CDQAP - WDR General Order Reference Binder
TAB 5.7
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Sampling Protocol for Irrigated Pastures

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In May 2007, the Central Valley Regional Water Quality Control Board (Regional Water Board) adopted Waste Discharge Requirements General Order No. R5-2007-0035 for Existing Milk Cow Dairies (General Order)[1]. The Monitoring and Reporting Program (MRP) of the General Order requires analyses of various types of materials to define baseline conditions, develop and implement a Nutrient Management Plan, and describe potential pollutant load in illegal discharges. This Monitoring and Reporting Program was revised in February, 2011[2] and describes minimum **plant tissue sampling** requirements to obtain data for use in the site specific Nutrient Management Plan. Results must be submitted to the Central Valley Regional Water Quality Control Board as part of the appropriate annual reporting activities (due July 1 of the following calendar year).

Since animals harvest the plant tissue in irrigated pastures, unlike with other forage types where mechanical harvesting occurs, the quantity of material harvested by animals on irrigated pasture cannot be directly quantified. Determining nutrient quantity harvested by animals (pasture nutrient yield) requires completing two steps. The first step is sampling and analysis (lab analytical work) to determine nutrient content of plant tissue. The second step requires determining pasture dry matter yield (pounds per acre) harvested by animals during a specified time interval. The nutrient content of the plant tissue sampled multiplied by plant tissue dry matter yield will yield an estimate of nutrient consumption (removal) per acre of pasture.

Step 1. Sampling and Analysis of Pasture Plant Tissues to Determine Nutrient Content

Part I –Laboratory Selection and Identification of Sampling and Analytical Requirements

1. Table 1 outlines the minimum constituents and frequency of sampling and analysis requirements specified under the revised MRP.
2. Select a laboratory that participates in and utilizes methods described in the North American Proficiency Testing (NAPT) Program or alternative methodology accepted by the University of California or the Executive Officer of the Central Valley Regional Water Board (available at their website http://www.waterboards.ca.gov/centralvalley/water_issues/dairies/general_order_guidance/sampling_analysis/sampling_procedures_rev_30jan09.pdf).
3. Contact the analytical laboratory to obtain labels, sample containers, required record keeping, and chain of custody forms.

[1]Central Valley Regional Water Board. 2007. Order No. R5-2007-0035. Waste Discharge Requirements for General Order for Existing Milk Cow Dairies. May 3, 2007. Available at http://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/general_orders/r5-2007-0035.pdf.
[2]Central Valley Regional Water Quality Control Board. 2011. Revised Monitoring And Reporting Program Order No. R5-2007-0035. General Order For Existing Milk Cow Dairies Available at http://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/general_orders/r5-2007-0035_mrp_rev.pdf

Table 1. Nutrient Monitoring- Plant Tissue Analyses (minimum regulatory requirements).

At harvest: Record the total weight (tons), percent moisture of harvested material removed from each land application area. Laboratory analyses for total nitrogen, total phosphorus, and total potassium (expressed on a dry weight basis), and percent moisture. The following test is only required if the Discharger wants to add fertilizer in excess of 1.4 times the nitrogen expected to be removed by the harvested portion of the crop (see Attachment C of Order No. R5-2007-0035 for details): Laboratory analyses for total nitrogen, expressed on a dry weight basis

Part II – Sampling Preparation & Location Determination

Sampling sources, timing and frequency:

1. Determine how many different sampling areas you will need in order to have a representation of the different pasture types grazed during the grazing season. Give consideration to soil type, plant species composition, and pasture management practices. Sampling areas should be identified in your sampling and analysis plan.
2. Frequency of sampling should be based on pasture characteristics (i.e., species composition) and season of grazing. Nutrient concentration is fairly consistent throughout the summer grazing season in a well-managed pasture. One representative sample taken in mid-spring or summer should be sufficient to represent the pasture throughout the growing season. Nutrient content may vary considerably in fall if cool season species become dominant, so an additional early fall sample is recommended when cool season species are a major component of the pasture.

Sample Handling and Storage:

1. Determine how you will identify your samples (dairy name/location, date, pasture identification, and time of sampling). Field/pasture identification should be consistent with the land application areas identified in the Sampling and Analysis Plan.
2. Grab sample clippings representing each pasture should be placed in a large brown paper bag.
3. Sample bags should be stored inside at room temperature in a dry environment prior to **delivery** to the laboratory. Open the tops of bags to prevent mold growth. It is not necessary to place pasture clippings in a refrigerator or air tight container. (Note: the moisture content of the sample submitted to the laboratory will not be used to estimate pasture yield.) Once collected, the entire sample should be delivered to the laboratory.

