic composed of one or more synthetic sheets used for the purpose of liquid, gas or solid containment.

3.2 Hot Wedge Seaming – A thermal technique which melts the two opposing geomembrane surfaces to be seamed by running a hot metal wedge or knife between them. Pressure is applied to the top or bottom geomembrane, or both, to form a continuous bond. Seams of this type can be made with dual bond tracks separated by a nonbonded gap. These seams are referred to as dual hot wedge seams or double-track seams.

3.3 Hot Air Seaming – This seaming technique introduces high-temperature air or gas between two geomembrane surfaces to facilitate localized surface melting. Pressure is applied to the top or bottom geomembrane, forcing together the two surfaces to form a continuous bond.

3.4 Ultrasonic Seaming - A thermal technique which melts the two opposing geomembrane surfaces to be seamed by running a ultrasonically vibrated metal wedge or knife between them. Pressure is applied to the top or bottom geomembrane, or both, to form a continuous bond. Some seams of this type are made with dual bond tracks separated by a nonbonded gap. These seams are referred to as dual-track seams or double-track seams.

3.5 Extrusion Fillet Seaming – This seaming technique involves extruding molten resin at the edge of an overlapped geomembrane on another to form a continuous bond. A depreciated method called "extrusion flat" seaming extrudes the molten resin between the two overlapped sheets. In all types of extrusion seaming the surfaces upon which the molten resin is applied must be suitably prepared, usually by a slight grinding or buffing.

4. Significance and Use

4.1 The various methods of field fabrication of seams in polyolefin geomembranes are covered in existing ASTM standards mentioned in the referenced document section. What is not covered in

those documents is the numeric values of strength and related properties that the completed seam must meet, or exceed. This specification provides this information insofar as minimum, or maximum, property values are concerned when the field fabricated seams are sampled and laboratory tested in shear and peel. The specification also provides guidance as to what spacing intervals the samples should be taken at typical field installation projects.

5. Sample and Specimen Preparation

5.1 The spacing for taking field seam samples for destructive testing is to be 1 per 500 feet (1 per 150 m) of seam length, or as by directed by the construction quality assurance inspector. As the project continues and data is accumulated, however, this sampling interval should be varied according to the procedure set forth in GRI GM14. Following this procedure three different situations can result.

5.1.1 Good seaming with fewer rejected test results than the preset historic average can result in a sequential increase in the spacing interval, i.e., one per greater than 500 ft. (one per greater than 150 m).

5.1.2 Poor seaming with more rejected test results than the preset historic average can result in a sequential decrease in the spacing interval, i.e., one per less than 500 ft. (one per less than 150 m).

5.1.3 Average seaming with approximately the same test results as the preset historic average will result in the spacing interval remaining the same, i.e., one per 500 ft. (one per 150 m).

Note 3: The method of attributes referred to in GRI GM14 is only one of several statistical strategies that might be used to vary sampling frequency. The use of control charts should also be considered in this regard.

5.2 The size of field seam samples is to be according to the referenced test method, e.g., ASTM D6392 or site-specific CQA plan.

5.3 The individual test specimens taken from the field seam samples are to be tested according to the referenced test method, i.e., ASTM D6392 for HDPE, LLDPE and fPP, and ASTM D751 (as modified by NSF 54) for fPP-R. The specimens are to be conditioned prior to testing according to these same test methods and evaluated accordingly.

6. Assessment of Seam Test Results

6.1 HDPE seams – For HDPE seams (both smooth and textured), the strength of four out of five 1.0 inch (25 mm) wide strip specimens in shear should meet or exceed the values given in Tables 1(a) and 1(b). The fifth must meet or exceed 80% of the given values. In addition, the shear percent elongation, calculated as follows, should exceed the values given in Tables 1(a) and 1(b):

(1)

$$E = \frac{L}{L_o}(100)$$

where

E = elongation (%)
L = extension at end of test (in. or mm)
Lo = original average length (usually 1.0 in. or 25 mm)

Note 4: The assumed gage length is considered to be the unseamed sheet material on either side of the welded area. It generally will be 1.0 in. (25 mm) from the edge of the seam to the grip face.

For HDPE seams (both smooth and textured), the strength of four out of five 1.0 in. (25 mm) wide strip specimens tested in peel should meet or exceed the values given in Tables 1(a) and 1(b). The fifth must meet or exceed 80% of the given values.

In addition, the peel separation (or incursion) should not exceed the values given in Tables 1(a) and 1(b). The value shall be based on the proportion of area of separated bond to the area of the original bonding as follows:

(2)

$$S = \frac{A}{A_o}(100)$$

where

S = separation (%)
A = average area of separation, or incursion (in^2 or mm^2)
A0 = original bonding area (in^2 or mm^2)

Note 5: The area of peel separation can occur in a number of nonuniform patterns across the seam width. The estimated dimensions of this separated area is visual and must be done with care and concern. The area must not include squeeze-out which is part of the welding process.

Regarding the locus-of-break patterns of the different seaming methods in shear and peel, the following are unacceptable break codes per their description in ASTM D6392 (in this regard, SIP is an acceptable break code);

Hot Wedge: AD and AD-Brk > 25%

Extrusion Fillet: AD1, AD2 and AD-WLD (unless strength is achieved)

6.2 LLDPE seams – For LLDPE seams (both smooth and textured), the strength of four out of five 1.0 in. (25 mm) wide strip specimens in shear should meet or exceed the values given in Table 2(a) and 1(b). The fifth must meet or exceed 80% of the given values. In addition, the shear percent elongation, calculated as follows, should exceed the values given in Tables 2(a) and 2(b).

(1)

$$E = \frac{L}{L_o}(100)$$

where

E = elongation (%)
L = extension at end of test (in. or mm)
L_o = original average length (usually 1.0 in. or 25 mm)

Note 4: The assumed gage length is considered to be the unseamed sheet material on either side of the welded area. It generally will be 1.0 in. (25 mm) from the edge of the seam to the grip face.

For LLDPE seams (both smooth and textured), the strength of four out of five 1.0 in. (25 mm) wide strip specimens tested in peel should meet or exceed the values given in Tables 2(a) and 2(b). The fifth must meet or exceed 80% of the given values.

In addition, the peel separation (or incursion) should not exceed the values given in Tables 2(a) and 2(b). The value shall be based on the proportion of area of separated bond to the area of the original bonding as follows:

(2)

$$S = \frac{A}{A_o}(100)$$

where

S = separation (%)
A = average depth of separation, or incursion ($in.^2$ or mm^2)
A_o = original bonding distance ($in.^2$ or mm^2)

Note 5: The area of peel separation can occur in a number of nonuniform patterns across the seam width. The estimated dimensions of this separated area is visual and must be done with care and concern. The area must not include squeeze-out which is part of the welding process.

Regarding the locus-of-break patterns of the different seaming methods in shear and peel, the following are unacceptable break codes per their description in ASTM D6392 (in this regard, SIP is an acceptable break code);

Hot Wedge: AD and AD-Brk > 25%

Extrusion Fillet: AD1, AD2, AD-WLD (unless strength is achieved)

6.3 fPP Seams – For fPP seams (both nonreinforced and scrim reinforced), the strength of four out of five specimens in shear should meet or exceed the values given in Tables 3(a) and 3(b). The fifth must meet or exceed 80% of the given values. Note that the unreinforced specimens are 1.0 in. (25 mm) wide strips and the scrim reinforced specimens are 4.0 in. (100 mm) wide grab tests. In addition, the shear percent elongation on the unreinforced specimens, calculated as follows, should exceed the values given in Tables 3(a) and 3(b).

(1)

$$E = \frac{L}{L_o}(100)$$

where

E = elongation (%)
L = extension at end of test (in. or mm)
L_o = original gauge length (usually 1.0 in. or 25 mm)

Note 4: The assumed gage length is considered to be the unseamed sheet material on either side of the welded area. It generally will be 1.0 in. (25 mm) from the edge of the seam to the grip face.

Shear elongation is not relevant to scrim reinforced geomembranes and as such is listed as "not applicable" in Table 3(a) and 3(b).

For fPP seams (both nonreinforced and scrim reinforced), the strength of four out of five specimens in peel should meet or exceed the values given in Tables 3(a) and 3(b). The fifth must meet or exceed 80% of the given values. Note that the unreinforced specimens are 1.0 in. (25 mm) wide strips and the scrim reinforced specimens are grab tests. In addition, the peel percent separation (or incursion) should not exceed the values given in Tables 3(a) and 3(b). The values should be based on the proportion of area of separated bond to the area of the original bonding as follows.

(2)

$$S = \frac{A}{A_o}(100)$$

where

S = separation in (%)
A = average depth of separation, or incursion ($in.^2$ or mm^2)
A_o = original bonding distance ($in.^2$ or mm^2)

Note 5: The area of peel separation can occur in a number of nonuniform patterns across the seam width. The estimated dimensions of this separated area is visual and must be done with care and concern. The area must not include squeeze-out which is part of the welding process.

Regarding the locus-of-break patterns of the different seaming methods in shear and peel, the following are unacceptable break codes per their description in ASTM D6392 (in this regard, SIP is an acceptable break code);

Hot Wedge: AD and AD-Brk > 25%

Extrusion Fillet: AD1, AD2 and AD-WLD (unless strength is achieved)

7. Retest and Rejection

7.1 If the results of the testing of a sample do not conform to the requirements of this specification, retesting to determine conformance or rejection should be done in accordance with the construction quality control or construction quality assurance plan for the particular site under construction.

8. Certification

8.1 Upon request of the construction quality assurance officer or certification engineer, an installer's certification that the geomembrane was installed and tested in accordance with this specification, together with a report of the test results, shall be furnished at the completion of the installation.

Table 1(a) – Seam Strength and Related Properties of Thermally Bonded Smooth and Textured High Density Polyethylene (HDPE) Geomembranes **(English Units)**

Geomembrane Nominal Thickness	30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils
Hot Wedge Seams[1]							
shear strength[2], lb/in.	57	80	100	120	160	200	240
shear elongation at break[3], %	50	50	50	50	50	50	50
peel strength[2], lb/in.	45	60	76	91	121	151	181
peel separation, %	25	25	25	25	25	25	25
Extrusion Fillet Seams							
shear strength[2], lb/in.	57	80	100	120	160	200	240
shear elongation at break[3], %	50	50	50	50	50	50	50
peel strength[2], lb/in.	39	52	65	78	104	130	156
peel separation, %	25	25	25	25	25	25	25

Notes for Tables 1(a) and 1(b):

1. Also for hot air and ultrasonic seaming methods
2. Value listed for shear and peel strengths are for 4 out of 5 test specimens; the 5th specimen can be as low as 80% of the listed values
3. Elongation measurements should be omitted for field testing

Table 1(b) – Seam Strength and Related Properties of Thermally Bonded Smooth and Textured High Density Polyethylene (HDPE) Geomembranes **(S.I. Units)**

Geomembrane Nominal Thickness	0.75 mm	1.0 mm	1.25 mm	1.5 mm	2.0 mm	2.5 mm	3.0 mm
Hot Wedge Seams[1]							
shear strength[2], N/25 mm.	250	350	438	525	701	876	1050
shear elongation at break[3], %	50	50	50	50	50	50	50
peel strength[2], N/25 mm	197	263	333	398	530	661	793
peel separation, %	25	25	25	25	25	25	25
Extrusion Fillet Seams							
shear strength[2], N/25 mm	250	350	438	525	701	876	1050
shear elongation at break[3], %	50	50	50	50	50	50	50
peel strength[2], N/25 mm	197	263	333	398	530	661	793
peel separation, %	25	25	25	25	25	25	25

Table 2(a) – Seam Strength and Related Properties of Thermally Bonded Smooth and Textured Linear Low Density Polyethylene (LLDPE) Geomembranes **(English Units)**

Geomembrane Nominal Thickness	20 mils	30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils
Hot Wedge Seams[1]								
shear strength[2], lb/in.	30	45	60	75	90	120	150	180
shear elongation[3], %	50	50	50	50	50	50	50	50
peel strength[2], lb/in.	25	38	50	63	75	100	125	150
peel separation, %	25	25	25	25	25	25	25	25
Extrusion Fillet Seams								
shear strength[2], lb/in.	30	45	60	75	90	120	150	180
shear elongation[3], %	50	50	50	50	50	50	50	50
peel strength[2], lb/in.	22	34	44	57	66	88	114	136
peel separation, %	25	25	25	25	25	25	25	25

Notes for Tables 2(a) and 2(b):

1. Also for hot air and ultrasonic seaming methods
2. Values listed for shear and peel strengths are for 4 out of 5 test specimens; the 5th specimen can be as low as 80% of the listed values
3. Elongation measurements should be omitted for field testing

Table 2(a) – Seam Strength and Related Properties of Thermally Bonded Smooth and Textured Linear Low Density Polyethylene (LLDPE) Geomembranes **(S.I. Units)**

Geomembrane Nominal Thickness	0.50 mm	0.75 mm	1.0 mm	1.25 mm	1.5 mm	2.0 mm	2.5 mm	3.0 mm
Hot Wedge Seams[1]								
shear strength[2], N/25 mm	131	197	263	328	394	525	657	788
shear elongation[3], %	50	50	50	50	50	50	50	50
peel strength[2], N/25 mm	109	166	219	276	328	438	547	657
peel separation, %	25	25	25	25	25	25	25	25
Extrusion Fillet Seams								
shear strength[2], N/25 mm	131	197	263	328	394	525	657	788
shear elongation[3], %	50	50	50	50	50	50	50	50
peel strength[2], N/25 mm	109	166	219	276	328	438	547	657
peel separation, %	25	25	25	25	25	25	25	25

Table 3(a) – Seam Strength and Related Properties of Thermally Bonded Nonreinforced and Reinforced Flexible Polypropylene (fPP) Geomembranes **(English Units)**

Geomembrane Nominal Thickness	30 mil-NR	40 mil-NR	36 mil-R[4]	45 mil-R[4]
Hot Wedge Seams[1]				
shear strength[2], lb/in. (NR); lb (R)	25	30	200	200
shear elongation[3], %	50	50	n/a	n/a
peel strength[2], lb/in. (NR); lb (R)	20	25	20	20
peel separation, %	25	25	n/a	n/a
Extrusion Fillet Seams				
shear strength[2], lb/in. (NR); lb (R)	25	30	200	200
shear elongation[3], %	50	50	n/a	n/a
peel strength[2], lb/in. (NR); lb (R)	20	25	20	20
peel separation, %	25	25	n/a	n/a

Notes for Tables 3(a) and 3(b):

1. Also for hot air and ultrasonic seaming methods
2. Values listed for shear and peel strengths are for 4 out of 5 test specimens; the 5th specimen can be as low as 80% of the listed values
3. Elongation measurements should be omitted for field testing
4. Values are based on grab tensile strength and elongations per D751 for laboratory tested specimens

Table 3(a) – Seam Strength and Related Properties of Thermally Bonded Nonreinforced and Reinforced Flexible Polypropylene (fPP) Geomembranes **(S.I. Units)**

Geomembrane Nominal Thickness	0.75 mm-NR	1.0 mm-NR	0.91 mm-R[4]	1.14 mm-R[4]
Hot Wedge Seams[1]				
shear strength[2], N/25 mm (NR); N (R)	110	130	890	890
shear elongation[3], %	50	50	n/a	n/a
peel strength[2], N/25 mm (NR); N (R)	85	110	90	90
peel separation, %	25	25	n/a	n/a
Extrusion Fillet Seams				
shear strength[2], N/25 mm (NR); N (R)	110	130	890	890
shear elongation[3], %	50	50	n/a	n/a
peel strength[2], N/25 mm (NR); N (R)	85	110	90	90
peel separation, %	25	25	n/a	n/a

1.0 Basic Drawing Tools

1.01	**Line**	A straight line from one point to another
1.02	**Pline**	A line that can be modified to have width and/or be joined to other lines or polylines.
1.03	**Arc**	A curved line, usually with a starting point, middle point and an end point
1.04	**Circle**	A perfect circle. Can be defined by radius, diameter, two points or three points.
1.05	**Ellipse**	An egg shape, sort of.
1.06	**Polygon**	A shape, such as a triangle, that can be made with as many sides as desired.
1.07	**Donut**	A thick circle defined with an inner diameter and an outer diameter.

