Sampling & Analysis Plan

For

Costa View Farms

Madera County, California

Plan Certification Date: 11/29/11

This Sampling & Analysis Plan was developed as defined in Attachment C of the California RWQCB Order No. R5-2007-0035: Waste Discharge Requirements General Order for Existing Milk Cow Dairies.

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Sampling & Analysis Plan

For Existing Milk Cow Dairies Under the Waste Discharge Requirements
General Order No. R5-2007-0035

Facility Name: Costa View Farms
Facility Address:
Facility Contact & Phone #: Ex. 6 Personal Privacy (PP)
Facility Location:

Professional Certification of Sampling & Analysis Plan

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

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Owner and/or Operator Certification of Sampling & Analysis Plan

"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."

Owner Name **Operator Name**

Owner Signature **Operator Signature**

Date **Date**

Sampling Plan & Analysis

This is the Sampling and Analysis Plan for Costa View Farms as required in Section II and Technical Standard I of Attachment C of the Dairy General Order. All required sampling and analysis will be conducted as defined within this document and in the Monitoring and Reporting Program (MRP) of the Dairy General Order. The sampling plan will be modified whenever changes to the Monitoring and Reporting Program (MRP) of the Dairy General Order occur or when new best management practices become available.

All freshwater samples, such as irrigation water and groundwater, must be tested by a laboratory with the California Environmental Laboratory Accreditation Program (ELAP) certification. It is suggested, but not required at this time, that all agronomic samples be taken to a laboratory that participates in a proficiency program, such as but not limited to the National Association of Proficiency Testing (NAPT), Manure Analysis Proficiency (MAP), or Accredited Laboratory Program (ALP).

This plan reflects the minimum sampling required by the Dairy General Order. Any additional sampling should be done as defined in this plan. This plan should be updated when farm practices are modified and sampling requirements change.

Facility Description

The Costa View Farms has nine separation basins and one large retention pond. Three separation ponds and the retention pond are used to collect rainfall runoff, dairy waste and milk barn wastewater at any one time. These three separation ponds are used for wastewater storage until solids need to be removed. Then the three separation ponds in reserve will rotate into the waste system, while the other three are cleaned. Four separation ponds are used only for emergency purposes and do not routinely store wastewater. Four mechanical separators have recently been installed and are removing addition a solids from the waste stream. Recycled wastewater or used barn water is used to flush the lanes. Some of the separated solids are used for bedding. Corral manure is stored in the corrals and collected/removed several times a year. Dry manure and wastewater are applied to crop land associated with the dairy.

The dairy utilizes approximately 5858 farmable acres for the purpose of waste application. Corn, barley, wheat and sudan silage and alfalfa are grown on the above mentioned property. All wastewater and dry manure solids are applied to the crop land associated with the dairy. Some separator solids are used for bedding in the freestall barns.

Sampling Locations

Wastewater: Typically, sub-samples from around the storage pond are collected, mixed together to make a composite sample. Currently, no sampling port is located on the line from the wastewater pump to the main pipeline.

Dry Manure: Three types of samples are collected: Separator Manure, Corral Manure and Pond Solids. A separator manure sample is made up of sub-samples from the piles next to the separator. A corral manure sample is made up of sub-samples from multiple corrals on the dairy. A pond solids sample is made up of sub-samples from piles of solids removed from the settling basins. At times, samples are collected when spreader trucks are being filled.

Harvest Tissue: Sub-samples are collected as the harvested material is being dumped into the silage pile at the dairy.

Soils & Mid-Season Tissue: A soils map(s) of land application fields is included. Identification of sampling patterns for each field is shown. These sampling patterns are for soil and mid-season tissue samples. Sub-samples should be collected along the pattern defined on the map at equal intervals. Individual sample locations are not shown.

Groundwater Wells & Surface Water: The table below shows the source id and the sampling location for each source.

Source ID	Sample Location	Source Location
MID Canal	Take from canal at the NE corner of Field 16-2.	E & S sides of Field 16-2.
Small Barn	Take from milk house sink.	At small milk barn on east side of dairy
Big Barn	Take from spigot on north side of Big Barn.	At big milk barn on North side of dairy
12-4	Take from pipe that feeds into stand pipe next to well.	NE corner of Field 12-4
13-2	Take from water trough in pasture.	E side of Field 13-2, south half, by pastures
13-4	Take from bottom of air vent.	NE corner of Field 13-4
13-8	Take from bottom of air vent.	E side of Field 13-8, center
13-11	Take from bottom of air vent.	E side of Field 13-11, south quarter
13-12	Take from bottom of air vent.	NE corner of Field 13-12
14-2	Take from bottom of air vent.	NE corner of Field 14-2
14-3	Take from bottom of air vent.	NE corner of Field 14-3
14-5	Take from bottom of air vent.	E side of Field 14-5, south half
14-10	Take from bottom of air vent.	E side of Field 14-10, south quarter
15-1	Take from ball valve on SW side of tank.	SW corner of Field 15-1
15-3	Take from pipe that fills water truck.	NE corner of Field 15-3
15-5	Take from bottom of air vent.	NE corner of Field 15-5
15-6	Take from bottom of air vent.	NE corner of Field 15-6
16-1	Take from pipe that feeds into stand pipe next to well.	NE corner of Field 16-1
16-2	Take from bottom of air vent.	NE corner of Field 16-2
16-4	Take from bottom of air vent.	NE corner of Field 16-4

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Table continued.

Source ID	Sample Location	Source Location
16-6	Take from bottom of air vent.	NE corner of Field 16-6
1B-A (W)	Take from pipe that feeds into stand pipe next to well.	SE corner of CVW-1B
1B-B (W)	Take from valve next to well.	NE corner of CVW-1B
2 (W)	Take from valve next to well.	NE corner of CVW-2
3 (W)	Take from pipe that feeds into stand pipe next to well.	NE corner of CVW-3
4 (W)	Take from pipe that feeds into stand pipe next to well.	NE corner of CVW-4
5 (W)	Take from pipe that feeds into stand pipe next to well.	NE corner of CVW-5
7 (W)	Take from pipe that feeds into stand pipe next to well.	S side of CVW-7, center
8A (W)	Take from valve closest to well.	E side of CVW-8, center
8B (W)	Take from valve closest to well.	NE corner of CVW-8
9 (W)	Take from pipe that feeds into stand pipe next to well.	NE corner of CVW-9
11 (W)	Take from pipe that feeds into stand pipe next to well.	W side of CVW-11, south quarter
12 A(W)	Take from pipe that feeds into stand pipe next to well.	SE corner of CVW-12
12 B (W)	Take from pipe that feeds into stand pipe next to well.	NE corner of CVW-12

*Refer to sampling protocol for each type of sample to determine the number of sub-samples and the amount of sample needed for each sample.

All necessary maps are included at end of this report.

Process Wastewater

Process Wastewater Sampling Frequency

Required Sampling Frequency	Required Analysis	
	In Field Measurement	Laboratory Analysis*
Quarterly during one application event (four times per year)	Electrical Conductivity (EC) *(Optional)*	NO_3-N (if aerated), NH_4-N, TKN, P, K, TDS, EC
Annually prior to blending	None Required.	pH, NO_3-N (if aerated), NH_4-N, TKN, P, K, TDS, EC
Once every two (2) years	None Required.	Ca, Mg, Na, HCO_3, CO_3, SO_4, Cl
*A list of the analyte abbreviations is located at the end of this document. "In Field" analysis should be done in laboratory if not completed in the field.		

Process Wastewater Sample Collection Protocol

1. Identify where and how the sample will be collected.
   - The process wastewater should be collected during an application event prior to blending with irrigation water. The sample may be collected from a stand pipe, a spigot on the side of a pipe, or a mixing box. The process wastewater should be sampled prior to mixing/dilution with any freshwater sources.
2. Obtain equipment needed to collect the process wastewater sample. This will include a sample bottle, permanent marker, EC meter if field measurement is taken, a cup, and sampling forms. Safety equipment, such as goggles, mask and rubber gloves, may be needed.
3. Label collection bottle with the following information: sample ID, facility name, date and time sample was collected. Record the same information on the sample record form. Be sure to describe the collection location.
4. Fill sample bottle with the process wastewater. Fill cup with process wastewater if EC is measured in the field. Typically, a 16 oz sample will be sufficient for testing. Check with the testing laboratory prior to sampling.
5. When measuring EC in the field, complete the following:
   - Calibrate EC probe as defined by the manufacturer.
   - Place EC probe into cup of process wastewater.
   - Once reading has stabilized, record the EC reading and units on the sampling record form.
   - Discard wastewater back into waste system. Rinse probe & cup with clean water.
6. The process wastewater sample should be kept cool, in a refrigerator or cooler with ice, until delivered to a laboratory.
7. Complete a Chain of Custody form for all samples collected. This may be completed by the laboratory. Check with your laboratory prior to sampling.