Part III – Sample Collection

1. Gather sampling equipment needed, e.g. large paper bags (e.g., grocery bags), permanent marker, clippers, one square foot ring (for subsample collection), pasture identification information, and chain of custody form.
2. Label each paper bag with pasture identification (be sure identification is consistent with Nutrient Management Plan field labeling), the date and time of sampling, the name of the person taking the sample and whether it is a morning or afternoon sample.
3. Use one square foot area for clipping size.
4. Identify sampling pattern on a field scale map (examples in Figures 1 and 2).
5. Clip grab samples to just above ground level.
6. Avoid debris (dirt and feces) that will contaminate the grab sample.
7. Collect a group of five to seven sub-samples across the pasture and combine all collected material from these to form the composite sample for that sampling area (Figure 1). Composite sub-samples from smaller pastures when interior fencing creates smaller pastures/paddocks with similar plant species composition, soil type and pasture management (Figure 2). If pastures differ greatly in soil

type, species composition and/or management, then composite samples should be submitted **from each different pasture**.

8. Include all plant species present in the one-square foot area of the sub-sample (even weeds are using nutrients).
9. Place sub-sample in a labeled grocery bag and move to the next sub-sampling point.
10. Repeat steps 5 - 9 until all grab samples representing a single sampling area are placed in the same paper bag. Typically each grab sample represents approximately 10 acres.
11. Complete a chain of custody form and record the required information.

Figure 1. Collect grab samples in a single pasture for one composite sample.

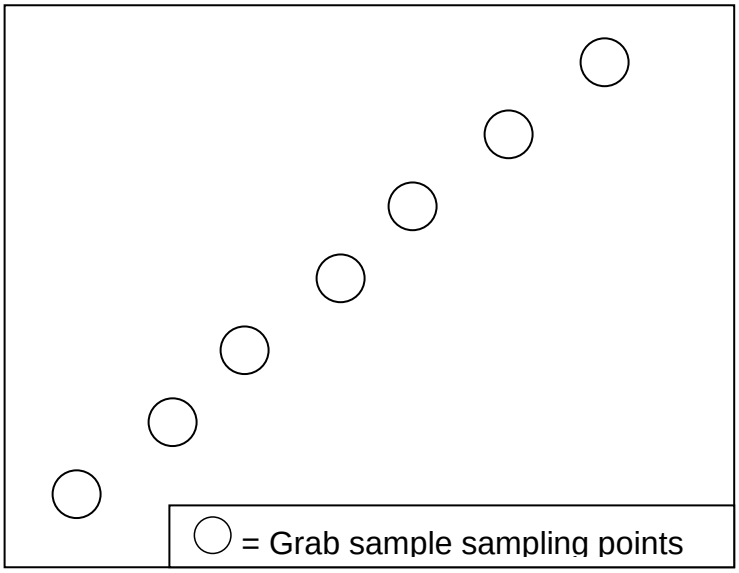
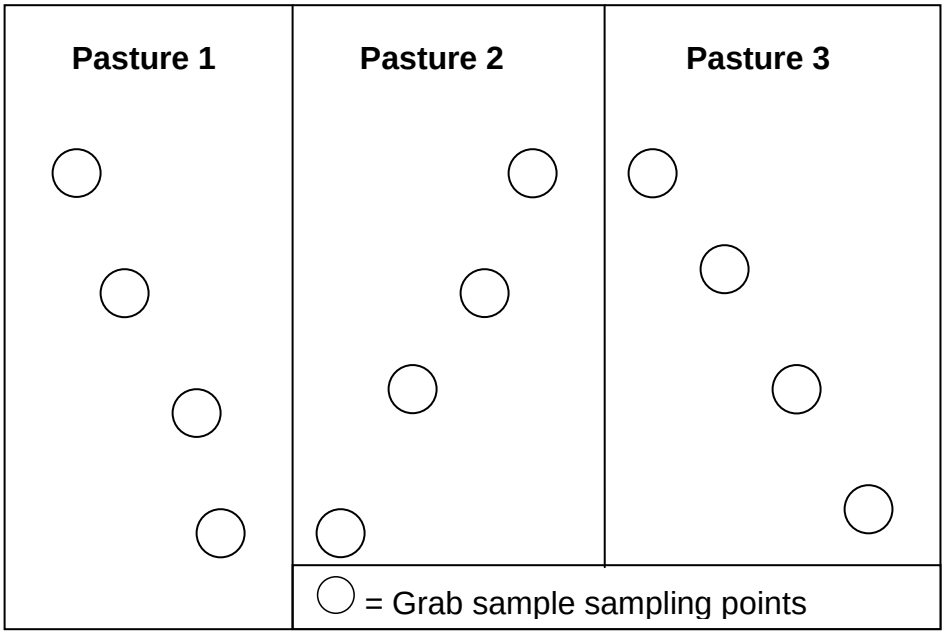


Figure 2. Collect grab samples in contiguous and homogenous irrigated pastures for one composite sample. Pastures 1, 2 and 3 collectively make one sampling area.