2.0 Basic Modification Tools

2.01	**Move**	Command line: move Select objects you want to move, press enter, select a base point, select the point you want to move to.
2.02	**Trim**	Command line: trim Select line or object you want to trim to, hit enter, then trim the lines or objects that are to be trimmed.
2.03	**Extend**	Command line: extend Select line or object you want to extend to, hit enter, then pick the lines you want extended
2.04	**Hatch**	Command line: hatch Pick the hatch you want, look at rotation and scale, associated or not, and then pick how you want to select the area to be hatched. You will need to play with these commands to learn.
2.05	**Explode**	Command line: explode This command is used to separate a block or break up a pline. Select the items you want to explode then hit enter.
2.06	**Stretch**	Command line: stretch This command must be started with a crossing window, window the objects you want to stretch, hit enter, provide a base point then stretch to a new point. It is sometimes helpful to use "snap" setting when using this command.
2.07	**Scale**	Command line: scale Select objects, pick a base point, type in how you want to scale the object. You can also do a reference scaling, Say you have a line in an object that is 6" long and you want it to be 24" long, you input the first dimension and then input the new dimension.
2.08	**Break**	Command break: Select the line you want to break, and then pick the two points you want to open.

2.09 **Break at**

Similar to Break, but you only break at one point.

2.10 **Fillet** Command line: Fillet

Create a fillet by picking two lines. Requires input of the two distances.

2.11 **Radius** Command line: Radius

Creates a radius by picking two lines. Requires inputting a radius. You can radius all corners of a polylines by picking 'polylines' from the side menu.

2.12 **Rotate** Command line: rotate

Pick object to rotate, hit enter, pick a base point, then the angle of rotation.angles are clockwise unless you use a negative, ie.. -90o

2.13 **Mirror** Command Line: mirror

Mirror places an mirror image around a reference line. Pick objects to be mirrored, hit enter, thin pick two points along reference line.

2.14 **Array** Command line: array

Pick objects to array, hit enter, enter number of times you wish to array, then pick the distances between arrays.

2.15 **Polar array** Command line: array p

Same as array but this arrays around a center point. Pick objects, then pick center point, then number of arrays, then the amount of angle, 0 to 360.

3.0 Drawing Commands

3.01 **Offset** Command Line: Offset

Offsets line to a defined distance entered by user.

3.02 **Draw Line w/ Typed Command** Command Line: line

Lines drawn from specific point with typed distance and rotation, ie... @24<45 this draws a line 24" long from a given point at a 45° angle

3.03 **Drawing Lines with Coordinates**
Command Line: line

Lines drawn from two points using given coordinates such are found on customer's drawings. You may enter coordinates in feet or inches. East coordinate goes first. Inches = 10",10" (enter) 20",20" always put a comma between east and north

Feet = 10',10' (enter) 20',20'

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Middle East	GSE Lining Technology-Egypt	The 6th of October City, Egypt		202 2 828 8888	Fax: 202 2 828 8889

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Geomembranes

GSE HD • GSE HD Textured • GSE White • GSE White Textured • GSE Conductive • GSE Conductive Textured • GSE Conductive White
GSE Green Textured • GSE HD Weld Edge Textured • GSE UltraFlex • GSE UltraFlex Textured • GSE UltraFlex White • GSE Ultraflex White Textured

Manufacturing Quality Assurance Manual

www.gseworld.com

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I. QUALITY MANIFEST

GSE Lining Technology, Inc. is committed to providing the highest quality products and services to our customers. This requires a firm, total quality commitment from all individuals within our organization that we will only supply materials that meet or exceed the requirements and specifications of GSE and our customers.

GSE's commitment to quality starts with the highest quality raw materials. The quality of incoming raw materials is controlled at the supplier level with a complete vendor evaluation program in place. This means purchasing only from suppliers who are committed to statistical process control thereby providing a consistent, high level of quality assurance of their products.

II. MANUFACTURING QUALITY ASSURANCE

GSE Lining Technology, Inc. has an on-site Manufacturing Quality Assurance Laboratory at each manufacturing plant. Having a fully equipped, well staffed, dedicated laboratory at each of the manufacturing facilities allows GSE to maintain a high level of quality and up-to-the-minute results on finished products. Each facility follows the same guidelines for evaluating the quality of GSE products and is capable of adapting to market-driven requirements.

A. Objective

The objective of the GSE Quality Assurance program is to define implementation of basic manufacturing quality assurance (MQA) procedures necessary to ensure consistent production of quality products supplied to the geosynthetic market. Note that at this time, these procedures are limited to polyethylene geomembranes.

B. Scope

In order to achieve GSE's stated purpose, a rigorous set of minimum standards and an effective test program to assure compliance has been established. These procedures and requirements are frequently reviewed and adjusted to assure compliance with current market demands and/or predetermined project specifications. These procedures assure that raw materials and process parameters are controlled to provide products complying with GSE's pre-defined minimum characteristics.

III. MANUFACTURING QUALITY ASSURANCE ORGANIZATION

This organization consists of the Manufacturing Quality Assurance Laboratories as well as the manufacturing personnel. The combination of expertise and experience from these groups provides GSE with the proper tools to maintain the highest level of quality and customer service in the industry.

The Quality Assurance Department at GSE is charged by the President to assure that only products meeting both GSE's and the customer's requirements are released for shipment. The Quality Assurance personnel are directly responsible for monitoring testing and providing feedback to the manufacturing department to ensure the production of the specified product quality. Each member of the Quality Assurance team must participate in detailed training that includes factory exposure.

IV. STAFF AND SCHEDULING

The Quality Assurance Laboratories are staffed whenever manufacturing is occurring; this is usually 24 hours per day, 365 days per year. This minimizes the amount of potentially inferior product produced before a manufacturing problem is identified.

V. PRODUCT IDENTIFICATION AND DOCUMENTATION

A. *Roll Numbering*

Each roll of geomembrane is assigned a unique roll number. The Quality Assurance Laboratory maintains records documenting the raw materials and resulting product quality information.

B. *Approval Procedure*

Results for each tested roll of product are checked against both GSE and customer specifications for compliance. The Quality Assurance Laboratory approves those materials that meet both of these requirements for shipment.

C. *Non-Conformance*

Material that does not meet GSE minimum standards is given a roll number but is rejected and not placed into inventory. The material is identified as scrap and will not be utilized.

Material that meets GSE minimum standards but does not meet a stricter customer specification is not allocated to that customer but is placed into inventory as GSE standard material.

D. *Documentation*

Individual Quality Assurance Certificates are generated and supplied for each roll of geomembrane product to include all relevant quality assurance information about the material(s).

VI. RECORDS RETENTION

GSE maintains reports and/or samples for products produced and sold. Records and/or samples are maintained according to GSE's standard retention policy according to the item.

MATERIAL	ITEM	YEARS
Raw materials	Resin Supplier Test Reports and Certifications	≥2
	GSE Resin Test Reports	≥2
	Resin Sample Retain (Archive)	≥2
Geomembrane	Raw Test Data (in computer database)	≥5
	Quality Control Certificates (in computer database)	≥5
	Sample Retain (approximately one square foot)	≥3

VII. TESTING CAPABILITIES

GSE maintains high capacity, state-of-the-art laboratory equipment suitable for performing the procedures listed in Appendices A-D. GSE's Houston laboratories are accredited by the GAI-LAP program. GSE's Houston laboratories, as part of GSE's Product Division, also hold ISO certification. The appropriate certificates are maintained for review upon request by authorized parties.

A. *Routine Testing*

Through careful investigation, GSE has developed a strict and thorough Quality Assurance program that exceeds the vast majority of customer specifications including GRI GM13, "Test Properties, Testing

Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes" and GRI GM17 "Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes". The testing program covers raw materials (see Appendix A) and finished goods (see Appendix B) and is adhered to at all GSE laboratories. The laboratory equipment used by GSE represents the most modern equipment available and meets or exceeds the requirements of all the test standards used.

B. Other Testing Capabilities

In addition to routine testing, GSE laboratories are equipped to perform a wide variety of other tests as required for unusual requests or product development. Further, although the GSE Quality Assurance Laboratories are fully equipped and able to perform most routinely specified tests in the industry, there are some tests that are more economically performed by a dedicated testing facility. GSE believes requirements for such testing should be carefully considered and defined in terms of specific design requirements if they are found to be necessary.

VIII. MATERIAL QUALITY ASSURANCE

GSE Lining Technology, Inc. has established strict specifications for all raw materials and finished products. Test results must fall within the acceptable limits of GSE and customer specifications.

A. Raw Material

GSE primarily uses two types of raw materials, "natural resin" and "masterbatch" in the manufacture of geomembrane products. Natural resin is the base material that is used to make a geomembrane. It contains stabilizers to prevent degradation from occurring during and after extrusion. "Masterbatch" is the term referring to the concentrated carbon black material used with the natural resin to produce the finished product. The natural resin and masterbatch are blended at the appropriate ratio at the manufacturing stage. The masterbatch can contain other additives depending upon the geomembrane product to be produced. GSE verifies the properties of each lot of raw material prior to their utilization.

When natural resin is received, samples are taken and subjected to the tests outlined in Appendix A. All test data are entered into the computer database and checked for accuracy, consistency and compliance with GSE specifications. The material is not accepted unless all standard test requirements are met and the GSE test values meet the requirements set forth in the raw material specifications.

Copies of the supplier's certificate of analysis (COA) for each lot of resin utilized in the production of the materials supplied to a specific project are supplied as standard documentation. In addition, the GSE test results for each lot of resin are provided in a separate report upon request.

Virgin resin is normally received in rail car lots. If resin is received by other transport and/or in other quantities, an equivalent suitable sampling procedure is provided (i.e. not less than one sample per shipment or one sample for each 50,000 lb., 23,000 kg)

B. Geomembrane Products

GSE has implemented a strict and thorough Quality Assurance program for all geomembrane products. The geomembrane product line can be broken into two primary categories: smooth and textured products. Tables containing GSE minimum properties and test frequencies for all GSE geomembrane products includ-

ing specialty products such as GSE White (light-reflective geomembrane) and GSE Conductive (field spark-testable geomembrane) are in Appendix B.

1. *On-Line Manufacturing Quality Assurance*

The Quality Assurance program for finished product begins during the manufacturing process. Each manufacturing line is equipped with state-of-the-art monitoring devices that provide feedback on the physical quality of the materials being produced. Each geomembrane production line is equipped with both a thickness gage and spark-testing device.

a) Thickness Measurement

As geomembrane is being produced, thickness readings are taken continuously over the length and width of the roll. These data are used to establish the minimum, maximum and average thickness values for each roll and are verified by thickness testing upon sampling of the finished goods.

b) Spark Testing

An electrical spark detector is in place on each manufacturing sheet line. This apparatus provides immediate notification of holes in the finished product. If a hole is detected, an alarm is triggered and the hole is identified. Rolls containing holes are rejected from standard product inventory.

2. *Smooth Geomembrane Materials*

Smooth geomembrane products available include high density and linear low density polyethylene materials with 2-3% carbon black. Specialty materials include White, electrically conductive, green surfaced, and smooth edge textured geomembranes.

a) Sampling

Geomembrane rolls are sampled for QA testing according to the frequencies in Appendix B. An approximate one-foot by roll width sample is cut for Quality Assurance testing. Specimens for testing are taken from five predetermined positions across the width of the roll. Specimens are cut for testing the machine direction and transverse direction. A "retain" or archive sample approximately 12 x 12 inch (30 x 30 cm) is taken from the corresponding transverse direction position from the laboratory sample. The retain is labeled and kept for future reference (see Section VI).

b) Evaluation of Results

All data are entered into a computer database for calculation and comparison to GSE and customer-specific specifications. If materials do not meet GSE minimums and/or the customer specifications, the manufacturing personnel are immediately notified in order for the appropriate adjustments to be made. Only products meeting GSE minimums and customer specifications will be approved for shipment.

c) Reporting

Every roll of material has a quality assurance roll certificate or Roll Test Data Report (RTDR). This report identifies the standards on which the GSE approval is based along with the actual test results demonstrated by the material.

3. Coextruded Textured Geomembranes

Textured geomembrane is produced utilizing a round die with coextrusion technology. The texture is produced in a process in which one or two of the outer layers of a three-layer extrusion are blended with nitrogen gas. Nitrogen bubbles form in the molten resin and escape upon exiting the die, creating a rough, textured surface. Regular, White, green surfaced, and conductive geomembranes are available with coextruded texturing.

a) Sampling

Geomembrane rolls are sampled for QA testing according to the frequencies in Appendix B. An approximate one-foot by roll width sample is cut for Quality Assurance testing. Specimens for testing are taken from five predetermined positions across the width of the roll. Specimens for testing the machine and transverse direction tensile are cut from each of the five positions. A "retain" or archive sample approximately 12 x 12 inch (30 x 30 cm) is taken from the corresponding transverse direction position from the laboratory sample. The retain is labeled and kept for future reference (see Section VI).

Evaluation of results and reporting practices are the same as for smooth geomembranes.

C. Third Party Conformance Sampling

Some specifications require independent Quality Assurance and/or conformance testing. GSE can provide assistance with the sampling of products by arranging for the conformance samples to be taken during production. By taking samples during production rather than on site, the customer can be assured that the samples are clean and available for conformance testing in a timely manner.

GSE encourages customers to audit GSE manufacturing and manufacturing quality assurance operations and/or to collect samples and conduct independent conformance testing prior to shipment of materials.

Appendix A - Minimum Testing Frequencies and Properties for GSE Raw Materials

MINIMUM TESTING FREQUENCIES FOR GSE RAW MATERIALS

Property	Test Method[1]	Natural Resin
Density	ASTM D 1505	once per rail car compartment
Melt Flow Index	ASTM D 1238 (190/2.16)	once per rail car compartment
OIT	ASTM D 3895 (1 ATM at 200° C)	once per resin lot
Carbon Black Content	ASTM D 1603*/4218	N/A
Carbon Black Dispersion	ASTM D 5596	NA

[1] GSE utilizes test equipment and procedures that enable effective and economical confirmation that the product will conform to specifications based on the noted procedures. Some test procedures have been modified for application to geosynthetics. All procedures and values are subject to change without prior notification.
*Modified.