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8. Deliver samples to laboratory as soon as possible; preferably within 24 hours.
9. Request the appropriate analysis for the sampling event, as described above or in the MRP section of the Dairy General Order.
10. A copy of the laboratory analysis, chain of custody and any field documentation should be stored on site for a minimum of five years.

Refer to the Record Keeping section of the dairy's Nutrient Management Plan for further details on required documentation of process wastewater applications and as required in the MRP of the Dairy General Order.

Manure

Manure Sampling Frequency

Required Sampling Frequency	Required Analysis	
	In Field Measurement	Laboratory Analysis*
Twice a year	None Required	TN, P, K, Moisture
Once every two (2) years.	None Required	Ca, Mg, Na, S, Cl, Fixed Solids
Exports	Moisture *(optional)*	Moisture
*A list of the analyte abbreviations is located at the end of this document.		

Manure Sample Collection Protocol

1. Identify where and how the sample will be collected.
    - Preferably, the manure should be collected during an application event or removal.
    - Sufficient number of samples need to be collected to adequately represent the type of manure being applied to land application areas or exported offsite. Some manure types are corral solids, separator solids, pond solids. These different sources may have different nutrient concentrations. Multiple samples may need to be collected and tested.
2. Obtain equipment needed to collect the manure sample. This will include a plastic bag, permanent marker, shovel, large bucket and sampling forms. Safety equipment, such as goggles, mask and rubber gloves, may be needed.
3. Label sample bag with the following information: sample ID, facility name, date, time sample was collected and the number of sub-samples collected. Record the same information on the sample record form. Be sure to describe the type of manure collected and the collection locations.
4. Collect a minimum of six (6) equal sized sub-samples of manure with the shovel and place into large bucket. Be sure to dig a minimum of one (1) foot below the surface of piles for each sub-sample.
    - Corral Solids: Collect samples from all piles within the corrals, which will be land applied or exported. Multiple corral solid samples may be collected based on animal type, such as milk cow, heifers or calves.
    - Separated solids: Collect samples from both fresh and dry separated solids, which will be land applied or exported.
    - Pond/Settled Solids: Collect samples from all piles of pond or settled solids, which will be land applied or exported.
5. Mix sub-samples thoroughly in bucket.
6. Fill a 2 quart zip-lock bag or half of a 1 gallon bag with the mixed manure.

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7. Manure sample should be kept cool until delivered to a laboratory. Preferably, place sample in a refrigerator or cooler with ice.
8. Complete a Chain of Custody form for all samples collected. This may be completed by the laboratory. Check with your laboratory prior to sampling.
9. Deliver samples to laboratory as soon as possible; preferably within 24 hours.
10. Request the appropriate analysis for the sampling event, as described above or in the MRP section of the Dairy General Order.
11. A copy of the laboratory analysis, chain of custody and any field documentation should be stored on site for a minimum of five years.

Refer to the Record Keeping section of the dairy's Nutrient Management Plan for further details on required documentation of manure applications and as required in the MRP of the Dairy General Order.

Plant Tissue

Plant Tissue Frequency

Required Sampling Frequency	Required Analysis	
	In Field Measurement	Laboratory Analysis*
At Harvest	None Required	TN, P, K, Moisture, Fixed Solids
Mid-Season (if required)	None Required	TN
*A list of the analyte abbreviations is located at the end of this document.		

Harvest Tissue Sample Collection Protocol

1. Identify what, where and how the sample will be collected.
    - Identify the type of sample that needs to be collected for each crop harvested.
    - Preferably, the tissue samples should be collected during harvest of the crop from each land application field.
    - Alternatively, the tissue samples may be collected from the silage pile within one (1) week of harvest if the source field is known.
2. Obtain equipment needed to collect the tissue sample. This will include a hay probe/cutter, knife or scissors, plastic/paper bag, permanent marker, large bucket, a shovel and sampling forms. Safety equipment, such as goggles, mask and gloves, may be needed.
3. Label sample bag with the following information: sample ID, facility name, date, time sample was collected and the number of sub-samples collected. Record the same information on the sample record form. Be sure to describe where the sub-samples were collected.
4. Collecting a tissue sample:
    - For **forage/grain crops (wet)**, collect a sub-sample from representative trucks as it is removed from the field or dumped. This is the preferred method of collection. Collect a minimum of five (5) equal sized sub-samples of harvested material and place into large bucket. Alternatively, collect silage sub-samples from pile after harvest is completed for each field. Be sure to dig a minimum of one (1) foot below the surface of piles for each sub-sample.
    - For **hay/straw crops (dry)**, collect sub-samples from the hay bales, preferably. Collect a minimum of twenty (20) equal sized sub-samples of harvested material and place into large bucket. A larger number of sub-samples may be needed for high yielding fields. Sub-samples should be collected from the bale ends. Alternatively, collect sub-samples from the windrows after cutting, just before being picked up, by using a sampling pattern as if collecting soil sub-samples. This should only be done if hay bales are not accessible after baling or will not be baled.

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- Hay Probe/Cutter: Place probe on the bale end at a 90° angle to bale face. Push probe into bale approximately 12-18". Only collect one sample per bale.

- For **irrigated pastures**, collect sub-samples from a one square foot area by using a sampling pattern as if collecting soil sub-samples. Cut/clip all plants (even weeds) within one square foot area at ground level. Try not to collect manure or dirt with plant sample. Collect a minimum of five (5) sub-samples of plant material and place into large bucket or paper bag. Plant material may need to be cut or chopped into smaller pieces for better mixing.

5. Mix sub-samples thoroughly in bucket/bag.
6. Fill a 1 gallon bag with the mixed tissue.
7. Tissue sample should be kept cool until delivered to a laboratory. Preferably, place wet samples in a refrigerator or cooler with ice. Dry samples can be kept in a cool place.
8. Complete a Chain of Custody form for all samples collected. This may be completed by the laboratory. Check with your laboratory prior to sampling.
9. Deliver samples to laboratory as soon as possible; preferably within 24 hours.
10. Request the appropriate analysis for the sampling event, as described above or in the MRP section of the Dairy General Order.
11. Upon receipt of the test results, the laboratory analysis, chain of custody and any field documentation should be stored on site for a minimum of five years.

Mid-Season Tissue Sample Collection Protocol

A mid-season tissue sample is required only when the farmer wants to add fertilizer of any type in excess of 1.4 times the nitrogen expected to be removed by the harvested crop tissue. The mid-season tissue should be used to assess the need for additional nitrogen fertilizer during the growing season. Contact your agronomist or crop advisor for more information and recommendations in this situation.

1. Identify where and how the sample will be collected. Identify the appropriate part of the plant that should be collected based on the crop type and maturity. A guide for "Sampling for Plant Tissue Analysis" from NMSU Cooperative Extension Service has been included at the end of this plan to provide more information on how and what to collect for a mid-season tissue sample.
2. Obtain equipment needed to collect the tissue sample. This will include a paper/plastic bag, permanent marker, large bucket and sampling forms. Safety equipment, such as goggles, masks and gloves, may be needed.
3. Label sample bag with the following information: sample ID, facility name, date, time sample was collected and the number of sub-samples collected. Record the same information on the sample record form. Be sure to describe where the sub-samples were collected.
4. Collect a minimum of twenty (20) sub-samples of harvested material and place into large bucket. Individual sub-samples are typically very small because only a fraction of the plant is needed for the test.

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5. Mix sub-samples thoroughly in bucket. Fill a paper/plastic bag with the mixed tissue.
6. Tissue sample should be kept cool until delivered to a laboratory. Preferably, place sample in a refrigerator or cooler with ice.
7. Complete a Chain of Custody form for all samples collected. This may be completed by the laboratory. Check with your laboratory prior to sampling.
8. Deliver samples to laboratory as soon as possible; preferably within 24 hours.
9. Request the appropriate analysis for the sampling event, as described above or in the MRP section of the Dairy General Order.
10. A copy of the laboratory analysis, chain of custody and any field documentation should be stored on site for a minimum of five years.

Refer to the Record Keeping section of the dairy's Nutrient Management Plan for further details on required documentation of crop information and as required in the MRP of the Dairy General Order.

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Soil

Soil Sampling Frequency

Required Sampling Frequency[1]	Required Analysis	
	In Field Measurement	Laboratory Analysis[2]
Once every 5 years from each land application area.	None Required	Soluble Phosphorus

[1] Sampling may be distributed over the 5-year period, completing 20% of the sampling per year.
[2] A list of the analyte abbreviations is located at the end of this document.