Step 2. Determining Pasture Dry Matter Yield

Estimating dry matter yield is more difficult for pasture than other crops because cows consume plants as they grow in pasture. The need to account for the intake of other feedstuffs by animals complicates the estimation of intake of pasture forage. The average total daily intake of dry matter by dairy cows has been published by NRC (1989) and Table 2 provides daily dry matter intake for small and large breed mid-lactation dairy cows. To determine the intake of pasture forage for a specific time period, subtract the amount of dry matter from other consumed feedstuffs (hay, grain, silage, etc.) fed to each animal group during that time period from the estimated total dry matter intake for each animal group during the same time period using the daily value selected from Table 2. It can be assumed that the remainder of the diet dry matter was consumed as pasture forage.

Table 2. Estimated daily dry matter intake for small and large breed mid-lactation dairy cows

Small breed cows (app. 1,000 lbs)	
Daily milk yield (lbs.)	Estimated Dry Matter Intake (lbs.)[1]
40	35 - 37
65	43 – 46
90	51 – 55
Large breed cows (app. 1,500 lbs.)	
Daily milk yield (lbs.)	Estimated Dry Matter Intake (lbs.)[1]
50	43 – 46
75	50 – 54
100	57 – 62
[1]Values are for mid-lactation (90 days milking). Adapted from NRC, 1989.	

To estimate production it is necessary to know:

1. Number of days a pasture is grazed.
2. Number of animals on the pasture each day it is grazed.
3. Size of the pasture (acres).
4. Estimated daily dry matter intake of the animals grazing the pasture (see example below) [note: units are pounds per day per head per day].
5. Supplemental dry matter provided to the animals (concentrates and forage) [note: units are pounds per day per head per day].
6. Estimated dry matter intake of animals from pasture (value from step 4 minus value from step 5) [note: units are pounds per head per day].

Pasture Production Calculation

Daily dry matter (DM) intake from pasture =

Total pounds estimated daily dry matter intake for group on pasture **-** Daily supplemental dry matter (concentrate and forage[2]) intake

[2] It is important to account for dry matter consumed that originated as high moisture forage supplemented to pasture dry matter. Dry matter from high moisture forage supplement = pounds of supplement fed daily per head x dry matter content.

Dry matter lbs per acre produced by the pasture per period =

$$\frac{\text{Number of days grazed} \times \text{Number of animals during grazing period} \times \text{Daily dry matter intake of grazing animals from pasture}}{\text{Pasture size in acres}}$$

Example:

The number of days a pasture is grazed	180
The number of animals on the pasture	80
The acreage of the pasture	40
The dry matter intake of the animals grazing the pasture (per head per day) (Table 1.)	48
Supplemental dry matter provided to the animals: 10 lbs dairy mix @ 90% DM (9 lbs) and 30 lbs silage @ 30% DM (9 lbs)	18
The dry matter intake of the animals from the pasture (48-18) (per head per day)	30

Dry matter lbs per acre produced by the pasture per period = 10,800 pounds of dry matter forage per acre for 180 day summer grazing period.

$$\frac{180 \quad x \quad 80 \quad x \quad 30}{40}$$

The results of the nutrient analyses will be used along with the results from estimating dry matter yields from pasture to determine nutrient removal from each pasture. The step of determining actual nutrient yields will be completed through a land application tracking system and/or during documentation for annual report submission.

Additional Information

- For additional information or clarification, contact your local University of California Cooperative Extension Farm Advisor or UCCE Specialist: http://animalscience.ucdavis.edu/extension/Advisors/index.htm
- Your analytical laboratory can provide additional information on sample collection.
- Further information on regulations and compliance can be obtained from the Central Valley Regional Water Quality Control Board: http://www.waterboards.ca.gov/centralvalley/water_issues/dairies/
- For information on the California Dairy Quality Assurance Program Environmental Stewardship Module "Compliance through Education", please go to http://www.cdqa.org.

Information in this document was compiled by UCCE and CDQAP to assist dairy producers in understanding and complying with the General Order Waste Discharge Requirements for Existing Milk Cow Dairies (Central Valley Regional Water Board Order R5-2007-0035). Effort has been made to ensure accuracy, but these summaries are not official regulatory guidance and are not legal advice. Producers are advised that these summaries are not intended to be a substitute for producers reading the complete order and consulting their own legal counsel to ensure compliance with the waste discharge requirements. Should any information here conflict with the General Order and/or official information provided by the Regional Board, Board-provided information takes precedence.

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