MINIMUM PROPERTIES FOR GSE RAW MATERIALS

Property	Test Method[1]	HDPE	LLDPE
Density [g/cm³]	ASTM D 1505	0.932	0.915
Melt Flow Index [g/10 min]	ASTM D 1238 (190/2.16)	≤ 1.0	≤ 1.0
OIT [minutes]	ASTM D 3895 (1 ATM at 200° C)	100	100

[1] GSE utilizes test equipment and procedures that enable effective and economical confirmation that the product will conform to specifications based on the noted procedures. Some test procedures have been modified for application to geosynthetics. All procedures and values are subject to change without prior notification.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE HD

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE				
Product Code			HDE 030A000	HDE 040A000	HDE 060A000	HDE 080A000	HDE 100A000
Thickness, (minimum average) mil (mm)	ASTM D 5199	every roll	30 (0.75)	40 (1.00)	60 (1.50)	80 (2.00)	100 (2.50)
Lowest individual reading (-10%)			27 (0.69)	36 (0.91)	54 (1.40)	72 (1.80)	90 (2.30)
Density, g/cm^3	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb					
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		114 (20)	152 (27)	228 (40)	304 (53)	380 (67)
Strength at Yield, lb/in-width (N/mm)			63 (11)	84 (15)	126 (22)	168 (29)	210 (37)
Elongation at Break, %	G.L. 2.0 in (51 mm)		700	700	700	700	700
Elongation at Yield, %	G.L. 1.3 in (33 mm)		12	12	12	12	12
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	21 (93)	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	54 (240)	72 (320)	108 (480)	144 (640)	180 (800)
Carbon Black Content, %	ASTM D 1603*/4218	20,000 lb	2.0	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1	+Note 1
Notched Constant Tensile Load, hr	ASTM D 5397, Appendix	200,000 lb	300	300	300	300	300
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**				
Oxidative Induction Time, min	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100	>100
Roll Length[1] (approximate), ft (m)			1,120 (341)	870 (265)	560 (171)	430 (131)	340 (104)
Roll Width[1], ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft^2 (m^2)			25,200 (2,341)	19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE HD is available in rolls weighing about 3,900 lb (1,769 kg)
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.
- [1]Roll lengths and widths have a tolerance of ± 1%.
- *Modified.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE WHITE

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE				
Product Code			HDE 030A010	HDE 040A010	HDE 060A010	HDE 080A010	HDE 100A010
Thickness, (minimum average) mil (mm)	ASTM D 5199	every roll	30 (0.75)	40 (1.00)	60 (1.50)	80 (2.00)	100 (2.50)
Lowest individual reading (-10%)			27 (0.69)	36 (0.91)	54 (1.40)	72 (1.80)	90 (2.30)
Density[2], g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb					
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		114 (20)	152 (27)	228 (40)	304 (53)	380 (67)
Strength at Yield, lb/in-width (N/mm)			63 (11)	84 (15)	126 (22)	168 (29)	210 (37)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		700	700	700	700	700
Elongation at Yield, %	G.L. = 1.3 in (33 mm)		12	12	12	12	12
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	21 (93)	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	54 (240)	72 (320)	108 (480)	144 (640)	180 (800)
Carbon Black Content[1] [2], %	ASTM D 1603*/4218	20,000 lb	2.0	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1	+Note 1
Notched Constant Tensile Load, hr	ASTM D 5397, Appendix	200,000 lb	300	300	300	300	300
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**				
Oxidative Induction Time[2], min	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100	>100
Roll Length[3] (approximate), ft (m)			1,120 (341)	870 (265)	560 (171)	430 (131)	340 (104)
Roll Width[3], ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			25,200 (2,341)	19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE White is available in rolls weighing about 3,900 lb (1,769 kg).
- [1]GSE White may have an overall ash content greater than 3.0% due to the white layer.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.
- [2]The values apply to the black layer only.
- [3]Roll lengths and widths have a tolerance of ± 1%.
- *Modified.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE CONDUCTIVE

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE			
Product Code			HDC 040A000	HDC 060A000	HDC 080A000	HDC 100A000
Thickness, (minimum average) mil (mm)	ASTM D 5199	every roll	40 (1.00)	60 (1.50)	80 (2.00)	100 (2.50)
Lowest individual reading (-10%)			36 (0.91)	54 (1.40)	72 (1.80)	90 (2.30)
Density, g/cm^3	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94
Tensile Properties (each direction)[1]	ASTM D 6693, Type IV	20,000 lb				
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		152 (27)	228 (40)	304 (53)	380 (67)
Strength at Yield, lb/in-width (N/mm)			84 (15)	126 (22)	168 (29)	210 (37)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		700	700	700	700
Elongation at Yield, %	G.L. = 1.3 in (33 mm)		12	12	12	12
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	72 (320)	108 (480)	144 (640)	180 (800)
Carbon Black Content[2], %	ASTM D 1603*/4218	20,000 lb	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1
Notched Constant Tensile Load, hr	ASTM D 5397, Appendix	200,000 lb	300	300	300	300
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**			
Oxidative Induction Time, min	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100
Roll Length[3] (approximate), ft (m)			870 (265)	560 (171)	430 (131)	340 (104)
Roll Width[3], ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft^2 (m^2)			19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE Conductive is available in rolls weighing about 3,900 lb (1,769 kg).
- [1]Due to surface effects caused by the conductive layer, these tensile properties are minimum average values.
- [2]GSE Conductive may have an overall carbon black percentage above 3.0% due to the high carbon black loadings in the conductive layer.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.
- [3]Roll lengths and widths have a tolerance of ± 1%.
- *Modified.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE CONDUCTIVE WHITE

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE			
Product Code			HDC 040A010	HDC 060A010	HDC 080A010	HDC 100A010
Thickness, (minimum average) mil (mm)	ASTM D 5199	every roll	40 (1.00)	60 (1.50)	80 (2.00)	100 (2.50)
Lowest individual reading (-10%)			36 (0.91)	54 (1.40)	72 (1.80)	90 (2.30)
Density[3], g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94
Tensile Properties (each direction)[1]	ASTM D 6693, Type IV	20,000 lb				
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		152 (27)	228 (40)	304 (53)	380 (67)
Strength at Yield, lb/in-width (N/mm)			84 (15)	126 (22)	168 (29)	210 (37)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		700	700	700	700
Elongation at Yield, %	G.L. = 1.3 in (33 mm)		12	12	12	12
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	72 (320)	108 (480)	144 (640)	180 (800)
Carbon Black Content[2] [3], %	ASTM D 1603*/4218	20,000 lb	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1
Notched Constant Tensile Load, hr	ASTM D 5397, Appendix	200,000 lb	300	300	300	300
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**			
Oxidative Induction Time[3], min	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100
Roll Length[4] (approximate), ft (m)			870 (265)	560 (171)	430 (131)	340 (104)
Roll Width[4], ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE Conductive White is available in rolls weighing about 3,900 lb (1,769 kg).
- [1]Due to surface effects caused by the conductive layer, these tensile properties are minimum average values.
- [2]GSE Conductive White may have an overall ash content greater than 3.0% due to the white and conductive outer layers.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.
- [3]The values apply to the black layer only.
- [4]Roll lengths and widths have a tolerance of ± 1%.
- *Modified.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE HD TEXTURED

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE				
Product Code			HDT 030G000	HDT 040G000	HDT 060G000	HDT 080G000	HDT 100G000
Thickness, (minimum average) mil (mm)	ASTM D 5994	every roll	29 (0.73)	38 (0.96)	57 (1.45)	76 (1.93)	95 (2.41)
Lowest individual for 8 out of 10 values			27 (0.69)	36 (0.91)	54 (1.40)	72 (1.80)	90 (2.30)
Lowest individual for any of the 10 values			26 (0.66)	34 (0.86)	51 (1.30)	68 (1.73)	85 (2.16)
Density, g/cm^3	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)[1]	ASTM D 6693, Type IV	20,000 lb					
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		45 (8)	60 (11)	90 (16)	120(21)	150 (27)
Strength at Yield, lb/in-width (N/mm)			63 (11)	84 (15)	126 (22)	168 (29)	210 (37)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		100	100	100	100	100
Elongation at Yield, %	G.L. = 1.3 in (33 mm)		12	12	12	12	12
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	21 (93)	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	45 (200)	60 (267)	90 (400)	120 (534)	150 (667)
Carbon Black Content, %	ASTM D 1603*/4218	20,000 lb	2.0	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1	+Note 1
Asperity Height	GRI GM 12	second roll	+Note 2	+Note 2	+Note 2	+Note 2	+Note 2
Notched Constant Tensile Load[2], hr	ASTM D 5397, Appendix	200,000 lb	300	300	300	300	300
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**				
Oxidative Induction Time, min	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100	>100
Roll Length[3] (approximate), ft (m)	Standard Textured		830 (253)	700 (213)	520 (158)	400 (122)	330 (101)
Roll Width[3], ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft^2 (m^2)			18,674 (1,735)	15,750 (1,463)	11,700 (1,087)	9,000 (836)	7,425 (690)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- +Note 2: 10 mil average. 8 of 10 readings ≥7 mils. Lowest individual ≥ 5 mils.
- GSE HD Standard Textured is available in rolls weighing about 4,000 lb (1,800 kg).
- [1]The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therefore, these tensile properties are minimum average values.
- [2]NCTL for HD Textured is conducted on representative smooth membrane samples.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.
- [3]Roll lengths and widths have a tolerance of ± 1%.
- *Modified.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE WHITE TEXTURED

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE			
Product Code			HDT 040G010	HDT 060G010	HDT 080G010	HDT 100G010
Thickness, (minimum average) mil (mm)	ASTM D 5994	every roll	38 (0.96)	57 (1.45)	76 (1.93)	95 (2.41)
Lowest individual for 8 out of 10 values			36 (0.91)	54 (1.40)	72 (1.80)	90 (2.30)
Lowest individual for any of the 10 values			34 (0.86)	51 (1.30)	68 (1.73)	85 (2.16)
Density[4], g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94
Tensile Properties (each direction)[1]	ASTM D 6693, Type IV	20,000 lb				
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		60 (11)	90 (16)	120 (21)	150 (27)
Strength at Yield, lb/in-width (N/mm)			84 (15)	126 (22)	168 (29)	210 (37)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		100	100	100	100
Elongation at Yield, %	G.L. = 1.3 in (33 mm)		12	12	12	12
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	60 (267)	90 (400)	120 (534)	150 (667)
Carbon Black Content[2][4], %	ASTM D 1603*/4218	20,000 lb	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1
Asperity Height	GRI GM 12	second roll	+Note 2	+Note 2	+Note 2	+Note 2
Notched Constant Tensile Load[3], hr	ASTM D 5397, Appendix	200,000 lb	300	300	300	300
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**			
Oxidative Induction Time[4], min	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100
Roll Length[5] (approximate), ft (m)			700 (213)	520 (158)	400 (122)	330 (101)
Roll Width[5], ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			15,750 (1,463)	11,700 (1,087)	9,000 (836)	7,425 (690)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 or 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- +Note 2: 10 mil average. 8 of 10 readings ≥7 mils. Lowest individual ≥ 5 mils.
- GSE White Textured is available in rolls weighing about 4,000 lb (1,800 kg).
- [1]The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therefore, these tensile properties are minimum average values.
- [2]GSE White Textured may have an overall ash content greater than 3.0% due to the white layer.
- [3]NCTL is conducted on representative smooth membrane samples.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.
- [4]The values apply to the black layer only.
- [5]Roll lengths and widths have a tolerance of ± 1%.
- *Modified.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE ULTRAFLEX

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE			
Product Code			LLD 030A000	LLD 040A000	LLD 060A000	LLD 080A000
Thickness, (minimum average) mil (mm)	ASTM D 5199	every roll	30 (0.75)	40 (1.00)	60 (1.50)	80 (2.00)
Lowest individual reading (-10%)			27 (0.69)	36 (0.91)	54 (1.40)	72 (1.80)
Density, g/cm³	ASTM D 1505	200,000 lb	0.92	0.92	0.92	0.92
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb				
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		114 (20)	152 (27)	228 (40)	304 (53)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		800	800	800	800
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	16 (71)	22 (98)	33 (147)	44 (200)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	42 (190)	56 (250)	84 (370)	112 (500)
Carbon Black Content, %	ASTM D 1603*/4218	20,000 lb	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**			
Oxidative Induction Time, min	ASTM D 3895, 200° C, 1 atm	200,000 lb	>100	>100	>100	>100
Roll Length (approximate), ft (m)			1,120 (341)	870 (265)	560 (171)	430 (131)
Roll Width[1], ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area[1], ft² (m²)			25,200 (2,341)	19,575 (1,819)	12,600 (1,171)	9,675 (899)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE UltraFlex is available in rolls weighing about 3,800 lb (1,724 kg) respectively.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.
- [1]Roll lengths and widths have a tolerance of ± 1%.
- *Modified.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE ULTRAFLEX WHITE

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE	
Product Code			LLD040A010	LLD060A010
Thickness, (minimum average) mil (mm)	ASTM D 5199	every roll	40 (1.00)	60 (1.50)
Lowest individual reading (-10%)			36 (0.91)	54 (1.40)
Density[2], g/cm³	ASTM D 1505	200,000 lb	0.92	0.92
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb		
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		152 (27)	228 (40)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		800	800
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	22 (98)	33 (147)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	56 (250)	84 (370)
Carbon Black Content[1] [2], %	ASTM D 1603*/4218	20,000 lb	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**	
Oxidative Induction Time[2], min	ASTM D 3895, 200° C; 0_2 1 atm	200,000 lb	>100	>100
Roll Length[3] (approximate), ft (m)			870 (265)	560 (171)
Roll Width[3], ft (m)			22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			19,575 (1,819)	12,600 (1,171)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE UltraFlex White is available in rolls weighing about 3,800 lb (1,724 kg).
- [1]GSE UltraFlex White may have an overall ash content greater than 3.0% due to the white layer.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.
- [2]The values apply to the black layer only.
- [3]Roll lengths and widths have a tolerance of ± 1%.
- *Modified.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE ULTRAFLEX TEXTURED

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE		
Product Code			LUT040G000	LUT060G000	LUT080G000
Thickness, (minimum average) mil (mm) Lowest individual for 8 out of 10 values Lowest individual for any of the 10 values	ASTM D 5994	every roll	38 (0.96) 36 (0.91) 34 (0.86)	57 (1.45) 54 (1.40) 51 (1.30)	76 (1.93) 72 (1.80) 68 (1.73)
Density, g/cm^3	ASTM D 1505	200,000 lb	0.92	0.92	0.92
Tensile Properties (each direction)[1] Strength at Break, lb/in-width (N/mm) Elongation at Break, %	ASTM D 6693, Type IV Dumbell, 2 ipm G.L. = 2.0 in (51 mm)	20,000 lb	 60 (11) 250	 90 (16) 250	 120 (21) 250
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	22 (98)	33 (147)	44 (200)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	44 (200)	66 (300)	88 (400)
Carbon Black Content, %	ASTM D 1603*/4218	20,000 lb	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1
Asperity Height	GRI GM 12	second roll	+Note 2	+Note 2	+Note 2
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**		
Oxidative Induction Time, min	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100
Roll Length[2] (approximate), ft (m)			700 (213)	520 (158)	400 (122)
Roll Width[2], ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft^2 (m^2)			15,750 (1,463)	11,700 (1,087)	9,000 (836)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- +Note 2: 10 mil average. 8 of 10 readings ≥7 mils. Lowest individual ≥ 5 mils.
- GSE UltraFlex Textured is available in rolls weighing about 3,900 lb (1,769 kg).
- [1]The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therefore, these tensile properties are average roll values.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.
- [2]Roll lengths and widths have a tolerance of ± 1%.
- Modified.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE ULTRAFLEX WHITE TEXTURED