Recommended Sampling Frequency	Recommended Analysis	
	In Field Measurement	Laboratory Analysis[2]
Spring pre-plant for each crop.	None Required	0 to 1 foot: NO_3-N, OM 1 to 2 foot: NO_3-N
Fall pre-plant for each crop.	None Required	0 to 1 foot: NO_3-N, PO_4-P, K, OM, EC 1 to 2 foot: NO_3-N

Soil Sample Collection Protocol

1. Identify where and how the sample will be collected.
   - Identify the best sampling pattern which will result in the most representative sample of the field, soil type, or history.
   - Frequently used patterns to cover a whole field are the W, V, X or Z patterns. Samples are collected in the pattern of the letters. It may not be appropriate to use the same pattern on all fields due the field size and shape.
   - If precision agricultural tools are being used, multiple samples per field may be needed based on the precision zones. Contact your agronomist or crop advisor to define these zones.
   - Dischargers with **less** than 400 acres of land application area should collect a composite soil sample for every 40 acres of land application area as recommended by the Regional Water Quality Control Board. Dischargers with **more** than 400 acres of land application area should collect a composite soil sample for every 80 acres of land application area as recommended by the Regional Water Quality Control Board.
2. Obtain equipment needed to collect the soil sample. This will include a sample bag, permanent marker, bucket, soil probe or auger and sampling forms. Multiple

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buckets will be needed if more than one depth is being collected. Safety equipment, such as goggles, mask and gloves, may be needed.

3. Label sample bag with the following information: sample ID, facility name, date, time sample was collected, the number of sub-samples collected and the depth of the sample. Record the same information on the sample record form. Be sure to describe or sketch where the sub-samples were collected. Field maps can be used to identify sample locations.
4. Collect a minimum of 10 sub-samples per depth of soil and place into bucket. For sampling by depth, separate buckets should be used for each depth.
5. Mix sub-samples thoroughly in each bucket.
6. Fill a 1 quart bag or half of a brown paper lunch sack with the soil.
7. Complete a Chain of Custody form for all samples collected. This may be completed by the laboratory. Check with your laboratory prior to sampling.
8. Deliver samples to laboratory as soon as possible; preferably within 24 hours.
9. Request the appropriate analysis for the sampling event, as described above or in the MRP section of the Dairy General Order.
10. A copy of the laboratory analysis, chain of custody and any field documentation should be stored on site for a minimum of five years.

Refer to the Record Keeping section of the dairy's Nutrient Management Plan for further details on required documentation of crop information and as required in the MRP of the Dairy General Order.

Fresh Water

Two types of fresh water samples are required to be sampled. The first is groundwater, which includes all domestic and irrigation wells on the dairy and associated with the land application fields. The groundwater sources must be sampled once per calendar year. The second type of fresh water sample is irrigation water sources, such as irrigation wells and canal water. These sources should be sampled once during each irrigation season during an actual irrigation event. Well water tested as a groundwater source will also satisfy the irrigation source testing requirement. Below is a description of sampling requirements and protocol for both types of fresh water samples. All fresh water samples must be analyzed by a laboratory with the CA Environmental Laboratory Accreditation Program (ELAP) certification.

Sample bottles should be obtained from the ELAP laboratory that will be performing the analysis. Notify the ELAP Laboratory which analytes will be tested, so they can provide the appropriate collection bottles. Some samples must be preserved with an acid to stabilize the analytes. Take care not to spill or over fill the sample bottles with preservative, as the acid to sample ratio will be invalid. If preservative is used, proper safety equipment and techniques should be used by the sampler.

Groundwater Sampling Frequency

Groundwater Monitoring	Required Sampling Frequency	Required Analysis	
		In Field Measurement[1]	Laboratory Analysis[1]
Domestic & Agricultural Supply Wells	Annually	EC *(optional)*, NH_4-N	NO_3-N, EC NH_4-N *(if present)*
Domestic & Agricultural Supply Wells	Every 5 Years[2]	None Required	Ca, Mg, Na, HCO_3, SO4, Cl, CO_3, TDS
Subsurface (tile) Drainage System	Annually	EC *(optional)*, NH_4-N	NO_3-N, TP, TDS, EC, NH_4-N *(if present)*

[1] "In Field" analysis should be done in laboratory if not completed in the field. Testing of presence or absence of Ammonium-Nitrogen is required in the field. If present, a laboratory test for Ammonium-Nitrogen is required. A list of the analyte abbreviations is located at the end of this document.
[2] This test may be completed on 20% of the wells each year over the 5 year period. All wells must be tested by the end of 5 years.

Groundwater Sample Collection Protocol

1. Identify the how, when and where the groundwater sample will be collected.

- **Domestic wells** should be sampled from the closest access point to the well, preferably before the pressure tank. The sample should be collected after water has been running from the access point for 10 to 20 minutes.
- **Irrigation wells** should be sampled from the closest access point to the well, which may be from a stand pipe, a plug hole or a spigot on the side of a pipe, or a mixing box. The fresh water sample should be collected prior to mixing with fertilizer or process wastewater. The sample should be taken after the well pump has been running a minimum of 30 minutes or at least three (3) well volumes have been removed from the well. Preferably, a sample should be collected when the well pump has been running for 12 hours during an irrigation event.
- **Subsurface drainage systems** should be sampled at the discharge point into a canal or drain.

2. Obtain equipment needed to collect the fresh water sample. This will include sample bottles, permanent marker, EC meter if field measurement taken, a cup, ammonium-nitrogen field test kit and sampling forms. If a preservative is used, then safety equipment, such as goggles, mask and rubber gloves, may be needed. The sample bottles should be provided by the ELAP laboratory.
3. Label sample bottle provided by the ELAP laboratory with the following information: sample ID, facility name, date, and time sample was collected. Record the same information on the sample record form and the chain of custody. Also, record the location of the source and where the sample was collected to ensure repeatability of sample collection in the future.
4. **No preservative:** Rinse sample bottle, provided by the ELAP laboratory, and cup three (3) times with fresh water from the source. Fill sample bottle with fresh water. Fill cup with fresh water for ammonium-nitrogen test and EC test if measured in the field.
5. **Preservative:** Do not rinse bottle containing preservative. Use a spare collection bottle to fill the preserved sample bottle. Be sure to rinse spare bottle three (3) times with fresh water from the source. Take care not to spill or over fill the preserved sample bottle, as the acid to sample ratio will be invalid.
6. When measuring EC in the field, complete the following:
   - Calibrate EC probe as defined by the manufacturer.
   - Place EC probe into cup of fresh water.
   - Once reading has stabilized, record the EC reading and units on the sampling record form.
   - Discard fresh water. Rinse probe & cup with clean water.
7. Measuring ammonium-nitrogen in the field: Consult with laboratory personnel for recommendations for the most appropriate field test kit for ammonium-nitrogen. Follow the directions on the ammonium-nitrogen test kit. Be sure to document the presence or absence of the ammonium-nitrogen on sampling record form.
8. The fresh water sample should be kept in a refrigerator or cooler with ice until delivered to an ELAP laboratory.
9. Complete a Chain of Custody form for all samples collected. This may be completed by the laboratory. Check with your laboratory prior to sampling.

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10. Deliver samples to laboratory within **24 hours** of collection of the sample. Check holding times with the ELAP laboratory prior to sampling as holding times may vary by laboratory.
11. Request the appropriate analysis for the sampling event, as described above or in the MRP section of the Dairy General Order.
12. A copy of the laboratory analysis, chain of custody and any field documentation should be stored on site for a minimum of five years

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Irrigation Water Sampling Frequency

From page MRP-4 from the Monitoring and Reporting Program Section of the Dairy General Order, data collected to satisfy the groundwater monitoring requirements will satisfy the irrigation water sample requirement.

Required Sampling Frequency	Required Analysis	
	In Field Measurement	Laboratory Analysis*
One irrigation event during each irrigation season during an actual irrigation event for each irrigation water source (well and canal).	None Required	EC, TN, TDS
*A list of the analyte abbreviations is located at the end of this document.		

1. Identify the how, when and where the irrigation water sample will be collected.
   - **Irrigation wells** should be sampled from the closest access point to the well, which may be from a stand pipe, a plug hole or a spigot on the side of a pipe, or a mixing box. The fresh water sample should be collected prior to mixing with fertilizer or process wastewater. The sample should be taken after the well pump has been running a minimum of 30 minutes or at least three (3) well volumes have been removed from the well. Preferably, a sample should be collected when the well pump has been running for 12 hours during an irrigation event.
   - **Canal or river water** should be sampled from the discharge point closest to the canal. The sample should be collected prior to mixing with other fresh water sources, process wastewater, or fertilizer. Sample may also be collected directly from canal or river prior to outlet.
2. Obtain equipment needed to collect the fresh water sample. This will include a sample bottles, permanent marker, a cup and sampling forms. If a preservative is used, then safety equipment, such as goggles, mask and rubber gloves, may be needed. The sample bottles should be provided by the ELAP laboratory.
3. Label sample bottle provided by the ELAP laboratory with the following information: sample ID, facility name, date, and time sample was collected. Record the same information on the sample record form and the chain of custody. Also, record the location of the source and where the sample was collected to ensure repeatability of sample collection in the future.
4. **No preservative:** Rinse sample bottle, provided by the ELAP laboratory, and cup three (3) times with fresh water from the source. Fill sample bottle with fresh water. Fill cup with fresh water for ammonium-nitrogen test and EC test if measured in the field.
5. **Preservative:** Do not rinse bottle containing preservative. Use a spare collection bottle to fill the preserved sample bottle. Be sure to rinse spare bottle three (3) times with fresh water from the source. Take care not to spill or over fill the preserved sample bottle, as the acid to sample ratio will be invalid.

