

Manure Recycling and Innovative Products Task Force (MRIP)

MRIP Final Report to Secretary Karen Ross, California Department of Food and Agriculture (CDFA)

December 14, 2022

Contents

Forward by California Department of Food and Agriculture Secretary Karen Ross.....2

1. Introduction and MRIP Background.....3

2. Challenges and Opportunities4

3. MRIP Process Overview5

4. Relative Contribution and Timeline of Strategies to Address Nitrogen Surplus.....9

5. MRIP Recommendations to Address Nitrogen Surplus9

 Section 5.1: Conventional Strategies 10

 Section 5.2: Compost Strategies 11

 Section 5.3: Denitrification and Treatment 12

 Section 5.4: Nitrogen Capture 14

6. Conclusions and Next Steps15

Appendix A: MRIP Guiding Principles.....17

Appendix B: MRIP Roster20

Appendix C: FINAL CHARTER.....22

Appendix D: Recent Dairy Manure Compost Research and Data29



CALIFORNIA DEPARTMENT OF
FOOD & AGRICULTURE



FOREWORD

BY CDFA SECRETARY KAREN ROSS

Livestock manure handling can utilize technology and innovation to capture its nutrients, mitigate environmental impacts and recover value-added products to improve the financial viability of our family-owned dairies. Improved manure management is an excellent example of a smart resource recovery strategy as the basis of a circular economy. I am grateful to the volunteers who have served on this task force to identify the possibilities of turning the challenges of manure management into opportunities.

Dairy manure is a valuable resource. However, the excess of some nutrients in manure is a critical concern that must be addressed for the safety of our communities and our environment. The collaboration of our California farmers, academia, and public partners, through the Manure Recycling and Innovative Products (MRIP) Task Force, has positioned us to protect our local communities, preserve our land, water, and air, and improve the sustainability of our food production system by delivering these important nutrients where they are needed most.

The work presented in this report is the result of highly qualified people from academia, the private sector, public agencies, and non-governmental organizations working together for more than 15 months to find feasible and innovative nutrient management solutions for California's diverse dairy operations. This task force explored conventional strategies, compost strategies, nitrogen capture, denitrification and treatment, and the potential for existing and emerging strategies to address nutrient surplus, all while considering the environmental, social, regulatory, and economic impacts.

The Manure Recycling and Innovative Products (MRIP) Task Force has succeeded in developing recommendations for strategies to capture **and enhance the value** of dairy manure. The value highlighted by these strategies includes building healthy soils and sequestering carbon, offsetting industrial fertilizer use, protecting water and air quality, and reducing agriculture's carbon footprint in California. These benefits impact not just farmers, but the state, our consumers, and our environment.

This task force has helped develop an initial roadmap, and I look forward to the continued work of this group and our progress toward making a circular fertilizer economy a reality. **Together, we are creating transformational change.** I am so grateful to be a part of it, and I thank you all for your willingness to rise to this challenge.

Karen Ross

Manure Recycling and Innovative Products Task Force (MRIP)

MRIP Final Report to Secretary Karen Ross, California Department of Food and Agriculture (CDFA)

1. Introduction and MRIP Background

In October 2021, CDFA convened the MRIP to develop recommendations on how to capture and enhance the value of dairy manure to support healthy soils, protect water quality, and reduce agriculture's carbon footprint in California. As defined by CDFA, interim and final Task Force recommendations are expected to:

- Increase the understanding of the scale and distribution of nitrogen surplus on dairies and potential demand from other crops for nitrogen and other manure nutrients;
- Identify research, technical and policy actions that encourage action and innovation to recycle surplus nutrients for use in agriculture; creating a circular fertilizer/soil amendment economy that builds healthy soils, conserves and protects water, and makes our state's agriculture more sustainable;
- Organize short-, mid-, and long-term potential solutions and create a roadmap for continued progress, including estimates of time and resources necessary to achieve research, policy, technology development, and education/outreach objectives.