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE		
Product Code			LUT040G010	LUT060G010	LUT080G010
Thickness, (minimum average) mil (mm)	ASTM D 5994	every roll	38 (0.96)	57 (1.45)	76 (1.93)
Lowest individual for 8 out of 10 values			36 (0.91)	54 (1.40)	72 (1.80)
Lowest individual for any of the 10 values			34 (0.86)	51 (1.30)	68 (1.73)
Density[3], g/cm^3	ASTM D 1505	200,000 lb	0.92	0.92	0.92
Tensile Properties (each direction)[1]	ASTM D 6993, Type IV	20,000 lb			
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		60 (11)	90 (16)	120 (21)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		250	250	250
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	22 (98)	33 (147)	44 (200)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	44 (200)	66 (300)	88 (400)
Carbon Black Content[2] [3], %	ASTM D 1603*/4218	20,000 lb	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1
Asperity Height	GRI GM 12	second roll	+Note 2	+Note 2	+Note 2
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**		
Oxidative Induction Time[3], min	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100
Roll Length[4] (approximate), ft (m)			700 (213)	520 (158)	400 (122)
Roll Width[4], ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft^2 (m^2)			15,750 (1,463)	11,700 (1,087)	9,000 (836)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- +Note 2: 10 mil average. 8 of 10 readings ≥7 mils. Lowest individual ≥ 5 mils.
- GSE UltraFlex White Textured is available in rolls weighing about 3,900 lb (1,769 kg).
- [1]The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therefore, these tensile properties are average roll values.
- [2]GSE UltraFlex White Textured may have an overall ash content greater than 3.0% due to the white layer.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.
- [3]The values apply to the black layer only.
- [4]Roll lengths and widths have a tolerance of ± 1%.
- *Modified.

MINIMUM WELD PROPERTIES FOR STANDARD HDPE GEOMEMBRANES[1]

Property	Test Method	30 (0.75)	40 (1.0)	60 (1.5)	80 (2.0)	100 (2.5)	120 (3.0)
Peel Strength (fusion), ppi (kN/m)	ASTM D 6392	49 (8.6)	65 (11.4)	98 (17.2)	130 (22.8)	162 (28.4)	196 (34.3)
Peel Strength (extrusion), ppi (kN/m)	ASTM D 6392	39 (6.8)	52 (9.1)	78 (13.7)	104 (18.2)	130 (22.8)	157 (27.5)
Shear Strength (fusion & ext), ppi (kN/m)	ASTM D 6392	61 (10.7)	81 (14.2)	121 (21.2)	162 (28.4)	203 (35.5)	242 (42.4)

[1] These values apply to both coextruded and flat cast produced geomembranes and white-surfaced and conductive products.

MINIMUM WELD PROPERTIES FOR STANDARD LLDPE GEOMEMBRANES[1]

Property	Test Method	30 (0.75)	40 (1.0)	60 (1.5)	80 (2.0)	100 (2.5)
Peel Strength (extrusion) ppi (kN/m)	ASTM D 6392	36 (6.3)	48 (8.4)	72 (12.6)	96 (16.8)	120 (21.0)
Peel Strength (fusion), ppi (kN/m)	ASTM D 6392	38 (6.7)	50 (8.8)	75 (13.1)	100 (17.5)	125 (21.9)
Shear Strength (fusion & ext), ppi (kN/m)	ASTM D 6392	45 (7.9)	60 (10.5)	90 (15.8)	120 (21.0)	150 (26.3)

[1] These values apply to both coextruded and flat cast produced geomembranes to include white-surfaced products.

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South America	GSE Lining Technology Chile S.A.	Santiago, Chile		56 2 595 4200	Fax: 56 2 595 4290
Asia Pacific	GSE Lining Technology Company Limited	Bangkok, Thailand		66 2 937 0091	Fax: 66 2 937 0097
Europe & Africa	GSE Lining Technology GmbH	Hamburg, Germany		49 40 767420	Fax: 49 40 7674234
Middle East	GSE Lining Technology-Egypt	The 6th of October City, Egypt		202 2 828 8888	Fax: 202 2 828 8889

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Geonets & Geocomposites

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Installation Quality Assurance Manual

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I. ROLL PACKAGING AND LABELS

A. GSE geocomposite rolls shall be shipped from the factory in opaque protective covering to prevent damage and UV degradation. GSE geonets do not need to be further protected from UV degradation during shipping or storage.

B. Each roll of GSE geonet and geocomposite are labeled with the following information:

- Name of Manufacturer
- Product Code
- Product Description
- Roll Number
- Roll Dimensions

II. MATERIAL DELIVERY

A. Upon arrival on site, QA personnel will do an inventory of materials on-site.

B. Roll numbers of the geonet or geocomposite will be logged on the Inventory Check List (see Appendix A) and cross-referenced with the bills of lading.

C. Copies of the Inventory Checklist and signed Bill of Ladings should be sent to the home office with on-site QA personnel retaining the originals.

D. Any visible damage to roll materials should be noted on the roll and Inventory Check list.

III. UNLOADING AND STORAGE PROCEDURES

A. Rolls of material shall be unloaded with equipment that will not damage the geonet or geocomposite.

B. Fabric-straps, spreader bars, stinger bars, or other approved equipment shall be used for handling rolls of geonet and geocomposite.

C. Materials should be stored in a flat, dry and well drained area.

D. The surface shall be free of sharp rocks or other objects that could damage the materials.

E. The storage area must be as close as possible to the work area to minimize site handling.

IV. SUBGRADE PREPARATION

The subgrade shall be free of sharp rocks or materials that could otherwise cause damage to the material.

V DEPLOYMENT

Geonet and geocomposite shall be handled in such a manner as to ensure that it is not damaged in any way.

A. On slopes, the material shall be anchored in the anchor trench and then rolled down the slope in such a manner as to continually keep the material under tension.

B. In the presence of wind, the leading edge of the material shall be weighted with sandbags or ballasts until the final cover is placed.

C. Care shall be taken to assure that any underlying layers are not damaged during placement. Low ground pressure machines such as ATV's to facilitate deployment over the geosynthetic layers is recommended. Low ground pressure machines are machines with a ground pressure less than 8 psi when carrying a driver weighing approximately 150 lbs.

D. Care shall be taken to avoid entrapment of stones, mud and other materials during placement and seaming operations.

VI. OVERLAPS AND SEAMS

A. The recommended geonet overlap in the machine direction is 3-inches to 5-inches. The recommended overlap is 6-inches to 12-inches in the transverse direction.

B. On slopes the ends of the materials shall be shingled down in the direction of the slope.

C. A plastic cable tie should be placed once per every five linear feet in the machine direction and once per every linear foot in the transverse direction.

D. If the product is a geocomposite, the geotextile on the bottom shall be overlapped and the geotextile on top shall be overlapped, sewn or heat-bonded. The exact seaming method or overlap must be specified in project construction documents.

VII. COVER SOIL PLACEMENT

A. Prior to placement of cover soil, a Certificate of Acceptance (see Appendix C) must be signed by responsible party and an installer's representative.

B. Any cover material, such as soil, that is placed over the drainage material shall be placed in such a manner as to assure that it is not damaged.

C. Care shall be taken to minimize any slippage of the geonet or geocomposite and to assure that no tensile stress is induced in the material.

D. Cover soils deployed over the geonet or geocomposite should be free of all sharp objects, such as sharp rocks and sticks.

E. Wide track equipment should be used to distribute cover soil over the geocomposite.

F. A minimum of 12-inches of cover soil is required to separate the equipment from the geocomposite to prevent damage.

Appendix A - GSE Inventory Check List

Date: _____

Project: _____ **Site Manager:** _____

Project #: _____ **QA Technician:** _____ **Page:** _____ of _____

Row #	Material	Roll#	Used	Material	Roll#	Used	Material	Roll#	Used
A									
B									
C									
D									
E									
F									
G									
H									
I									
J									
K									
L									
M									
N									
O									
P									
Q									
R									
S									
T									
U									
V									
W									
X									
Y									
Z									
AA									
BB									
CC									
DD									
EE									
FF									
GG									
HH									
II									

Appendix B - GSE Panel Placement Log

Project Name: _____ Site Manager: _____

Location: _____ Product Code: _____

Job Number: _____

Q.A. Tech: _____

Panel Number	Roll Number	Deployment Date	Width (Feet)	Length Feet	Square Feet Smooth	Square Feet Textured

Appendix C - Certificate of Acceptence

GSE Lining Technology, Inc.
19103 Gundle Road
Houston Texas 77073
800-435-2008
281-443-8564
281-875-6010 Fax

Job No.: _____
Project: _____
Client: _____
Bill To: _____
_____
_____

Job Description: _____
% Complete of Total Job: _____

Certificate of Acceptence

Material	Estimated Square Feet	Final Quantity/Description

I, the undersigned, duly representative of:
Do hereby take over and accept the work described above from the date hereof and confirm to the best of my knowledge the work has been completed in accordance with specifications and the terms and conditions of the contract.

Name	Signature	Title	Date

Certificate accepted by GSE Lining Technology, Inc. Representative.

Name	Signature	Title	Date

North America	GSE Lining Technology, Inc.	Houston, Texas	800 435 2008	281 443 8564	Fax: 281 230 8650
South America	GSE Lining Technology Chile S.A.	Santiago, Chile		56 2 595 4200	Fax: 56 2 595 4290
Asia Pacific	GSE Lining Technology Company Limited	Bangkok, Thailand		66 2 937 0091	Fax: 66 2 937 0097
Europe & Africa	GSE Lining Technology GmbH	Hamburg, Germany		49 40 767420	Fax: 49 40 7674234
Middle East	GSE Lining Technology-Egypt	The 6th of October City, Egypt		202 2 828 8888	Fax: 202 2 828 8889

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Geonets & Geocomposites

GSE HyperNet • GSE HyperNet HF • GSE HyperNet HS • GSE HyperNet UF • GSE FabriNet
GSE FabriNet HF • GSE FabriNet HS • GSE FabriNet UF • GSE PermaNet HL • GSE PermaNet UL

Manufacturing Quality Assurance Manual

www.gseworld.com

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I. QUALITY MANIFEST

GSE Lining Technology, Inc. is committed to providing the highest quality products and services to our customers. This requires a firm, total quality commitment from all individuals within our organization that we will only supply materials that meet or exceed the requirements and specifications of GSE and our customers.

GSE's commitment to quality starts with the highest quality raw materials. The quality of incoming raw materials is controlled at the supplier level with a complete vendor evaluation program in place. This means purchasing only from suppliers who are committed to statistical process control thereby providing a consistent, high level of quality assurance of their products.

II. MANUFACTURING QUALITY ASSURANCE

GSE Lining Technology, Inc. has an on-site Manufacturing Quality Assurance Laboratory at each manufacturing plant. Having a fully equipped, well staffed, dedicated laboratory at each of the manufacturing facilities allows GSE to maintain a high level of quality and up-to-the-minute results on finished products. Each facility follows the same guidelines for evaluating the quality of GSE products and is capable of adapting to market-driven requirements.

A. Objective

The objective of the GSE Quality Assurance program is to define implementation of basic manufacturing quality assurance (MQA) procedures necessary to ensure consistent production of quality products supplied to the geosynthetic market. Note that at this time, these procedures are limited to polyethylene drainage products including geonets and geocomposites.

B. Scope

In order to achieve GSE's stated purpose, a rigorous set of minimum standards and an effective test program to assure compliance has been established. These procedures and requirements are frequently reviewed and adjusted to assure compliance with current market demands and/or predetermined project specifications. These procedures assure that raw materials and process parameters are controlled to provide products complying with GSE's pre-defined minimum characteristics.

III. MANUFACTURING QUALITY ASSURANCE ORGANIZATION

This organization consists of the Manufacturing Quality Assurance Laboratories as well as the manufacturing personnel. The combination of expertise and experience from these groups provides GSE with the proper tools to maintain the highest level of quality and customer service in the industry.

The Quality Assurance Department at GSE is charged by the President to assure that only products meeting both GSE's and the customer's requirements are released for shipment. The Quality Assurance personnel are directly responsible for monitoring testing and providing feedback to the manufacturing department to ensure the production of the specified product quality. Each member of the Quality Assurance team must participate in detailed training that includes factory exposure.

IV. STAFF AND SCHEDULING

The Quality Assurance Laboratories are staffed whenever manufacturing is occurring; this is usually 24 hours per day, 365 days per year. This minimizes the amount of potentially inferior product produced before a manufacturing problem is identified.

V. PRODUCT IDENTIFICATION AND DOCUMENTATION

A. *Roll Numbering*

Each roll of geonet and geocomposite is assigned a unique roll number. The Quality Assurance Laboratory maintains records documenting the raw materials and resulting product quality information.

B. *Approval Procedure*

Results for each tested roll of product are checked against both GSE and customer specifications for compliance. The Quality Assurance Laboratory approves those materials that meet both of these requirements for shipment.

C. *Non-Conformance*

Material that does not meet GSE minimum standards is given a roll number but is rejected and not placed into inventory. The material is identified as scrap and will not be utilized.

Material that meets GSE minimum standards but does not meet a stricter customer specification is not allocated to that customer but is placed into inventory as GSE standard material.

D. *Documentation*

Individual Quality Assurance Certificates are generated and supplied for each roll of geonet and geocomposite product to include all relevant quality assurance information about the material(s). The geotextile components of the drainage geocomposite materials are tracked throughout the manufacturing process. Therefore, "traceability reports" are available.

VI. RECORDS RETENTION

GSE maintains reports and/or samples for products produced and sold. Records and/or samples are maintained according to GSE's standard retention policy according to the item.

MATERIAL	ITEM	YEARS
Raw materials	Resin Supplier Test Reports and Certifications	≥2
	GSE Resin Test Reports	≥2
	Resin Sample Retain (Archive)	≥2
Geonet and Geocomposite	Raw Test Data (in computer database)	≥5
	Quality Control Certificates (in computer database)	≥5
	Sample Retain (approximately one square foot)	≥5

VII. TESTING CAPABILITIES

GSE maintains high capacity, state-of-the-art laboratory equipment suitable for performing the procedures listed in Appendix A and B. GSE's Houston and Kingstree laboratories are accredited by the GAI-LAP program. GSE's Houston and Kingstree Quality Assurance Laboratories, as part of GSE's Product Division, also hold ISO certification. The appropriate certificates are maintained for review upon request by authorized parties.