6. The fresh water sample should be kept in a refrigerator or cooler with ice until delivered to an ELAP laboratory.
7. Complete a Chain of Custody form for all samples collected. This may be completed by the laboratory. Check with your laboratory prior to sampling.
8. Deliver samples to laboratory within **24 hours** of collection of the sample. Check holding times with the ELAP laboratory prior to sampling as holding times may vary by laboratory.
9. Request the appropriate analysis for the sampling event, as described above or in the MRP section of the Dairy General Order.
10. A copy of the laboratory analysis, chain of custody and any field documentation should be stored on site for a minimum of five years

Refer to the Record Keeping section of the dairy's Nutrient Management Plan for further details on required documentation of fresh water irrigation applications and as required in the MRP of the Dairy General Order.

Groundwater Monitoring Wells

If groundwater monitoring wells are installed on the facility as required by the Regional Water Quality Control Board, then the monitoring wells should be sampled and samples analyzed as defined in Attachment A of the Monitoring and Reporting Program of the Dairy General Order and the approved Monitoring Well Sampling Plan.

If you are participating in the Representative Groundwater Monitoring Program, refer to the terms and conditions of that program. Be sure to keep a copy of any reports submitted to the RWQCB on your behalf.

Discharges

If surface discharge occurs at your facility, then samples should be collected and analyzed as defined in the Monitoring and Reporting Program (pages MRP-4 – MRP-6) of the Dairy General Order. Sampling, notification requirements and report submissions are detailed in this section. Additional information can be found in the CDQAP Reference Binder.

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ADDITIONAL INFORMATION

List of Analyte Abbreviations	
TN	Total Nitrogen
NO_3-N	Nitrate-Nitrogen
TKN	Total Kjeldahl Nitrogen
NH_4-N	Ammonium-Nitrogen
TP	Total phosphorus
H_2PO_4	Phosphate (soluble phosphorus)
K	Potassium
Ca	Calcium
Mg	Magnesium
Na	Sodium
SO_4	Sulfate
Cl	chloride
Bicarb	bicarbonate (HCO_3)
Carbonate	Carbonate (CO_3)
OM	Organic Matter
TDS	Total Dissolved Solids
EC	Electrical Conductivity

Conversions	
Convert	**Multiply By**
ppm to lbs/1000 gal	0.008345
ac-in to gallons	27154
ac-ft to gallons	325852
% to ppm	10000
% to lbs/gal	80
% to lbs/ac-in	2254
NO_3-N (as N) to NO_3	4.5
P to P_2O_5	2.29
K to K_2O	1.21

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The following is a list of additional sources where more information about sampling and analysis of water, wastewater, manure, soil and plant tissue.

University of California – Agriculture & Natural Resources Publications
http://anrcatalog.ucdavis.edu/

University of Wisconsin-Extension Publications
http://learningstore.uwex.edu/

NC Cooperative Extension - Publications for Animal Agriculture
http://www.ces.ncsu.edu/Publications/animalagriculture.php

Manure handling and application records.
http://manure.ucdavis.edu/

Western Fertilizer Handbook
Author: CPHA; **Copyright:** 2002; **Edition:** 9th; **Publisher:** Interstate

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Forms

The following are data collection forms which may be used to document each sampling event. It is not required to use these forms, but is recommended that some form of sampling documentation is done to ensure sample integrity. Also included is a chain of custody.

Sample Collection Data Sheets

1. Process Wastewater
2. Dry Manure
3. Soil
4. Crop Tissue
5. Fresh Water

Chain of Custody

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JMLORD, INC.

267 N. FULTON, FRESNO, CA 93701-1610
PHONE: (559) 268-9755 FAX: (559) 486-6504
WWW.JMLORDINC.COM

PROCESS WASTEWATER SAMPLING RECORD

Facility: _____ **Date:** _____

Pond ID: _____

Refer to the Sampling and Analysis Plan for details of how the sample should be collected.

Freeboard (ft) _____

Sampling Location (briefly Describe) _____

_____

_____

_____

Draw Lagoon and Sample Location.

Sample Properties at Time of Sampling

Time _____

EC: ☐ Measured in laboratory.

☐ Field measurement. EC _____ (µS or mS)

Circle the correct units for EC.

Sampler Signature: _____

JMLORD, INC.

267 N. FULTON, FRESNO, CA 93701-1610
PHONE: (559) 268-9755 FAX: (559) 486-6504
WWW.JMLORDINC.COM

DRY MANURE SAMPLING RECORD

Facility:_____ **Date:** _____

Source ID:_____

Refer to the Sampling and Analysis Plan for details of how the sample should be collected.

Describe and/or Draw Sample Locations.

Sampler Signature: _____

JMLORD, INC.

267 N. FULTON, FRESNO, CA 93701-1610
PHONE: (559) 268-9755 FAX: (559) 486-6504
WWW.JMLORDINC.COM

SOIL SAMPLING RECORD

Facility:_____ **Date:**_____

Source ID:_____

Refer to the Sampling and Analysis Plan for details of how the sample should be collected.

Field ID	Crop[1]	Depth of Sample (ft)	No. of Sub-Samples	Sample Pattern[2]

[1] Identify current crop if sample is taken mid-season or next crop if taken after harvest.
[2] Identify sampling pattern used to collect a composite sample from the field. EX: Z, W, V or random.

Sampler Signature: _____

JMLORD, INC.

267 N. FULTON, FRESNO, CA 93701-1610
PHONE: (559) 268-9755 FAX: (559) 486-6504
WWW.JMLORDINC.COM

CROP TISSUE SAMPLING RECORD

Facility:_____ **Date:** _____

Field ID:_____ **Crop:** _____

Refer to the Sampling and Analysis Plan for details of how the sample should be collected.

Describe and/or Draw Sample Locations.

Sampler Signature: _____

JMLORD, INC.

267 N. FULTON, FRESNO, CA 93701-1610
PHONE: (559) 268-9755 FAX: (559) 486-6504
WWW.JMLORDINC.COM

FRESH WATER SAMPLING RECORD

For any fresh water source, such as domestic wells, irrigation wells or canal water used for irrigation. Refer to the Sampling and Analysis Plan for details of how the sample should be collected.

Facility: _____ **Date:** _____

Source ID: _____ **Time:** _____

Source Location: _____

_____

Sample Properties at Time of Sampling

Sample Type: ☐ Groundwater Well ☐ Surface Water

EC: ☐ Measured in laboratory.
☐ Field measurement. EC _____ (µS or mS)
Circle the correct units for EC.

Ammonium: ☐ Field measurement. ☐ Present ☐ Absent
☐ Not Applicable.

Notes: _____

_____

_____

_____

_____

Sample should be delivered to an ELAP Certified Laboratory for testing within 48 hours of collection. Field testing for ammonium is only required for groundwater wells. If ammonium is present, sample must also be analyzed for ammonium in the ELAP laboratory.

Sampler Signature: _____

JMLORD, INC.

267 N. FULTON, FRESNO, CA 93701-1610
PHONE: (559) 268-9755 FAX: (559) 486-6504
WWW.JMLORDINC.COM

CHAIN OF CUSTODY

Facility Name: _____ Client No. _____

Client Name: _____

Sampled By: NAME _____ Initials: _____
(Please Print)

Lab ID For Lab Use	Sample I.D.	Crop	Samples Taken Date	Samples Taken Time	Sample Type	Analysis Requested (Lab Test Code)

Comments: _____

Relinquished By: _____ Date: _____ Time: _____

Recieved By: _____ Date: _____ Time: _____

Sample Type: S = soil; P = plant material; WW = wastewater; M = Manure; I = irrigation or fresh water

Facility Maps

The following maps have been included:

- ☑ Dairy Site/Production Area Map (s)
- ☑ Land Application Field Map (s)
- ☑ Soil Map (s)
- ☐ Well Map (s)

Costa View Dairy

Madera Co.

General Vicinity Map

LEGEND

- CV Dairy
- CV Fields
- Nearby Surface Water
- SJV_Roads
- state_highways

0 0.5 1 2 3 4 5 Miles

Background is 2009 NAIP Aerial Photo.