In March 2022, the MRIP delivered interim recommendations to CDFA Secretary Karen Ross in support of these goals. These recommendations were intended to reduce and/or better utilize surplus dairy-produced nitrogen and other manure nutrients statewide, creating economic opportunities while reducing environmental impacts to communities. Specifically, the intent of the recommendations is to improve water quality and reduce greenhouse gas emissions while minimizing or avoiding other potential unintended impacts such as increased emissions of other air pollutants due to increased transportation of manure or other changes in manure management. This concept is integral to all recommendations in this report and is captured in the MRIP Guiding Principles. These Principles were unanimously supported by the MRIP and approved by CDFA on December 2, 2021, and include statements on the shared expectations, interests, and aspirations of all MRIP members. The Guiding Principles are included in Appendix A.

An interim report was unanimously approved by all MRIP members present on March 23, 2022. Of the 21 MRIP members, 16 were present at the meeting to approve this Report on November 18, 2022. The report was approved at that time as follows:

- 13 members approved the report with no changes
- 3 members abstained, citing their role as neutral advisors from state agencies
- An additional 5 members were not present and abstained from voting
- No additional comments requesting modification to this Report were received from MRIP members following the meeting.

Since the development of the interim report, great additional progress has been made. MRIP members and stakeholders from the California dairy industry have worked to provide updates to the recommendations (where appropriate), developed research descriptions to address data gaps, and identified potential funding sources for future work to address nitrogen surplus issues. Additionally, with interim report as a starting point, the California Dairy Research Foundation (CDRF) applied for and

received a grant of nearly \$85 million from the U.S. Department of Agriculture, to be used for on-dairy projects that reduce or capture both surplus nitrogen and methane on California's dairies. CDRF partnered with a number of other organizations in seeking the USDA grant, many of whom also participated in the MRIP Task Force. Notably, CDFA was chosen to administer the USDA grant award process because of its experience in funding manure management improvements on California dairies through its successful Dairy Digester Research and Development Program (DDRDP) and Alternative Manure Management Program (AMMP).

MRIP deliberations and its interim report also helped inform CDFA as it developed its new program, the California Livestock Methane Measurement, Mitigation and Thriving Environments Research Program (CLIM3ATE-RP). The new CLIM3ATE-RP program (final details undergoing public comment period at time of publication of this report) proposed to provide \$10 million in funding for research and pilot projects, including approximately \$5 million for Manure Recycling and Innovative Products Development.¹

Additionally, through CDFA's AMMP program, the agency in September 2022 provided partial funding for an innovative vermifiltration/denitrification at a dairy in Tulare County, supporting an MRIP recommendation that such systems should be expanded and tested.

Additionally, MRIP deliberations and interim recommendations have led to productive discussions with the San Joaquin Valley Air Pollution Control District, which is reviewing scientific research results to develop a science-based emission factor for manure compost, a key step needed before additional dairy manure composting operations can receive permits.

These are just a few of the many developments that have occurred concurrent, and to some degree as a result of the MRIP Task Force collaboration. This final report provides updates to the interim recommendations, discusses key success stories, and provides guidance on next steps for the MRIP moving forward.

2. Challenges and Opportunities

This section provides a brief overview of the scale and importance of California dairies to the economy, the unique challenges posed by surplus dairy manure and the resulting nitrogen surplus, and potential opportunities to address this surplus while also creating new or expanded revenue streams through better application of manure to cropland or manure conversion to innovative new products.

California agriculture contributed nearly \$50 billion in farm gate value in 2020; dairies were the single largest contributor to this sum, with nearly in \$7.5 billion in economic output.² A 2019 report attributed \$57.7 billion in direct, indirect and induced economic activity to the California dairy industry, and creation of 180,000 jobs.³ However, dairies also generate environmental impacts including greenhouse

¹ After this report was finalized in December 2022, funding for the CLIM3ATE-RP program was limited to \$5 million dollars, and approximately \$2 million of the reduced total was directed towards Manure Recycling and Innovative Products Development projects.

² California Department of Food and Agriculture crop reports for 2020, <https://www.cdfa.ca.gov/Statistics/>

³ Matthews, W and Sumner, D. "Contributions of the California Dairy Industry to the California Economy in 2018: A report for the California Milk Advisory Board," p. 11, University of California, Agricultural Issues Center

gas (GHG) emissions, water quality degradation, and air pollution that must be addressed to protect surrounding communities, the environment, and the long-term viability of the dairy industry itself.