A. *Routine Testing*

Through careful investigation, GSE has developed a strict and thorough Quality Assurance program that exceeds the vast majority of customer specifications. The testing program covers raw materials and finished goods and is adhered to at all GSE laboratories. The laboratory equipment used by GSE represents the most modern equipment available and meets or exceeds the requirements of all the test standards used. Test frequencies and number of test specimen per sample are established based on statistical analysis and complexity of procedures.

B. *Other Testing Capabilities*

In addition to routine testing, GSE laboratories are equipped to perform a wide variety of other tests as required for unusual requests or product development. Further, although the GSE Quality Assurance Laboratories are fully equipped and able to perform most routinely specified tests in the industry, there are some tests that are more economically performed by a dedicated testing facility. GSE believes requirements for such testing should be carefully considered and defined in terms of specific design requirements if they are found to be necessary.

VIII. MATERIAL QUALITY ASSURANCE

GSE Lining Technology, Inc. has established strict specifications for all raw materials and finished products. Test results must fall within the acceptable limits of GSE and customer specifications.

A. *Raw Material*

GSE primarily uses two types of raw materials, "natural resin" and "masterbatch" in the manufacture of geonet products. Natural resin is the base material that is used to make a geonet. It contains stabilizers to prevent degradation from occurring during and after extrusion. "Masterbatch" is the term referring to the concentrated carbon black material used with the natural resin to produce the finished product. The natural resin and masterbatch are blended at the appropriate ratio at the manufacturing stage. The masterbatch can contain other additives depending upon the geonet product to be produced. GSE verifies the properties of each lot of raw material prior to their utilization.

When natural resin is received, samples are taken and subjected to the tests outlined in Appendix A. All test data are entered into the computer database and checked for accuracy, consistency and compliance with GSE specifications. The material is not accepted unless all standard test requirements are met and the GSE test values meet the requirements set forth in the raw material specifications.

Copies of the supplier's certificate of analysis (COA) for each lot of resin utilized in the production of the materials supplied to a specific project are supplied as standard documentation. In addition, the GSE test results for each lot of resin are provided in a separate report upon request.

Virgin resin is normally received in rail car lots. If resin is received by other transport and/or in other quantities, an equivalent suitable sampling procedure is provided (i.e. not less than one sample per shipment or one sample for each 50,000 lb., 23,000 kg)

B. *Geonet Products*

Geonet drainage products with bi-planar geometry are produced. The reader is requested to refer to GSE Geonet data sheets for test methods, frequencies and specifications.

1. Sampling

A one-foot by roll width sample is cut for Quality Assurance testing from every tenth roll produced. An archive sample is cut from each tested roll. This sample is taken from a random location then labeled and stored for future reference (see Section VI). Test frequencies and number of test specimen per sample are established based on statistical analysis of the available data and complexity of the test procedures.

2. Evaluation of Results

All data are entered into a computer database for calculation and comparison to established order specifications. If materials do not meet the required GSE standards and/or the customer specifications the manufacturing personnel are immediately notified in order for the appropriate adjustments to be made. Only products meeting GSE standards and customer specifications will be approved for shipment.

3. Reporting

A Quality Assurance Certificate is issued for every roll of finished product. This report identifies the standards on which the GSE approval is based along with the actual test results demonstrated by the material.

C. Geocomposite Products

Geocomposite products are produced by heat bonding a geotextile to one or both sides of a geonet product. Sampling, evaluation of results and reporting practices are the same as for geonet products. Please refer to GSE geocomposite data sheets for test methods, frequencies and specifications

D. Third Party Conformance Sampling

Some specifications require independent Quality Assurance and/or conformance testing. GSE can provide assistance with the sampling of products by arranging for the conformance samples to be taken during production. By taking samples during production rather than on site, the customer can be assured that the samples are clean and available for conformance testing in a timely manner.

GSE encourages customers to audit GSE manufacturing and manufacturing quality assurance operations and/or to collect samples and conduct independent conformance testing prior to shipment of materials.

Appendix A - Minimum Testing Frequencies and Properties for GSE Raw Materials

MINIMUM TESTING FREQUENCIES FOR GSE RAW MATERIALS[1,2]

Property	Test Method	Natural Resin
Density	ASTM D 1505	once per rail car compartment
Melt Flow Index	ASTM D 1238 (190/2.16)	once per rail car compartment
Carbon Black Content	ASTM D 1603*/4218	N/A
Carbon Black Dispersion	ASTM D 5596	NA

[1] GSE utilizes test equipment and procedures that enable effective and economical confirmation that the product will conform to specifications based on the noted procedures. Some test procedures have been modified for application to geosynthetics. All procedures and values are subject to change without prior notification.

[2] Refer to GSE's ISO 9000 quality manual for raw material requirements for individual products.

*Modified.

North America	GSE Lining Technology, Inc.	Houston, Texas	800 435 2008	281 443 8564	Fax: 281 230 8650
South America	GSE Lining Technology Chile S.A.	Santiago, Chile		56 2 595 4200	Fax: 56 2 595 4290
Asia Pacific	GSE Lining Technology Company Limited	Bangkok, Thailand		66 2 937 0091	Fax: 66 2 937 0097
Europe & Africa	GSE Lining Technology GmbH	Hamburg, Germany		49 40 767420	Fax: 49 40 7674234
Middle East	GSE Lining Technology-Egypt	The 6th of October City, Egypt		202 2 828 8888	Fax: 202 2 828 8889

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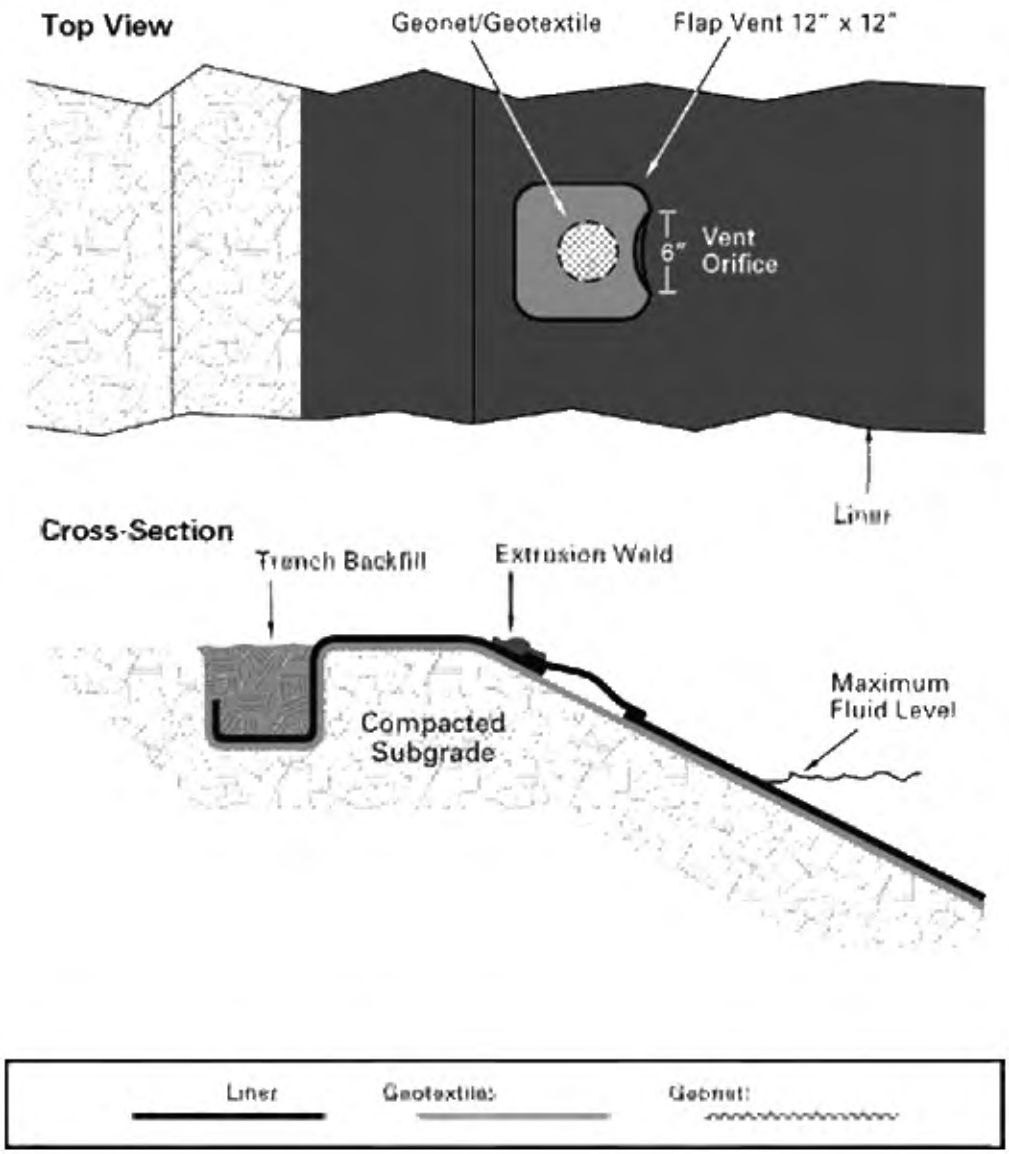
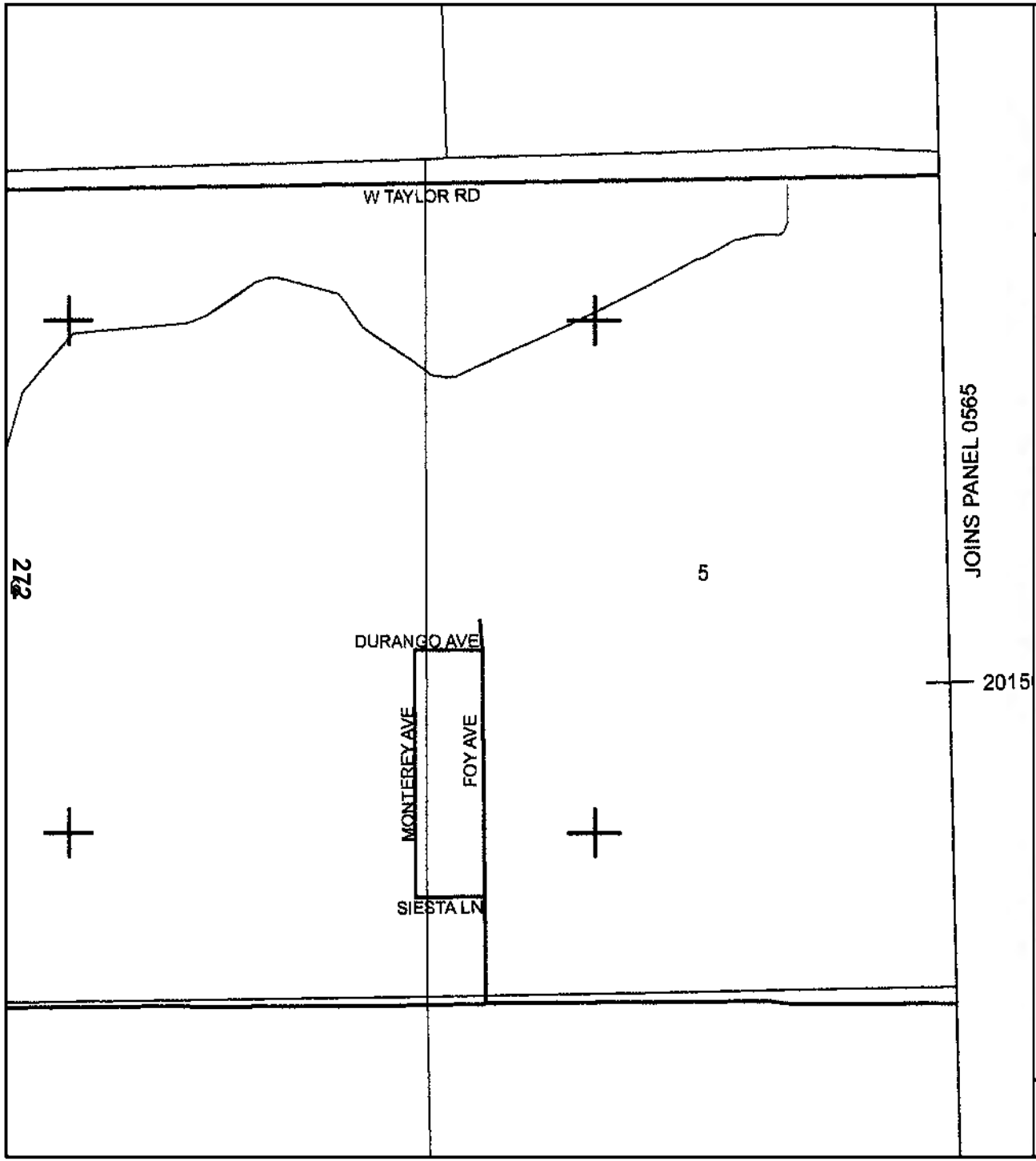
AIR-GAS FLAP TYPE VENT



Appendix G
FEMA Map



MAP NUMBER
06099C0545E

EFFECTIVE DATE
SEPTEMBER 26, 2008

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain boundary
- Floodway boundary
- Zone D Boundary
- CBRS and OPA Boundary

Stanislaus County
Striving to be the Best

DEPARTMENT OF PLANNING AND COMMUNITY DEVELOPMENT

1010 10th Street, Suite 3400, Modesto, CA 95354
Phone: 209.525.6330 Fax: 209.525.5911

CEQA INITIAL STUDY

Adapted from CEQA Guidelines APPENDIX G Environmental Checklist Form, Final Text, December 30, 2009

1.	**Project title:**	Use Permit Application No. PLN2015-0019 – Trinkler Dairy Farms, Inc.
2.	**Lead agency name and address:**	Stanislaus County 1010 10th Street, Suite 3400 Modesto, CA 95354
3.	**Contact person and phone number:**	Rachel Wyse, Associate Planner
4.	**Project location:**	7251 Crows Landing Road, at the southwest corner of Crows Landing and W Taylor Roads, in the Ceres area. (APN: 022-007-013).
5.	**Project sponsor's name and address:**	Jon Rebiero, Trinkler Dairy Farms, Inc. PO Box 10 Ceres, CA 95307
6.	**General Plan designation:**	Agriculture
7.	**Zoning:**	A-2-40 (General Agriculture)

8. Description of project:

Request to increase the permitted herd size of an existing dairy facility from 3,150 to 5,175 animal units. The increase in animal units will consist of: 3,180 milk cows and 600 dry cows, not to exceed a combined total of 3,780 mature cows (milk and dry), and 1,395 heifers [275 (15-24 months); 520 (4-6 months); and 600 calves (0-3 months)] on 80± acres of a 220± acre parcel in the A-2-40 (General Agriculture) zoning district. Medium heifers (7-14 months) will not be kept at this facility. This expansion will require the construction of a 165,240 square foot freestall barn, a 26,100 square foot rotary milk parlor, a 10,800 square foot calf barn, a 307,500 square foot feed storage pad, and a new wastewater storage pond (lagoon). A sealed feed storage system will be utilized for bagged silage. The freestall barn's feed lanes and walkways will continue to be flushed three times per day and baby calves kept in calf barns. The new storage pond will be 375 feet wide by 500 feet long by 15 feet deep with 3:1 embankment slopes. Of the 15 foot depth, only five (5) feet will be below existing grade. Additional construction details can be found in the attached Pond Construction Work Plan.