Prepared By
JMLord, Inc.
August 2010

Costa View Dairy

Madera Co.

Dairy Map

LEGEND

- CV Dairy
- Waste System
- Roofed Structures
- Corrals
- Commodity Storage
- Equipment
- CV Pipeline
- Irrigation Ditch
- Recycle Line
- Runoff Flow
- CV Wells
- Lift Pump
- Wastewater Pump
- Mixing Point
- Suspected Well
- Nearby Surface Water
- SJV_Roads

0 0.1 0.2 0.4 0.6 0.8 1 Miles

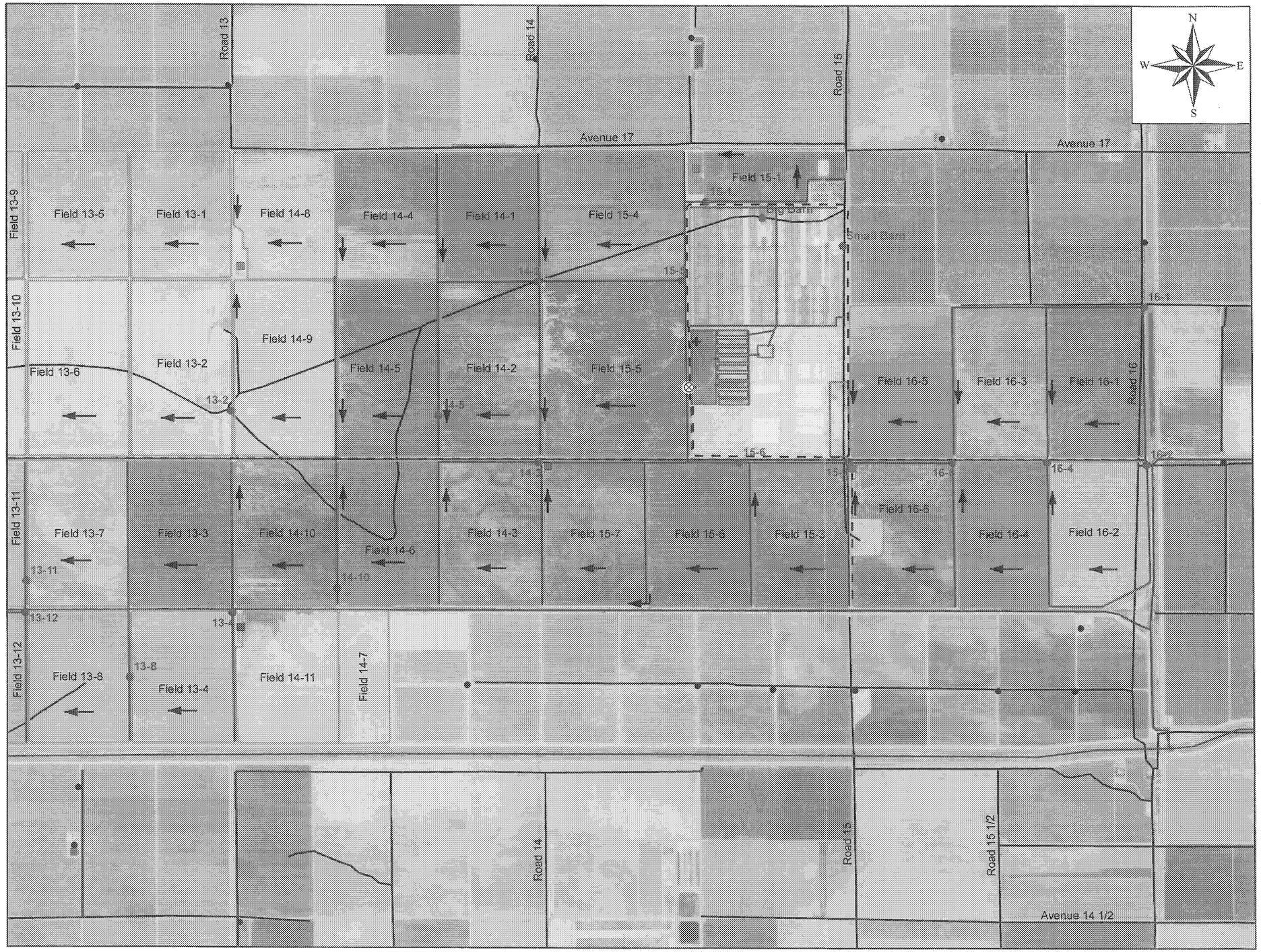
Background is 2009 NAIP Aerial Photo.

Prepared By
JMLord, Inc.
August 2010

Costa View Dairy

Madera Co.

Land Application Map - East Half



LEGEND

- CV Dairy
- CV Fields
- Waste System
- CV Pipeline
- Irrigation Ditch
- Field Flow
- CV Wells
- Lift Pump
- Wastewater Pump
- Mixing Point
- Tailwater Pond
- Suspected Well
- Nearby Surface Water
- SJV_Roads

0 0.25 0.5 1 1.5 2 2.5 Miles

Background is 2009 NAIP Aerial Photo.

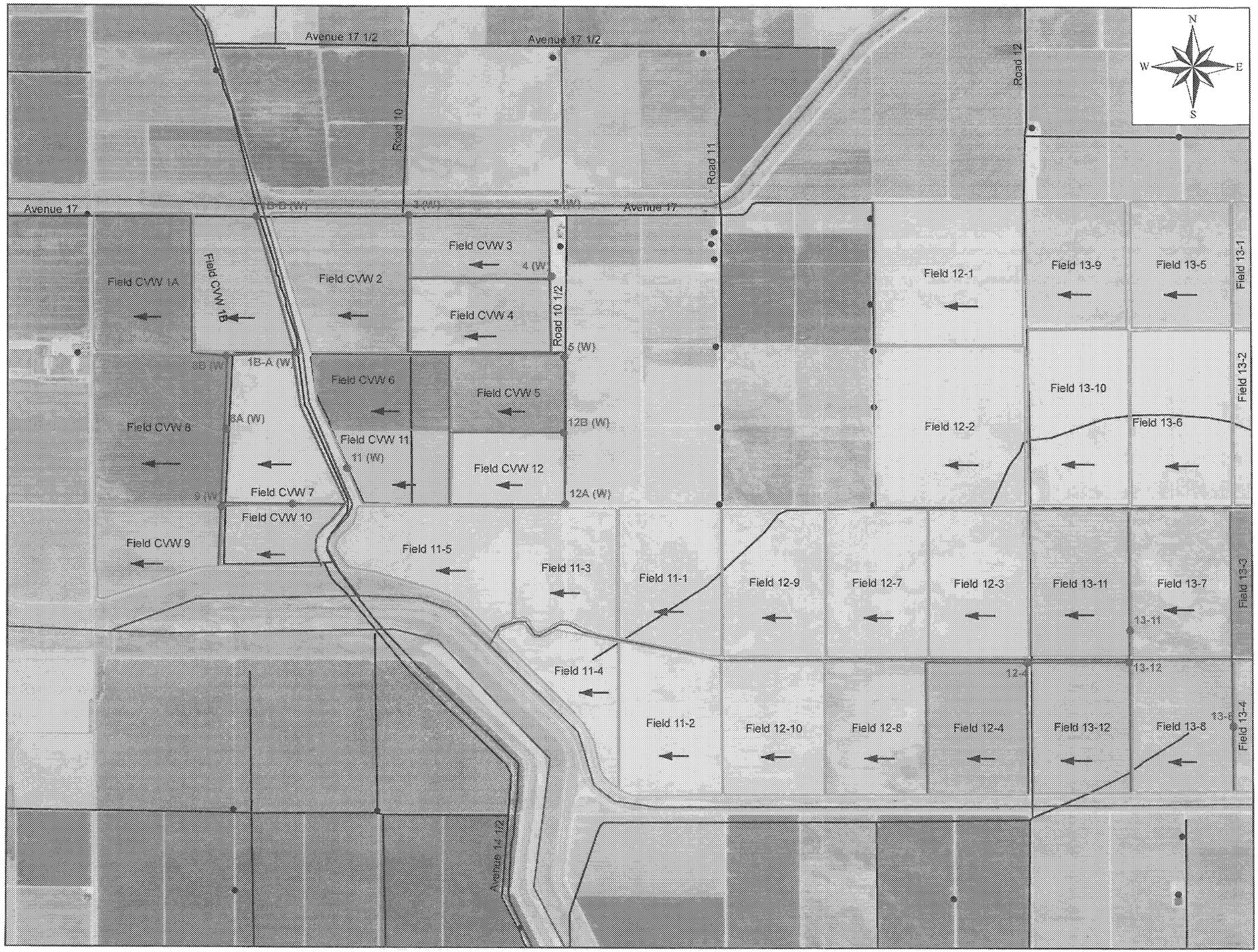
Additional field information has been attached.