The expansion will result in an increase in volume of waste and, as such, requires Waste Discharge Requirements (WDR) from the Regional Water Quality Control Board. The attached Waste Management Plan (WMP) and Nutrient Management Plan (NMP) provide details on managing the increase in animal units and resulting waste. Wastewater and/or dry manure will be utilized on 1003 acres of land application areas currently planted in corn, wheat, or almonds (see WMP Figure 3 – Field and Cropping Map). The dairy currently averages between seven (7) and eight (8) truck trips per day; truck trips which are expected to increase to 11 and 12 per day at full build out. Feed and supplement deliveries are anticipated to increase from an average of one (1) to two (2) deliveries per day. Milk transport trips are anticipated to increase from approximately three (3) to six (6) trips per day. Calf transport occurs daily with no additional trips expected. The duration of weekly pregnancy checks and breeding conducted by the veterinarian will increase in time but not frequency. Transfer of heifers to and from the facility will roughly double from two (2) per week to four (4) per week. Employees are anticipated to increase from eight current employees, to a maximum of 14 employees post-project.

The site is currently improved with four homes served by private well and septic systems, 370,610± square feet of dairy facility structures and two (2) wastewater storage ponds (lagoons). A new domestic well will be constructed to serve the new milk parlor building.

9.	**Surrounding land uses and setting:**	The property is surrounded by agricultural parcels ranging in size from .5± to 160± acres, planted in row crops and orchards with scattered single family dwellings. The Monterey Park Tract is located southwest of the site and a number of dairies are located within a two mile radius of the project site. The Turlock Irrigation District (TID) Lateral No. 3 runs along the northern property line.
10.	**Other public agencies whose approval is required (e.g., permits, financing approval, or participation agreement.):**	Regional Water Quality Control Board San Joaquin Valley Air Pollution Control District Department of Environmental Resources – Hazardous Waste Division Building Permits Division CA Department of Fish and Wildlife
11.	**Attachments:**	Maps Waste Management Plan Nutrient Management Plan Pond Construction Plan Early Consultation Referral Responses Negative Declaration

ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED:

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "Potentially Significant Impact" as indicated by the checklist on the following pages.

☐ **Aesthetics**	☐ **Agriculture & Forestry Resources**	☐ **Air Quality**
☐ **Biological Resources**	☐ **Cultural Resources**	☐ **Geology / Soils**
☐ **Greenhouse Gas Emissions**	☐ **Hazards & Hazardous Materials**	☐ **Hydrology / Water Quality**
☐ **Land Use / Planning**	☐ **Mineral Resources**	☐ **Noise**
☐ **Population / Housing**	☐ **Public Services**	☐ **Recreation**
☐ **Transportation / Traffic**	☐ **Utilities / Service Systems**	☐ **Mandatory Findings of Significance**

DETERMINATION: (To be completed by the Lead Agency)
On the basis of this initial evaluation:

☒ **I find that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.**

☐ **I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.**

☐ **I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.**

☐ **I find that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.**

☐ **I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.**

Rachel Wyse, Associate Planner
Prepared By

December 9, 2016
Date

EVALUATION OF ENVIRONMENTAL IMPACTS:

1) A brief explanation is required for all answers except "No Impact" answers that are adequately supported by the information sources a lead agency cites in the parentheses following each question. A "No Impact" answer is adequately supported if the referenced information sources show that the impact simply does not apply to projects like the one involved (e.g., the project falls outside a fault rupture zone). A "No Impact" answer should be explained where it is based on project-specific factors as well as general standards (e.g., the project will not expose sensitive receptors to pollutants, based on a project-specific screening analysis).

2) All answers must take account of the whole action involved, including off-site as well as on-site, cumulative as well as project-level, indirect as well as direct, and construction as well as operational impacts.

3) Once the lead agency has determined that a particular physical impact may occur, than the checklist answers must indicate whether the impact is potentially significant, less than significant with mitigation, or less than significant. "Potentially Significant Impact" is appropriate if there is substantial evidence that an effect may be significant. If there are one or more "Potentially Significant Impact" entries when the determination is made, an EIR is required.

4) "Negative Declaration: Less Than Significant With Mitigation Incorporated" applies where the incorporation of mitigation measures has reduced an effect from "Potentially Significant Impact" to a "Less Than Significant Impact." The lead agency must describe the mitigation measures, and briefly explain how they reduce the effect to a less than significant level (mitigation measures from Section XVII, "Earlier Analyses," may be cross-referenced).

5) Earlier analyses may be used where, pursuant to the tiering, program EIR, or other CEQA process, an effect has been adequately analyzed in an earlier EIR or negative declaration.

Section 15063(c)(3)(D). In this case, a brief discussion should identify the following:

a) Earlier Analysis Used. Identify and state where they are available for review.

b) Impacts Adequately Addressed. Identify which effects from the above checklist were within the scope of and adequately analyzed in an earlier document pursuant to applicable legal standards, and state whether such effects were addressed by mitigation measures based on the earlier analysis.

c) Mitigation Measures. For effects that are "Less than Significant with Mitigation Measures Incorporated," describe the mitigation measures which were incorporated or refined from the earlier document and the extent to which they address site-specific conditions for the project.

6) Lead agencies are encouraged to incorporate into the checklist references to information sources for potential impacts (e.g., general plans, zoning ordinances). References to a previously prepared or outside document should, where appropriate, include a reference to the page or pages where the statement is substantiated.

7) Supporting Information Sources: A source list should be attached, and other sources used or individuals contacted should be cited in the discussion.

8) This is only a suggested form, and lead agencies are free to use different formats; however, lead agencies should normally address the questions from this checklist that are relevant to a project's environmental effects in whatever format is selected.

9) The explanation of each issue should identify:

a) the significant criteria or threshold, if any, used to evaluate each question; and

b) the mitigation measure identified, if any, to reduce the impact to less than significant.

ISSUES

I. AESTHETICS -- Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Included	Less Than Significant Impact	No Impact
a) Have a substantial adverse effect on a scenic vista?				**X**
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?				**X**
c) Substantially degrade the existing visual character or quality of the site and its surroundings?			**X**	
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?			**X**	

Discussion: Any development resulting from this project will be consistent with existing area developments. The site itself is not considered to be a scenic resource or a unique scenic vista. The site is currently developed with 370,610± square feet of existing dairy facilities/structures. The existing structures are comprised of metal, which is a material consistent with accessory structures in and around the A-2 (General Agriculture) zoning district. The applicant is proposing to construct a 165,240 square foot freestall barn and a 26,100 square foot milking parlor south of the existing dairy footprint, a 10,800 square foot calf barn, a wastewater storage pond (lagoon), and a 307,500 square foot feed storage pad to the north of the existing dairy facility. Proposed structures will be aesthetically consistent with existing structures. Standard conditions of approval will be added to this project to address glare from any previously installed or any proposed supplemental on-site lighting.

Mitigation: None.

References: Stanislaus County General Plan and Support Documentation[1].

II. AGRICULTURE AND FOREST RESOURCES: In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Department of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment project; and forest carbon measurement methodology provided in Forest Protocols adopted by the California Air Resources Board. -- Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Included	Less Than Significant Impact	No Impact
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?			**X**	
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?			**X**	

c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?				**X**
d) Result in the loss of forest land or conversion of forest land to non-forest use?				**X**
e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use?			**X**	

Discussion: Request to increase the number of permitted milk cows by 1,780 head for a total of 3,180; increase dry cows by 425 head for a total of 600; and reduce support stock by 180 head for a total of 1,395, on 80± acres of a 220± acre parcel. The site contains four (4) homes with private well(s) and septic systems, and includes 370,610 square feet of dairy structures as well as two (2) wastewater storage ponds. The attached Waste Water Management Plan (WMP) and Nutrient Management Plan (NMP) provide details on managing the expanded dairy cows, increased waste, and waste pond management. Wastewater and/or dry manure will be utilized on 1003 acres of land application areas currently planted in corn, wheat, or almonds (see Maps).

The existing dairy facility, located at 7251 Crows Landing Road, further identified as APN: 022-007-013, encompasses 80± acres of a 220± acre parcel and is currently enrolled under Williamson Act Contract No. 71-0194. Surrounding land uses consist of mostly cropland, scattered single family homes and agricultural buildings. A number of dairies are located within a two (2) mile radius of the project site. A residential subdivision, Monterey Park Tract, is located southwest of the project site.

The portion of the parcel where the dairy operation is located has soils classified by the California Department of Conservation Farmland Mapping and Monitoring Program as Confined Animal Agriculture. The remainder of the parcel is designated mostly as Prime Farmland with a portion designated as Farmland of Statewide Importance, and as Stanislaus Unique Farmland. The USDA Natural Resources Conservation Service's Eastern Stanislaus County Soil Survey indicates that the property is made up of Delhi loamy sand (DeA), Dinuba sandy loam (DrA), Hilmar loamy sands (HfA and HkbA), Tujunga loamy sand (TuA), Storie Index Ratings range from 57 to 77, with 98.6% of the soils having a grade 2 designation and are thus considered to be prime soils. Specific soils impacted by the construction of the new wastewater storage pond are identified in the Pond Construction Work Plan, attached and incorporated herein.

The proposed use is permitted in Stanislaus County; however, the Regional Water Quality Control Board (RWQCB) has determined that WDRs are required, which requires CEQA compliance. RWQCB has reviewed the applicant's WMP, NMP, and the new wastewater pond construction plans and specifications and has stated the plans are sufficient.

This project will have no impact to forest land or timberland. The project will not conflict with any agricultural activities in the area and/or lands enrolled in the Williamson Act. The project was referred to the Department of Conservation, but a response has not been received to date.

Mitigation: None.

References: USDA Natural Resource Conservation Service Web Soil Survey Version 9, Sep. 18, 2014; emails dated October 27, 2014, from Charlene Herbst, Regional Water Quality Control Board staff; USDA Soil Conservation Service Soil Survey of Eastern Stanislaus Area CA; California Farmland Mapping and Monitoring Program Data; Applicant Maps; Trinkler Dairy Farms Wastewater Management Plan, Nutrient Management Plan, and Pond Construction Work Plan; the Stanislaus County Zoning Ordinance; Stanislaus County General Plan and Support Documentation[1].

III. AIR QUALITY: Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. -- Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Included	Less Than Significant Impact	No Impact
a) Conflict with or obstruct implementation of the applicable air quality plan?			X	
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?			X	
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?			X	
d) Expose sensitive receptors to substantial pollutant concentrations?			X	
e) Create objectionable odors affecting a substantial number of people?			X	

Discussion: The project site is within the San Joaquin Valley Air Basin, which has been classified as "severe non-attainment" for ozone and respirable particulate matter (PM-10) as defined by the Federal Clean Air Act. The San Joaquin Valley Air Pollution Control District (SJVAPCD) has been established by the State in an effort to control and minimize air pollution. As such, the District maintains permit authority over stationary sources of pollutants.

The facility is requesting to increase the permitted herd size from 3,150 to 5,175 total animal units. The increased animal units consist of: 3,180 milk cows and 600 dry cows not to exceed a combined total of 3,780 mature cows (milk and dry), and 1,395 heifers [275 (15-24 months); 520 (4-6 months); and 600 calves (0-3 months)] on a 220± acre parcel in the A-2-40 (General Agriculture) zoning district. Medium heifers (7-14 months) will not be kept at this facility. This expansion will require the construction of a 165,240 square foot freestall barn, a 26,100 square foot milk parlor, a 10,800 square foot calf barn, a 307,500 square foot feed storage pad, and a new wastewater storage pond (lagoon). A sealed feed storage system (i.e. Ag bags) will be used exclusively to store bagged silage. The freestall barn's feed lanes and walkways will continue to be flushed three (3) times per day and baby calves kept in calf barns. The new storage pond will be 375 feet wide by 500 feet long by 15 feet deep with 3:1 embankment slopes. Of the 15 foot depth, only five (5) feet will be below existing grade. The volume of the lagoon meets volumetric requirement in accordance with Natural Resources Conservation Service guideline #359. Additional construction details can be found in the attached Pond Construction Work Plan. An Authority to Construct has been submitted to SJVAPCD. Best Available Control Technology (BACT) will be required, as per SJVAPCD staff, to address the increase in animal unit numbers. These design elements together with categorizing support stock into age ranges will result in reducing potentially significant impacts, as identified in the SJVAPCD Early Consultation Referral Response, to less than significant.

Trinkler Dairy Farms, Inc. submitted an Authority to Construct – Modification of Emission Unit With Valid PTO/Valid ATC Application with the SJVAPCD in February 2015. This project (SJVAPCD #N1150266) was referred to SJVAPCD and a response letter was received in April 2015, which indicated concerns with the project's potential impact to construction emissions, operational emissions (both permitted stationary sources and non-permitted mobile sources), nuisance odors, and health impacts from toxic air contaminants (TACs). The referral response indicated that the application did not provide sufficient information to allow the District to assess the projects' impact on air quality and recommended that the applicant provide a more detailed assessment. The project was put on hold to allow the applicant time to work with the SJVAPCD. In December 2015, after working with SJVAPCD staff, the project was redesigned and SJVAPCD best management practices were agreed to and incorporated into the project to address the aforementioned air impacts identified by the SJVAPCD. As a part of the process the applicant and SJVAPCD staff completed an Ambient Air Quality Analysis (AAQA) and Health Risk Assessment (HRA) and the wastewater storage pond (lagoon) was subsequently relocated to allow the project to pass the hydrogen sulfite (H2S) portion of the AAQA. Ultimately, the emissions assessment must indicate an increase of less than 10 tons per year of oxides of nitrogen (NOx), 10 tons per year of

reactive organic gases (ROG), 15 tons per year of particulate matter of 10 microns or less in size (PM10), or 10 tons per year of Volatile Organic Compounds (VOC) to be under the District's threshold of significance. In order to achieve the SJVAPCD requirements the following best management practices will be utilized by the applicant and added to the project's Conditions of Approval to avoid creating significant impacts to Air Quality:

- To reduce impacts from construction related exhaust emissions, the developer shall utilize off-road construction fleets that can achieve fleet average emissions equal to or cleaner than the Tier II emission standards, as set for in §2423 of Title 13 of the California Code of Regulations, and Part 89 of Title 40 Code of Federal Regulations. This can be achieved through any combination of uncontrolled engines and engines complying with Tier II and above engine standards.

- To reduce potential health impacts created by toxic air contaminants (TAC) and to insure that the proposed wastewater storage pond (lagoon) passes the AAQA for H2S, the proposed lagoon shall be a minimum of 87 meters wide and 200 meters long. The lagoon shall be set back a minimum distance of 140 meters away from the northern fence line. Construction of the pond, as required, will insure that the project will be under the District's threshold of significance for TACs.

- To ensure the project passes the RMR portion of the project the two (2) homes, located directly east of the proposed calf barn, shall only be utilized by single employees of the dairies. No families are permitted to reside in these residences.