Prepared By
JMLord, Inc.
August 2010

Costa View Dairy

Madera Co.

Land Application Map - West Half



0 0.25 0.5 1 1.5 2 2.5 Miles

Background is 2009 NAIP Aerial Photo.

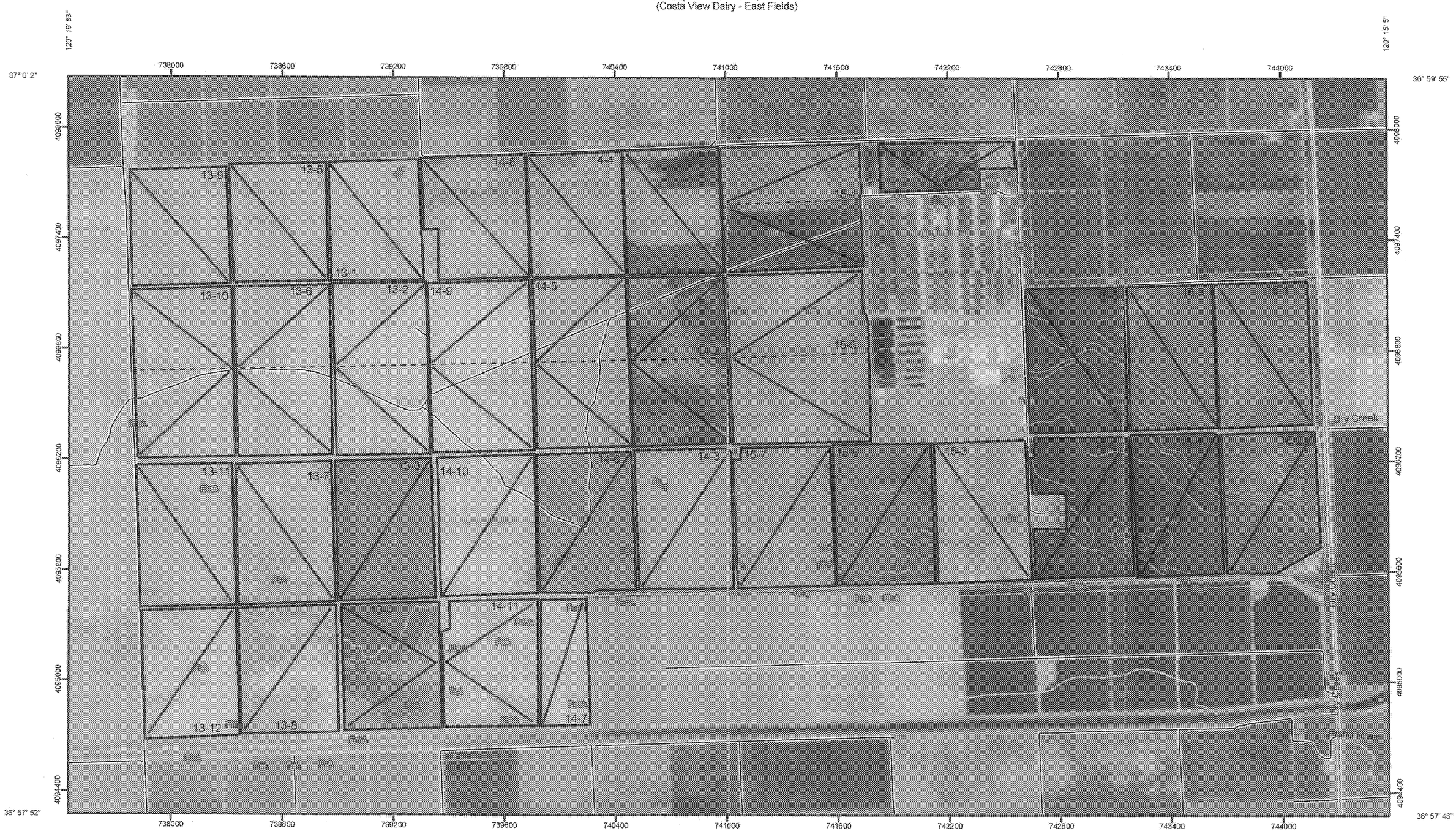
LEGEND

- CV Dairy
- CV Fields
- Waste System
- CV Pipeline
- Irrigation Ditch
- Field Flow
- CV Wells
- Lift Pump
- Wastewater Pump
- Mixing Point
- Tailwater Pond
- Suspected Well
- Nearby Surface Water
- SJV_Roads

Additional field information has been attached.

Prepared By
JMLord, Inc.
August 2010

Soil Map—Madera Area, California
(Costa View Dairy - East Fields)



USDA Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

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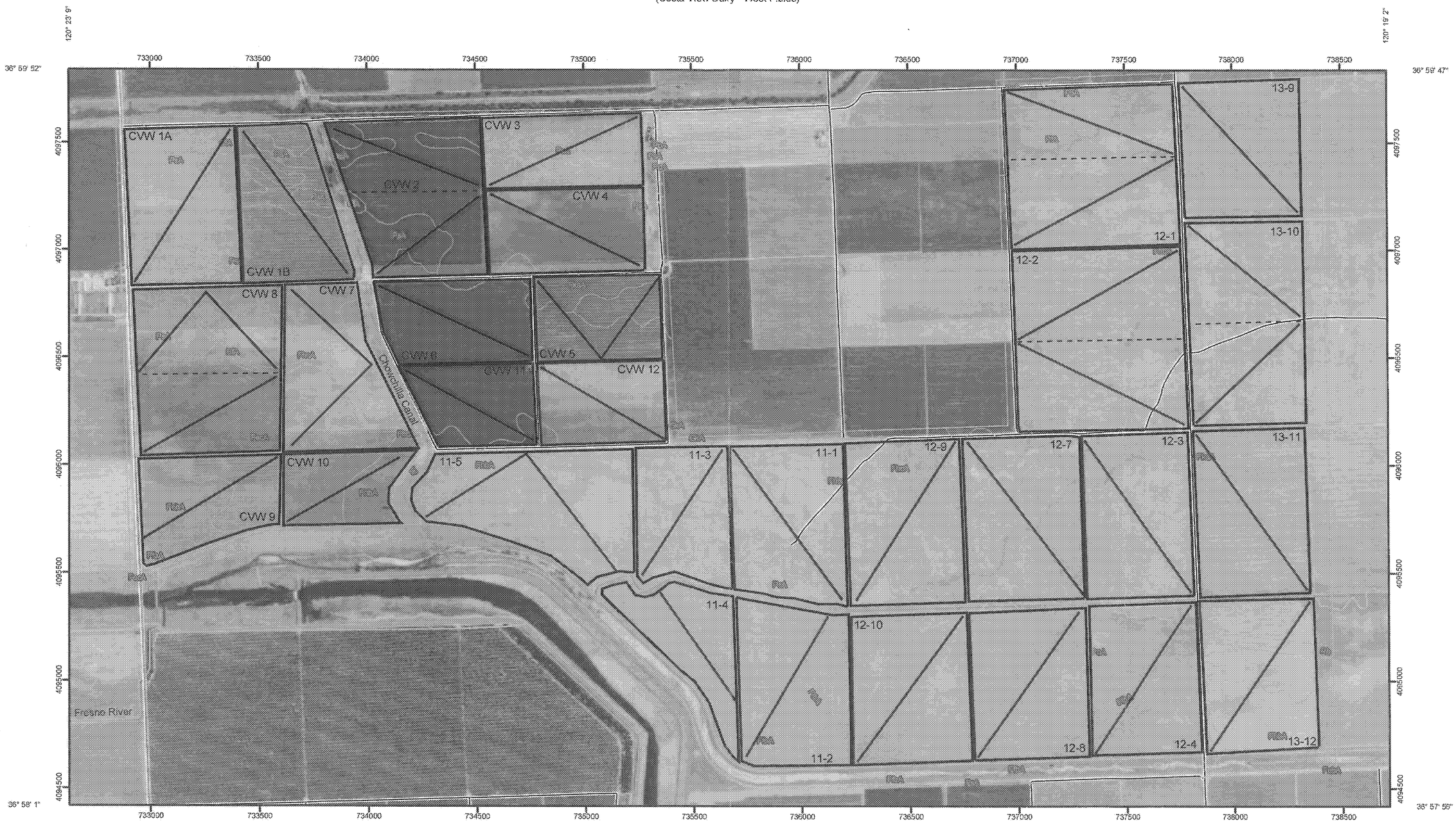
Soil Map—Madera Area, California
(Costa View Dairy - West Fields)



Map Scale: 1:16,800 if printed on B size (11" x 17") sheet.