- All new construction requires completion of an Authority to Construct (ATC) Permit and may be subject to the following District Rules: Regulation VIII (Fugitive PM 10 Prohibitions), Rule 4102 (Nuisance), Rule 4601 (Architectural Coatings), Rule 4641 (Cutback, Slow Cure, and Emulsified Asphalt, Paving and Maintenance Operations), Rule 4550 (Conservation Management Practices), and Rule 4570 (Confined Animal Facilities).

- The applicant shall be in compliance with all applicable District's rules and regulations.

The SJVAPCD response letter indicated that the project should also be evaluated to determine the likelihood that the project would result in nuisance odors; however, odors from agricultural operations in the raising of animals, such as a dairy, are exempt from Rule 4102 (Nuisance). Even though the project may be exempt from Rule 4102, it may still be subject to additional project modifications and/or SJVAPCD rules as a part of their CEQA review. Should that be the case the applicant will be required to comply with SJVAPCD recommendations. Chapter 9.32 Agricultural Land Policies requires purchasers and users of rural property be notified of the Right-to-Farm Ordinance; establishes that conditions (noise, odor, dust, etc.) resulting from agricultural operations, conducted in a manner consistent with proper and accepted customs and standards, are not a nuisance; and establishes a grievance committee to mediate disputes involving agricultural operations.

Mitigation: None.

References: Referral response dated April 7, 2015, from the San Joaquin Valley Air Pollution Control District; Email dated May 16, 2016, from Joe Ramos discussing needed project changes with San Joaquin Valley Air Pollution Control District employees from November 30 thru December 14, 2015; Email dated November 18 and December 1, 2016, from Carlos Garcia, San Joaquin Valley Air Pollution Control District staff; Stanislaus County General Plan and Support Documentation[1]

IV. BIOLOGICAL RESOURCES -- Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Included	Less Than Significant Impact	No Impact
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?			**X**	

b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?			**X**	
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?				**X**
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?			**X**	
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?				**X**
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?				**X**

Discussion: The project is located within the Ceres Quad of the California Natural Diversity Database. There are 15 plants and animals which are state or federally listed, threatened, or identified as species of special concern within the Ceres California Natural Diversity Database Quad. Species listed include the Swainson's hawk, tricolored blackbird, burrowing owl, riffle sculpin, hardhead, steelhead (Central Valley DPS), chinook salmon, obscure bumble bee, Cortch bumble bee, valley elderberry longhorn beetle, modestan blister beetle, Townsend's big-eared bat, heartscale, and subtle orache.

There are no streams, lakes, ponds or natural watercourses on the property besides the wastewater lagoon, private irrigation facilities. Turlock Irrigation District (TID) Lateral No. 3 is north and adjacent to W Taylor Road. The site is relatively flat and contains the dairy operation, single family dwellings, field crops, some shrubs and scattered trees.

The proposed increased herd will be located on the current dairy site comprised of a wastewater lagoon, 370,610 square feet of existing dairy structures, and four (4) residences on approximately 80± acres of the total 220± acre parcel. As a part of the expansion the following dairy facilities will be constructed adjacent to and north and south of the existing dairy footprint: a 165,240 square foot freestall barn, a 26,100 square foot milk parlor, a 10,800 square foot calf barn, a 307,500 square foot feed storage pad, and a wastewater storage pond (lagoon) (See Maps). The remaining acreage will continue to be planted in field crops.

The project will not conflict with a Habitat Conservation Plan, a Natural Community Conservation Plan, or other locally approved conservation plans. Impacts to endangered species or habitats, locally designated species, or wildlife dispersal or mitigation corridors are considered to be less than significant.

An Early Consultation was referred to the California Department of Fish and Wildlife (formerly the Department of Fish and Game) and no response was received.

Mitigation: None.

References: Application information; Trinkler Dairy Farms, Inc. Wastewater Management Plan; California Department of Fish and Wildlife's Natural Diversity Database Quad Species List; Stanislaus County General Plan and Support Documentation[1]

V. CULTURAL RESOURCES -- Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Included	Less Than Significant Impact	No Impact
a) Cause a substantial adverse change in the significance of a historical resource as defined in § 15064.5?			X	
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to § 15064.5?			X	
c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?			X	
d) Disturb any human remains, including those interred outside of formal cemeteries?			X	

Discussion: It does not appear that this project will result in significant impacts to any archaeological or cultural resources. The application information indicates that no historical buildings are on site, nor will any buildings be demolished as a part of this project. According to Assessor records the four (4) homes on the property were constructed in 1940, two (2) homes in 1945 and 1952 and, as such, could possibly qualify as historical resources; however, as no construction or demolition is being proposed in conjunction with these structures the project is expected to have a less than significant impact on cultural resources.

The applicant is proposing to construct a 165,240 square foot freestall barn, a 26,100 square foot milking parlor, a 10,800 square foot calf barn, a wastewater storage pond (lagoon) and 307,500 square foot feed storage pad to the north and south of the existing dairy facility. Since ground disturbance and construction can reveal archaeological resources, a standard condition of approval will be added to this project to address any discovery of cultural resources during any ground disturbing activities. The project was referred to the Native American Heritage Commission (NAHC) via the State Clearinghouse; however, a response to the Early Consultation has not been received to date.

Mitigation: None.

References: Application information; Stanislaus County General Plan and Support Documentation[1]

VI. GEOLOGY AND SOILS -- Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Included	Less Than Significant Impact	No Impact
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.				X
ii) Strong seismic ground shaking?				X
iii) Seismic-related ground failure, including liquefaction?				X
iv) Landslides?				X
b) Result in substantial soil erosion or the loss of topsoil?			X	
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?			X	

d) Be located on expansive soil creating substantial risks to life or property?			**X**	
e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?			**X**	

Discussion: The USDA Natural Resources Conservation Service's Eastern Stanislaus County Soil Survey indicates that the property is made up of Delhi loamy sand (DeA), Dinuba sandy loam (DrA), Hilmar loamy sands (HfA and HkbA), Tujunga loamy sand (TuA).

As contained in Chapter 5 of the General Plan Support Documentation, the areas of the County subject to significant geologic hazard are located in the Diablo Range, west of Interstate 5; however, as per the California Building Code, all of Stanislaus County is located within a geologic hazard zone (Seismic Design Category D, E, or F) and a soils test may be required at building permit application. Results from soils test(s) determine if unstable or expansive soils are present. If such soils are present, special engineering of the structure will be required to compensate for the soil deficiency. Any structures resulting from this project will be designed and built according to building standards appropriate to withstand shaking for the area in which they are constructed. An early consultation referral response received from the Department of Public Works is requiring that a grading, drainage, and erosion/sediment control plan for the project be submitted prior to issuance of a building permit for any new or expanding dairy facility structure. Likewise, any addition of a septic system or alternative waste water disposal system would require Department of Environmental Resources (DER) approval, which also takes soil type into consideration within the specific design requirements.

DER, Public Works, Planning, and the Building Permits Division review and approve building and/or grading permits to ensure their standards are met. Conditions of approval regarding these standards will be applied to the project and triggered as a part of the building permit process.

Mitigation: None.

References: USDA Natural Resources Conservation Service's Eastern Stanislaus County Soil Survey; Referral response from the Stanislaus County Department of Public Works dated April 24, 2015; Title 24 California Building Code; Stanislaus County General Plan and Support Documentation[1]

VII. GREENHOUSE GAS EMISSIONS -- Would the project:	**Potentially Significant Impact**	**Less Than Significant With Mitigation Included**	**Less Than Significant Impact**	**No Impact**
a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?			**X**	
b) Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?			**X**	

Discussion: The principal Greenhouse Gasses (GHGs) are carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), sulfur hexafluoride (SF6), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), and water vapor (H2O). CO2 is the reference gas for climate change because it is the predominant greenhouse gas emitted. To account for the varying warming potential of different GHGs, GHG emissions are often quantified and reported as CO2 equivalents (CO2e). In 2006, California passed the California Global Warming Solutions Act of 2006 (Assembly Bill [AB] No. 32), which requires the California Air Resources Board (ARB) design and implement emission limits, regulations, and other measures, such that feasible and cost-effective statewide GHG emissions are reduced to 1990 levels by 2020.

After working with SJVAPCD staff, the project was redesigned and SJVAPCD air quality best management practices were agreed to and incorporated into the project to address the aforementioned air impacts identified by the SJVAPCD (See Section III - Air Quality). As a part of the process the applicant and SJVAPCD staff completed an Ambient Air Quality

Analysis (AAQA) and Health Risk Assessment (HRA), and the storage pond (lagoon) was subsequently relocated and redesigned to allow the project to pass the hydrogen sulfite (H2S) portion of the AAQA, limit the use of the two dwellings east of the proposed calf barn to adult dairy workers with no children, categorize heifers into age ranges and reduce the number of proposed support stock and exclusively use a sealed feed storage system (i.e. Ag bags) for bagged silage.

Ultimately, the emissions assessment must indicate an increase of less than 10 tons per year of oxides of nitrogen (NOx), 10 tons per year of reactive organic gases (ROG), 15 tons per year of particulate matter of 10 microns or less in size (PM10), or 10 tons per year of Volatile Organic Compounds (VOC) to be under the District's threshold of significance. In order to achieve the SJVAPCD requirements the applicant will utilize the aforementioned best management practices discussed herein and in Section III - Air Quality of this document. These practices will be added to the project's Conditions of Approval to reduce impacts to air quality and greenhouse gas emissions to less than significant.

At this time there is no adopted methodology or Best Management Practices for reducing greenhouse gas emissions for a dairy operation either locally or through SJVAPCD. However, on September 22, 2009, the United States Environmental Protection Agency (EPA) administrator signed the Final Mandatory Reporting of Greenhouse Gas Rule to require large emitters and suppliers of GHGs to begin collecting data starting January 1, 2010, under a new reporting system. The minimum average annual animal population for dairies to emit 25,000 metric tons of GHG or more per year is 3,200 dairy cows. Operators of facilities with less than 3,200 dairy cows are under the threshold for required reporting under this rule. This project proposes a maximum of 3,180 milk cows which, based on this methodology, would be under the EPA's GHG reporting threshold of significance as per the EPA's Greenhouse Gas Rule. Should Best Management Practices for the reduction of Greenhouse Gases from dairy operations be adopted either locally or by SJVAPCD, Trinkler Dairy will be required, by a condition of approval for this project, to meet those standards. The project as proposed, with input from the SJVAPCD and conditions of approval in place, will have a less than significant impact on greenhouse gas emissions.

Mitigation: None.

References: Referral response dated April 7, 2015, from the San Joaquin Valley Air Pollution Control District; Email dated May 16, 2016, from Joe Ramos discussing needed project changes with San Joaquin Valley Air Pollution Control District employees from November 30 thru December 14, 2015; Email dated November 18 and December 1, 2016, from Carlos Garcia, San Joaquin Valley Air Pollution Control District staff; United States Environmental Protection Agency (EPA) administrator signed the Final Mandatory Reporting of Greenhouse Gas Rule; Stanislaus County General Plan and Support Documentation[1]

VIII. HAZARDS AND HAZARDOUS MATERIALS -- Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Included	Less Than Significant Impact	No Impact
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?			**X**	
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?				**X**
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?				**X**
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?				**X**
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?				**X**

f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?				**X**
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?				**X**
h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?			**X**	

Discussion: Hazardous materials potentially used on site include: pipeline cleaning soap; acid cleaner; iodine; teat dip; refrigerant (R22) (used in the milk barn); formaldehyde and copper sulfate (used in cow foot baths); diesel fuel and gasoline (in tanks); motor oil hydraulic fluid; brake fluid; and antifreeze (for farm vehicle maintenance).

Pesticide exposure is a risk in agricultural areas. Sources of exposure include contaminated groundwater, which is consumed, and drift from spray applications. Application of sprays is strictly controlled by the Agricultural Commissioner and can only be accomplished after first obtaining permits. DER is responsible for overseeing hazardous materials in this area. The project was referred to the Hazardous Materials Division via the Environmental Review Committee (ERC). A referral response of "no comments at this time" was received from the ERC.

No significant impacts associated with hazards or hazardous materials are anticipated to occur as a result of the proposed project.

Mitigation: None.

References: Referral response dated April 2, 2015, from the Environmental Review Committee; Stanislaus County General Plan and Support Documentation[1]

IX. HYDROLOGY AND WATER QUALITY -- Would the project:	**Potentially Significant Impact**	**Less Than Significant With Mitigation Included**	**Less Than Significant Impact**	**No Impact**
a) Violate any water quality standards or waste discharge requirements?			**X**	
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?			**X**	
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?			**X**	
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?			**X**	
e) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?			**X**	

f) Otherwise substantially degrade water quality?			**X**	
g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?				**X**
h) Place within a 100-year flood hazard area structures which would impede or redirect flood flows?				**X**
i) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?			**X**	
j) Inundation by seiche, tsunami, or mudflow?				**X**

Discussion: Run-off is not considered an issue because of several factors which limit the potential impact. These factors include a relative flat terrain of the subject site and relatively low rainfall intensities. Areas subject to flooding have been identified in accordance with the Federal Emergency Management Act (FEMA). The project site is located in FEMA Flood Zone X, which includes areas determined to be outside the 0.2% annual chance floodplains and, as such, flooding is not an issue with respect to this project. The Stanislaus County Department of Public Works has reviewed the project and is requiring a grading, drainage, and erosion/sediment control plan for any new dairy facility structures or additions to existing dairy facility structures. Consequently, run-off associated with the construction of the new structures and the possible need for a grading, drainage, and erosion/sediment control plan will be reviewed and determined as part of the overall building permit review process. No septic systems are being proposed as a part of this project.

Groundwater in this area of the County is 30± feet below surface level; however, according to the Pond Construction Work Plan groundwater records show the water depth to be between 10.7 and 15.2 feet within a mile of the project site. It is generally anticipated that nitrates are most likely elevated given the local and surrounding land use, sandy soil and surface application of lagoon wastewater. A new domestic well will be installed to serve the new milk parlor building. All well permits are reviewed by DER to determine if the well is a public water system and to ascertain what type of wellhead treatment is needed, if any, to insure that the proposed well's water meets State water quality standards for the intended use. New wells may be subject to CEQA if an existing system includes a new well or if a public water system is required or if the well permit is not exempted from County Code Chapter 9.37. The project was referred to DER, who after a preliminary review determined that the new well is unlikely to be subject to a separate CEQA process.

The WMP and NMP were reviewed by RWQCB staff to determine if the amount of wastewater generated, utilized to wash down the facility, and applied to crops was in accordance with the standards outlined in the General Order, and whether WDR and CEQA were required. Likewise, the Pond Construction Work Plan is being reviewed to insure that the proposed lagoon is correctly sized and designed so as to avoid impacts to groundwater. The purpose of these plans, and the General Order, is to insure that approved plans are designed and implemented to insure that the impact of animal waste on surface and groundwater quality is minimized and poses a less than significant impact on water quality.