N

Meters: 0, 250, 500, 1,000, 1,500

Feet: 0, 1,000, 2,000, 4,000, 6,000

Field Boundary

Sampling Pattern

Multiple Samples per Field

USDA Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

10/21/2011
Page 1 of 3

Sampling for Plant Tissue Analysis
Guide A-123

NMSU Cooperative Extension Service

Sampling for Plant Tissue Analysis

Cooperative Extension Service
College of Agriculture and Home Economics

Guide A-123

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This publication is scheduled to be updated and reissued 6/04.

Of the many factors affecting crop quality and yield, fertility is one of the most important. It is fortunate that producers can control fertility by managing the plant's nutritional status. Nutrient status is an unseen factor in plant growth, except when imbalances become so severe that visual symptoms appear on the plant.

The only way to know whether a crop is adequately nourished is to have the plant tissue analyzed during the growing season. Plant tissue analysis is offered by NMSU's Soil, Plant, and Air Testing Laboratory.

WHAT PLANT TISSUE ANALYSIS SHOWS

Plant tissue analysis shows the nutrient status of plants at the time of sampling. This, in turn, shows whether soil nutrient supplies are adequate. In addition, plant tissue analysis will detect unseen deficiencies and may confirm visual symptoms of deficiencies. Toxic levels also may be detected. Though usually used as a diagnostic tool for future correction of nutrient problems, plant tissue analysis from young plants will allow a corrective fertilizer application that same season.

Not all abnormal appearances are due to a deficiency. Some may be due to too much of certain elements. Also, symptoms of one deficiency may look like those of another. A plant tissue analysis can pinpoint the cause, if it is nutritional. A plant analysis is of little value if the plants come from fields that are infested with weeds, insects, disease organisms; if the plants are stressed for moisture; or if plants have some mechanical injury.

The most important use of plant analysis is as a monitoring tool for determining the adequacy of current fertilization practices. Sampling a crop periodically during the season or once each year provides a record of its nutrient content that can be used through the growing season or from year to year. With soil test information and a plant analysis report, a producer can closely tailor fertilization practices to specific soil-plant needs.

It also may be possible to prevent nutrient stress in a crop if the plant analysis indicates a potential problem developing early in the season. Corrective measures can be applied during the season or, if the crop is perennial, during the next year. Combined with data from a soil analysis, a tissue analysis is an important tool in determining nutrient requirements of a crop. By request, the following elements can be determined in a plant sample:

Nitrogen	Sulfur	Boron
Phosphorus	Iron	Sodium
Potassium	Copper	Chlorine
Calcium	Zinc	Molybdenum
Magnesium	Manganese	

Levels of elements such as cadmium, lead, arsenic, and selenium also can be examined. See table 1 for sufficiency levels of plant nutrients.

COLLECTING AND PREPARING THE SAMPLE

If you suspect a nutrient deficiency:

1) Sample when the symptom first appears (see table 2 for deficiency symptoms).
2) In the same field or area, collect similar samples of plant materials from plants that appear abnormal.
3) Make sure that the symptoms are not due to a factor unrelated to plant nutrition.

The parts of plants to sample depend on the plant and its growth stage. Table 3 lists the best parts to sample for common crops (see also fig. 1). More specific sampling strategies may be necessary for cotton and peppers (chile). Also, many devices are available

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for a "quick test" of the plant nitrogen status. Chlorophyll meters for certain crops can be used to predict the cost/benefit of additional nitrogen fertilizer.

Instructions for petiole or leaf sampling may differ. Also, comparing samples from both a "good" and a "bad" area often helps in determining corrective action. If specific sampling guidelines are not given here, collect recently mature leaves just below the growing point from at least 10 plants.

When gathering the tissue sample in the field, use a clean container. A plastic pail or a paper bag works best. Never use a metal container because it can contaminate the sample.

If the plant samples have soil, fertilizer, dust, or spray residues on them, they will need to be cleaned. A dry brush works best, but for stubborn residues, wipe the samples with a damp cloth or wash them with distilled or deionized water. However, do not prolong the washing because it can leach nutrients out of the tissue.

Air-dry the samples in the shade, not in the sun. To prevent contamination, place the dried samples into clean paper bags or envelops for mailing to the laboratory. Never place fresh plant tissue samples in plastic bags for mailing. The plastic bags do not allow the samples to dry, so they may decompose. It is also a good idea to take a soil sample in the same vicinity as the plant sample because the soil test may help to interpret the plant tissue analysis readings. Mail the samples to: Soil, Water, and Air Testing Laboratory / New Mexico State University / Gerald Thomas Hall, room 269 / P.O. Box 30003, MSC 3Q / Las Cruces, NM 88003.

A nominal fee will be charged. Your county Extension agent can provide further details.

Provide Information with the Sample

When mailing samples to the laboratory, be sure to provide the following information:

- Type of crop.
- Variety.
- Soil type (if known).
- Current crop fertilization and management practices (such as stand, kinds and rates of fertilizer, method of fertilizer application).
- Last year's crop fertilization practices and yield.
- Irrigation frequency and quality of irrigation water.
- Visual appearance of crop.
- Insect and disease problems (if any).

This information is necessary for sound interpretation of the plant tissue analysis.

Things to Avoid

Do not sample the following:

- Young, emerging leaves; old, mature leaves; and seeds. These plant parts usually are not suitable because they are not likely to reflect the nutrient status of the whole plant.
- Diseased or dead plants.
- Plants that have insect or mechanical damage.
- A single plant showing visual deficiency symptoms, unless it is possible to sample normal plants from an adjacent area in the field. Normal plants give a reference to help interpret the chemical analysis of the deficient plant sample.

Table 1. Sufficiency levels of plant nutrients for crops at growth stages shown in table 3.*

	Sufficiency levels						
Element	Corn	Grain sorghum	Soybeans	Small grains	Peanuts	Alfalfa	Bermuda grass
Nitrogen, %	2.7–3.5	3.3–4.0	4.2–5.5	1.7–3.0	3.5–4.5	4.5–5.0	2.5–3.0
Phosphorus, %	.25–.40	.20–.35	.26–.50	.20–.50	.20–.35	.26–.70	.26–.32
Potassium, %	1.7–2.5	1.4–2.5	1.7–2.5	1.5–3.0	1.7–3.0	2.0–3.5	1.8–2.1
Calcium, %	.21–1.0	.30–.60	.36–2.0	.20–.50	1.25–1.75	.50–3.0	—
Magnesium, %	.21–.60	.20–.50	.26–1.0	.15–.50	.30–.80	.30–1.0	—
Sulfur, %	—	—	—	.15–.40	.20–.30	.26–.50	.15–.20
Boron, ppm	4–25	1–10	21–55	5–10	20–50	30–80	—
Copper, ppm	6–20	2–7	10–30	5–25	10–50	7–30	—
Iron, ppm	21–250	65–100	51–350	50–150	100–350	—	—
Manganese, ppm	20–150	8–190	21–100	25–100	100–350	31–100	—
Zinc, ppm	20–70	15–30	21–50	15–70	20–50	21–70	—

*Adapted from Soil Fertility Handbook, Oklahoma State University.

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Table 2. General symptoms of nutrient deficiency in plants.

Nitrogen: Plant light green, lower leaves yellow to light brown, stalks short and slender, plants stunted.

Phosphorus: Plants dark green, often developing red and purple pigments; lower leaves sometimes yellow; plants stunted.

Potassium: Spots of dead tissue, usually at the tips and between the veins; marked margins of leaves.

Magnesium: Mottled or chlorotic leaves, which typically redden; leaf tips and margins turned or cupped upward.

Calcium: Young leaves of terminal bud hooded; with severe deficiency, dying buds; dying back at the tips and margins of the leaf.

Sulfur: In young leaves, veins and tissue between veins are light green.

Iron: Young leaves are chlorotic, with principal veins typically green; stalks short and slender.

Zinc: Leaf spots on older leaves, with spots rapidly enlarging and generally involving the area between the veins; thick leaves; stalks with shortened internodes.

Boron: Young leaves of the terminal bud are light green at the base; the bud eventually dies.

Copper: Young leaves are permanently wilted, with spotty or marked chlorosis.

Manganese: Spots of dead tissue scattered over the leaf; smallest veins tend to remain green.

Table 3. Tissue sampling techniques for specific plants.