As mentioned previously, the Central Valley RWQCB is responsible for water quality issues related to the project. The project is being circulated for CEQA purposes as RWQCB has determined that WDR are required. RWQCB reviewed the WMP and NMP and determined the documents to be adequate on August 3, 2015, via email. Review of the project by SJVAPCD resulted in project modifications and shortly thereafter, a Pond Construction Work Plan and modified WMP were submitted to Planning and forwarded to RWQCB. RWQCB has reviewed the revised WMP and found it to be adequate. The Pond Construction Work Plan for the new wastewater storage pond is currently under review. The applicant will be required to adhere to the approved WMP, NMP, Pond Construction Work Plan and all RWQCB standards, which once implemented will result in the project having a less than significant impact on groundwater resources and water quality.

Mitigation: None.

References: E-mail received from the Central Valley Regional Water Quality Control Board, dated August 3, 2015, and February 24, 2016; Stanislaus County General Plan and Support Documentation[1]

X. LAND USE AND PLANNING -- Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Included	Less Than Significant Impact	No Impact
a) Physically divide an established community?				**X**
b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?			**X**	
c) Conflict with any applicable habitat conservation plan or natural community conservation plan?			**X**	

Discussion: The project site is designated Agriculture and zoned A-2-40 (General Agriculture). The project will ultimately house 3,780 mature cows (3,180 milk cows and 600 dry cows) and 1395 heifers, which is permitted in the A-2-40 zoning district. RWQCB has determined that the proposed project is subject to CEQA and, as such, requires that the applicants obtain a Use Permit in accordance with §21.20.030(F) of the Stanislaus County Zoning Ordinance. CEQA is required in instances where a dairy will be required to obtain individual WDRs as part of an expansion. This project will not conflict with any applicable habitat conservation plan or natural community conservation plan and will not physically divide an established community.

Mitigation: None.

References: Application information; Email dated October 27, 2014, from Charlene Herbst, Regional Water Quality Control Board staff; Stanislaus County Zoning Ordinance and Stanislaus County General Plan and Support Documentation[1]

XI. MINERAL RESOURCES -- Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Included	Less Than Significant Impact	No Impact
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?				**X**
b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?				**X**

Discussion: The location of all commercially viable mineral resources in Stanislaus County has been mapped by the State Division of Mines and Geology in Special Report 173. There are no known significant resources on the site.

Mitigation: None.

References: Stanislaus County General Plan and Support Documentation[1]

XII. NOISE -- Would the project result in:	Potentially Significant Impact	Less Than Significant With Mitigation Included	Less Than Significant Impact	No Impact
a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?			**X**	
b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?			**X**	

c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?			**X**	
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?			**X**	
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?				**X**
f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?				**X**

Discussion: Noise impacts associated with on-site activities and traffic are not anticipated to exceed the normally acceptable level of noise. The project will increase ambient noise levels. Permanent increases may result as the number of animal units is increased on site; however, noise associated with animals in the Agricultural zone is permissible and not considered to be nuisance noise.

Mitigation: None.

References: Stanislaus County General Plan and Support Documentation[1]

XIII. POPULATION AND HOUSING -- Would the project:	**Potentially Significant Impact**	**Less Than Significant With Mitigation Included**	**Less Than Significant Impact**	**No Impact**
a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?				**X**
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?				**X**
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?				**X**

Discussion: The proposed use of the site will not create significant service extensions or new infrastructure which could be considered as growth inducing. No housing or persons will be displaced by this project; however, families will no longer be able to occupy the two (2) dwellings located east of the proposed calf barn once it is constructed. This condition is a result of the potential for toxic air contaminants (TACs) resulting from the use of tractor-trailers (big-rigs) to haul milk, silage, animal units, etc. TACs are especially harmful to the developing lungs of children. Although two homes are not considered to be substantial numbers, the applicant could obtain a temporary mobile home permit for farmworker housing for a displaced family whose adult members work for the dairy. Consequently, the project is still considered to have no impact on existing and replacement housing.

The increase in animal units will be accommodated via the construction of a 165,240 square foot freestall barn, a 26,100 square foot milking parlor, a 10,800 square foot calf barn, a wastewater storage pond, and 307,500 square foot feed storage pad to the north and south of the existing dairy facility. The project site is within and consistent with the A-2 (General Agricultural) zoning district, surrounded by field crops, orchards, and other dairies.

Mitigation: None.

References: Application information; Stanislaus County General Plan and Support Documentation[1]

XIV. PUBLIC SERVICES --	Potentially Significant Impact	Less Than Significant With Mitigation Included	Less Than Significant Impact	No Impact
a) Would the project result in the substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:				
Fire protection?			X	
Police protection?			X	
Schools?				X
Parks?				X
Other public facilities?			X	

Discussion: The County has adopted Public Facilities Fees, as well as a Fire Facility Fee on behalf of the appropriate fire district, to address impacts to public services. Such fees are required to be paid at the time of building permit issuance.

This project was circulated to all applicable school, fire, police, irrigation, and public works departments and districts during the Early Consultation referral period and no concerns were identified with regard to public services. All on-site irrigation facilities are privately owned. As such, TID identified no impacts and no comment regarding irrigation facilities. Since TID also provides electrical service to this site, a condition of approval will be added to the project requiring consultation with TID in the event that any pole or electrical facility relocation is required. This comment will be reflected in the project's conditions of approval.

Mitigation: None.

References: Referral Response from the Turlock Irrigation District dated April 6, 2015; Stanislaus County General Plan and Support Documentation[1]

XV. RECREATION --	Potentially Significant Impact	Less Than Significant With Mitigation Included	Less Than Significant Impact	No Impact
a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?				X
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?				X

Discussion: This project will not increase demands for recreational facilities, as such impacts typically are associated with residential development.

Mitigation: None.

References: Stanislaus County General Plan and Support Documentation[1]

XVI. TRANSPORATION/TRAFFIC -- Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Included	Less Than Significant Impact	No Impact
a) Conflict with an applicable plan, ordinance or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation including mass transit and non-motorized travel and relevant components of the circulation system, including but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit?			X	
b) Conflict with an applicable congestion management program, including, but not limited to level of service standards and travel demand measures, or other standards established by the county congestion management agency for designated roads or highways?			X	
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?			X	
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?			X	
e) Result in inadequate emergency access?			X	
f) Conflict with adopted policies, plans, or programs regarding public transit, bicycle, or pedestrian facilities, or otherwise decrease the performance or safety of such facilities?			X	

Discussion: The dairy currently averages between seven (7) and eight (8) truck trips per day; truck trips are expected to increase to 11 and 12 per day at full build out. Feed and supplement deliveries are anticipated to increase from an average of one (1) to two (2) deliveries per day. Milk transport trips are anticipated to increase from approximately three (3) to six (6) trips per day. Calf transport occurs daily with no additional trips expected. The duration of weekly pregnancy checks and breeding conducted by the veterinarian will increase in time but not frequency. Transfer of heifers to and from the facility will roughly double from two (2) to four (4) per week. Employees are anticipated to increase from eight (8) current employees, to a maximum of 14 employees post-project. Primary and secondary accesses to the site are provided via Crows Landing and W Taylor Roads, respectively.

A referral response from the Department of Public Works, received on April 24, 2015, indicated that the project is subject to the following conditions of approval: an encroachment permit must be obtained for the driveway existing in the right-of-way (ROW) of Crows Landing Road; ROW shall be dedicated through an Irrevocable Offer of Dedication (IOD); no parking, loading, or unloading of vehicles may occur within County Road ROW; and a grading and drainage plan shall be submitted to the Department of Public Works prior to issuance of a building permit for any new structure or addition to an existing structure. These conditions will be reflected in the project's conditions of approval.

Mitigation: None.

References: Referral response from the Department of Public Works on April 24, 2015; Stanislaus County General Plan and Support Documentation[1]

XVII. UTILITIES AND SERVICE SYSTEMS -- Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Included	Less Than Significant Impact	No Impact
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?			X	

b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?			**X**	
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?			**X**	
d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?			**X**	
e) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?				**X**
f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?				**X**
g) Comply with federal, state, and local statutes and regulations related to solid waste?				**X**

Discussion: Limitations on providing services have not been identified. The site will be served by private well, septic system, and on-site drainage. A referral response from the Department of Public Works requires that the Department review and approve a grading and drainage plan for any new building or building addition prior to issuance of the building permit. Conditions of approval shall be added to the project to reflect this requirement. On-site septic and well infrastructure will be reviewed by DER for adequacy through the building permit process.

Groundwater in this area of the County is 30± feet below surface level; however, according to the Pond Construction Work Plan groundwater records show the water depth to be between 10.7 and 15.2 feet within a mile of the project site. It is generally anticipated that nitrates are most likely elevated given the local and surrounding land use, sandy soil and surface application of lagoon wastewater. A new domestic well will be installed to serve the new milk parlor building. All well permits are reviewed by DER to determine if the well is a public water system and to ascertain what type of wellhead treatment is needed, if any, to insure that the proposed well's water meets State water quality standards for the intended use.

Wastewater will not be sent off-site to be treated and, as such, will not result in impacts to existing off-site facilities. The existing on-site private wastewater facilities will continue to be maintained by the dairy facility. This project proposes to utilize the existing wastewater storage ponds and construct a new wastewater storage pond. Wastewater Storage Pond 1 has a pond surface area of 112,000 square feet and a storage volume of 900,973 cubic feet. Wastewater Storage Pond 2 has a pond surface area of 231,125 square feet and a storage volume of 2,028,492 cubic feet. The new wastewater storage pond will have a pond surface area of 188,000 square feet and a storage volume of 1,798,199 cubic feet. The project was reviewed as a part of the Early Consultation process to insure that the WMP, NMP, and wastewater pond construction were adequately sized and constructed so as to avoid project impacts. The project as proposed is not expected to have a significant effect on the environment.

Mitigation: None.

References: Application Information; Pond Construction Work Plan; Waste Management Plan; Nutrient Management Plan; Referral response dated April 24, 2015, from the Department of Public Works; Stanislaus County General Plan and Support Documentation[1]

XVIII. MANDATORY FINDINGS OF SIGNIFICANCE --	Potentially Significant Impact	Less Than Significant With Mitigation Included	Less Than Significant Impact	No Impact
a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?				**X**
b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.)			**X**	
c) Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?				**X**

Discussion: Review of this project has not indicated any features which might significantly impact the environmental quality of the site and/or the surrounding area.

[1]Stanislaus County General Plan and Support Documentation adopted in October 1994, as amended. Optional and updated elements of the General Plan and Support Documentation: ***Agricultural Element*** adopted on December 18, 2007; ***Housing Element*** adopted on August 28, 2012; ***Circulation Element*** and ***Noise Element*** adopted on April 18, 2006.

NEGATIVE DECLARATION

NAME OF PROJECT: Use Permit Application No. PLN2015-0019 – Trinkler Dairy Farms, Inc.

LOCATION OF PROJECT: 7251 Crows Landing Road, at the southwest corner of Crows Landing and W Taylor Roads, in the Ceres area. (APN: 022-007-013).

PROJECT DEVELOPERS: Joe Rebiero, Trinkler Dairy Farms, Inc
PO Box 10
Ceres, CA 95307

DESCRIPTION OF PROJECT: **Request to increase a dairy herd size from 3,150 to 5,175 animal units, consisting of: 3,180 milk cows, 600 dry cows, and 1,395 heifers [275 (15-24 months); 520 (4-6 months); and 600 calves (0-3 months)] in the A-2-40 (General Agriculture) zoning district. Expansion will require the construction of a freestall barn, a milk parlor, a calf barn, a feed storage pad, and a waste water storage pond (lagoon). The 220± acre parcel is located at 7251 Crows Landing Road, at the southwest corner of Crows Landing and W. Taylor Roads, in the Ceres area. The Planning Commission will consider adoption of a CEQA Negative Declaration for this project.**

Based upon the Initial Study, dated **December 9, 2016**, the Environmental Coordinator finds as follows:

1. This project does not have the potential to degrade the quality of the environment, nor to curtail the diversity of the environment.

2. This project will not have a detrimental effect upon either short-term or long-term environmental goals.

3. This project will not have impacts which are individually limited but cumulatively considerable.

4. This project will not have environmental impacts which will cause substantial adverse effects upon human beings, either directly or indirectly.

The Initial Study and other environmental documents are available for public review at the Department of Planning and Community Development, 1010 10th Street, Suite 3400, Modesto, California.

Initial Study prepared by: Rachel Wyse, Associate Planner

Submit comments to: Stanislaus County
Planning and Community Development Department
1010 10th Street, Suite 3400
Modesto, California 95354

SUMMARY OF RESPONSES FOR ENVIRONMENTAL REVIEW REFERRALS

PROJECT: USE PERMIT APPLICATION PLN2015-0019 - TRINKLER DAIRY FARMS, INC.

REFERRED TO:				RESPONDED		RESPONSE			MITIGATION MEASURES		CONDITIONS	
	2 WK	30 DAY	PUBLIC HEARING NOTICE	YES	NO	WILL NOT HAVE SIGNIFICANT IMPACT	MAY HAVE SIGNIFICANT IMPACT	NO COMMENT NON CEQA	YES	NO	YES	NO
CA DEPT OF CONSERVATION: Land Resources	X	X	X		X							
CA DEPT OF FISH & WILDLIFE	X	X	X		X							
CA OPR STATE CLEARINGHOUSE	X	X	X	X		X				X		X
CA RWQCB CENTRAL VALLEY REGION	X	X	X	X		X				X	X	
COMMUNITY SERVICES DIST: Monterey Park Tract	X	X	X		X							
COOPERATIVE EXTENSION	X	X	X		X							
FIRE PROTECTION DIST: Westport	X	X	X		X							
IRRIGATION DISTRICT: Turlock	X	X	X	X		X				X	X	
MOSQUITO DISTRICT: Turlock	X	X	X		X							
MT VALLEY EMERGENCY MEDICAL	X	X	X		X							
PACIFIC GAS & ELECTRIC	X	X	X		X							
RAILROAD: Union Pacific	X	X	X		X							
SAN JOAQUIN VALLEY APCD	X	X	X	X		X				X	X	
SCHOOL DISTRICT 1: Ceres	X	X	X		X							
STAN ALLIANCE	X	X	X		X							
STAN CO AG COMMISSIONER	X	X	X		X							
STAN CO BUILDING PERMITS DIVISION	X	X	X	X		X				X	X	
STAN CO CEO	X	X	X		X							
STAN CO DER	X	X	X	X				X		X		X
STAN CO ERC	X	X	X	X				X		X		X
STAN CO FARM BUREAU	X	X	X		X							
STAN CO HAZARDOUS MATERIALS	X	X	X	X		X				X	X	
STAN CO PUBLIC WORKS	X	X	X	X		X				X	X	
STAN CO SHERIFF	X	X	X		X							
STAN CO SUPERVISOR DIST 5: DeMartini	X	X	X		X							
STAN COUNTY COUNSEL	X	X	X		X							
STANISLAUS FIRE PREVENTION BUREAU	X	X	X		X							
STANISLAUS LAFCO	X	X	X		X							
SURROUNDING LAND OWNERS			X									
TELEPHONE COMPANY:	X	X	X		X							
TRIBAL CONTACTS (CA Government Code §65352.3)	X	X	X		X							
US FISH & WILDLIFE	X	X	X		X							
USDA NRCS	X	X	X		X							