FIELD CROPS

Crop	When to sample	Where to sample	Number to sample
Alfalfa	Early bloom	Top 6 inches or upper third of plant	12–30
Canola	Before seed set	Recently mature leaf	60–70
Clover	Before bloom	Upper 1/3 of plant	30–40
Corn/sweet corn	Seedling stage	All above-ground portions	15–20
	OR		
	Before tasseling	First fully developed leaf from the top of the plant	15–20
	OR		
	Tasseling to silking	Leaf opposite and below ear	12–20
Cotton	Full bloom	Recently mature leaf from main stem	40–50
Grasses/ forage mixes	Stage of best quality (before seed emerges)	Upper 4 leaves	30–40
Peanuts	Before or at bloom	Recently mature leaves	40–50
Small grains (barley, oats, wheat, rye, rice)	Seedling stage	All above-ground portions	25–40
	Before heading	4 uppermost leaf blades	25–40
Sorghum (milo)	Before or at heading	2nd leaf from top of plant	20–30
Soybeans	Before or at bloom	Recently mature, trifoliate leaves from the top of the plant	20–30
Sugar beets	Midseason	Recently mature leaf at center of whorl	25–30
Sunflowers	Before heading	Recently mature leaf	20–30

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VEGETABLE CROPS

Crop	When to sample	Where to sample	Number to sample
Asparagus	Maturity	Fern, 18–30 inches above ground line	10–30
Beans	Seedling stage OR Before or at bloom	All above-ground portions Recently mature leaf	20–30 20–30
Broccoli	Before heading	Recently mature leaf	12–20
Brussels sprouts	Midseason	Recently mature leaf	12–20
Celery	Midseason	Outer petiole of recently mature leaf	12–20
Cucumbers	Before fruit set	Recently mature leaf	12–20
Head crops (cabbage, cauliflower)	Before heading	Recently mature leaf at center of whorl	12–20
Leaf crops (such as lettuce, spinach)	Midseason	Recently mature leaf	12–20
Melons	Before fruit set	Recently mature leaf	12–20
Peas	Before or at bloom	Leaves from 3rd node from top	40–60
Peppers	Midseason	Recently mature leaf	25–50
Potatoes	Before or at bloom	3rd to 6th leaf from growing tip	25–30
Sweet potatoes	Midseason or before root enlargement	3rd to 6th leaf from tip center or mature leaves	20–30 25–35
Root/bulb crops (such as carrots, beets, onions)	Midseason before root or bulb enlargement	Recently mature leaf	20–30
Tomatoes (field)	Midbloom	3rd to 4th leaf from growing tip	15–20
Tomatoes (trellis or indeterminate)	Midbloom from 1st to 6th cluster stage	Petiole of leaf below or opposite top cluster	12–20

ORNAMENTALS AND FLOWERS

Crop	When to sample	Where to sample	Number to sample
Carnations	Newly planted	4th to 5th leaf pair from base	20–30
	Established	5th to 6th leaf pair from base	20–30
Chrysanthemums	Before or at bloom	Top leaves on flowering stem	20–30
Ornamental trees and shrubs	Current year's growth	Recently mature leaf	30–70
Poinsettias	Before or at bloom	Recently mature leaf	15–20
Roses	At bloom	Recently mature compound leaf on flowering stem	25–30
Turf	Active growth	Leaf blades. Avoid soil contamination.	2 cups

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FRUIT AND NUT CROPS

Crop	When to sample	Where to sample	Number to sample
Apples, pears, almonds, apricots, cherries, prunes, plums	Midseason (June-July)	Leaves from current season's nonfruiting, nonexpanding spurs	50–100
Peaches and nectarines	Midseason (June-July)	Midshoot leaflets/leaves	25–100
Grapes	At bloom	Petioles or leaves adjacent to basal clusters at bloom	50–100
Pecans	Midseason	Midshoot leaflets/leaves	25–60
Pistachios	Mid- to ate season (August)	Terminal leaflets from nonfruiting shoots	25–60
Raspberries	Midseason	Recently mature leaves from laterals of primocanes	30–50
Strawberries	Midseason	Recently mature leaves	25–40
Walnuts	Midseason (June-July)	Terminal leaflets/leaves from nonfruiting shoots	25–40

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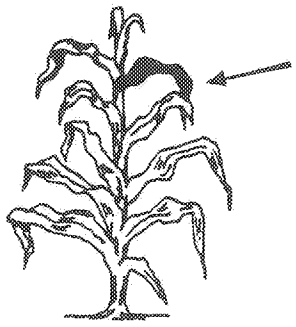
Figure 1. Desired sampling location for common crops.

Adapted from Reference Guide for Plant Tissue Analysis, Analytical Laboratories, Inc.

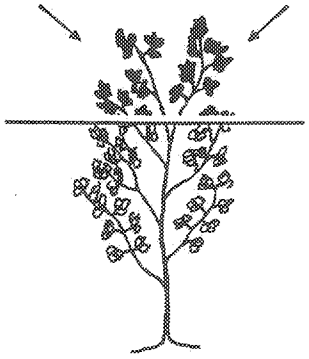
Corn...before tasseling

Collect the first fully developed leaves from the top of 15–20 plants. (If the plant is less than 12 inches tall, collect all of the above-ground portion.)



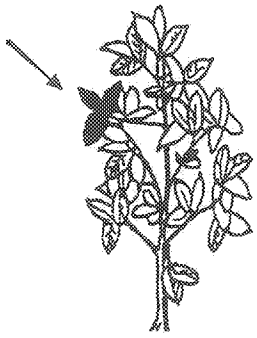
Alfalfa

Collect the top 6 inches or upper third of the plant at early bloom.



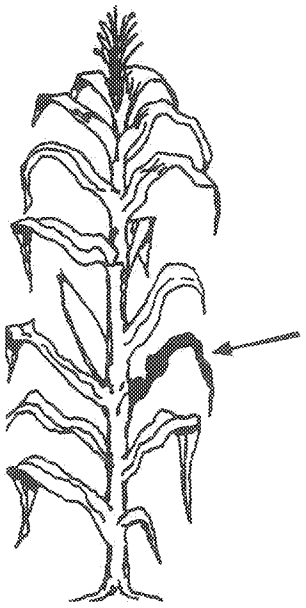
Soybeans

Collect recently mature trifoliate leaves from the top of 20–30 plants before or during bloom. (In the seedling stage, collect all of the above-ground portion of the plant.)



Corn...from tasseling to silking

Collect the leaves below and opposite from the ear of 15–20 plants.



Sorghum

Collect the second leaf from the top of 20–30 plants before or at heading.

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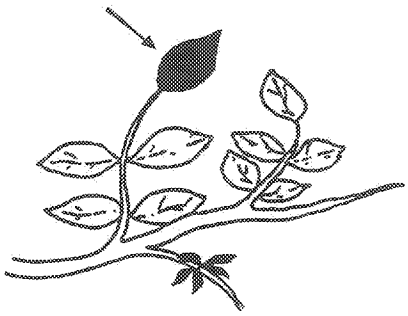
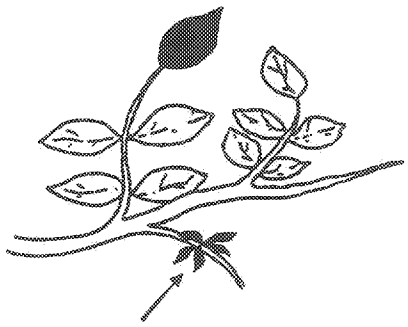
Pistachios and Walnuts
Collect terminal leaflets/leaves from nonfruiting shoots at mid- to late season.

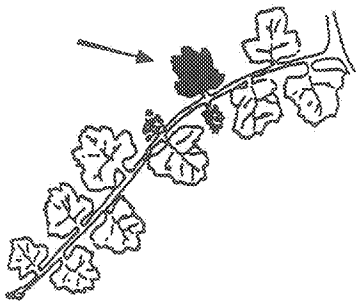


Apples, Pears, Almonds, Apricots, Cherries, Prunes, Plums
Collect the leaves from the current season's nonfruiting, nonexpanding spurs at midseason.

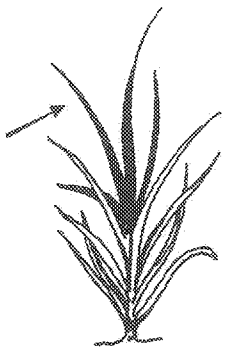


Pecans, Peaches, and Nectarines
Collect the midshoot leaflets/leaves at midseason.

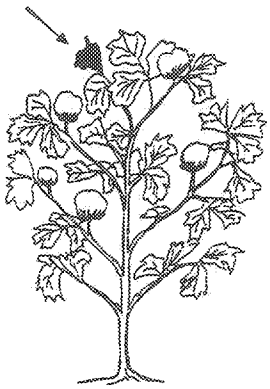
Grapes
Collect the petioles or leaves adjacent to basal clusters at bloom.



Small grains
Collect the four uppermost leaf blades from the top of 25–40 plants. Sample should equal 2 cups. (In the seedling stage, collect all of the above-ground portion.)



Cotton
Collect recently mature leaves from the main stem on 40 to 50 plants selected at random at full bloom.



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Originally written by Larry J. Cihacek and Ricardo E. Gomez.

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Revised June 1999 **Las Cruces, NM**
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