Progress is ongoing to address the issues above across the state, but localized impacts still exist. Nitrate contamination of groundwater drinking sources is an acute issue in many agricultural areas: animal manure (including dairies) contributes an estimated 1/3 of all nitrogen loading to groundwater in parts of California’s agricultural regions, with other irrigated agriculture contributing most of the remainder.⁴ For dairies, inefficient and/or overapplication of manure to cropland is the main source of loading; an important driver of this is surplus manure and lack of sufficient demand for that manure elsewhere.⁵

Finding viable alternatives to put this surplus to beneficial use is essential to addressing environmental impacts. While developing new or improved methods to utilize manure will require investments, the potential to reduce costs and generate new revenue is significant. Making investments in a more circular fertilizer and soil amendment economy in California’s dairy producing regions can improve drinking water quality for our communities, reduce GHG emissions, and improve the health and resiliency of our soils. Achieving this goal through the use of innovative, improved manure management strategies will provide a significant opportunity for California to lead in sustainable agricultural production.

3. MRIP Process Overview

The MRIP consists of a diverse group of stakeholders including dairy industry representatives, state agency and regulatory staff, the environmental justice community, and academia.

A complete roster of MRIP members is available in **Appendix B**. The MRIP Charter (included in **Appendix C**) was unanimously supported by the MRIP and subsequently approved by CDFA at the December 2, 2021, MRIP meeting and provides useful information on MRIP roles, responsibilities, and decision-making protocols.

The MRIP met seven times between October 26, 2021, and November 18, 2022. An overview of topics discussed, and key outcomes is listed below in Table 2.1: Summary of MRIP Plenary Meetings.

Meeting Date	Topics Discussed	Key Outcomes
October 26, 2021	Introduced MRIP Charter and Guiding Principles. Received feedback on MRIP goals and introduce key concepts.	Received initial input from MRIP members on the Charter and Guiding Principles.
December 2, 2021	Received updates on related research efforts under development by the University of	Achieved member support for and CDFA approval of, Charter

⁴ Harter, T. et al. (“Addressing Nitrate in California’s Drinking Water: Report for the State Water Resources Control Board Report to the Legislature.” Center for Watershed Sciences. University of California, Davis. <https://ucanr.edu/sites/groundwaternitrate/files/138956.pdf>.

⁵ "Summary Representative Monitoring Report, Revised," April 2019, Central Valley Dairy Representative Monitoring Program, p. 10, https://www.waterboards.ca.gov/centralvalley/water_issues/confined_animal_facilities/groundwater_monitoring/srmr_20190419.pdf

	California, Davis. Created MRIP Work Groups (see below) and received initial input on Work Group questions for consideration.	and Guiding Principles. Confirmed Work Group membership, leads, goals, and questions for consideration / recommendation development.
January 26, 2022	Received updates on related research efforts. Presented MRIP Work Group findings and recommendations to date.	MRIP members unanimously approved draft recommendations for further refinement and final approval at the February meeting.
February 23, 2022	Received updates on related research efforts. Presented MRIP Work Group findings and recommendations to date.	MRIP members present approved recommendations for inclusion in the March Interim Report and provided clarifying questions/suggestions for recommendation implementation.
March 23, 2022	Presented comments received on the Draft Interim Report.	MRIP Members present unanimously approved the draft recommendations and this Interim Report with the following abstentions: Clay Rodgers, Central Valley Regional Water Quality Control Board; Ramon Norman, San Joaquin Valley Air Pollution Control District.
September 28, 2022	Provide updates on the MRIP process and implementation of the Interim Report	MRIP Members received informational updates on each strategy area discussed below. MRIP co-chairs did not request specific decisions on any items.
November 18, 2022	Present the Final Report for MRIP approval	MRIP members present at the meeting approved the final report. No comments/modifications were made at that time.

Table 2.1: Summary of MRIP Plenary Meetings

Between plenary meetings of the MRIP, topic-specific Work Groups were convened to develop recommendations utilizing the following strategies for dairy manure management. The charge of each Work Group is described below:

- Conventional Strategies:** Develop strategies to reduce and better utilize nitrogen surplus with technology and equipment now widely available in the commercial market and increase understanding of how much of the dairy nitrogen surplus can be addressed using these strategies.

- **Compost Strategies:** Determine how much of current nitrogen surplus on dairies could be utilized by expanding composting of surplus manure and examine the permitting requirements and likely environmental and economic outcomes of increasing dairy compost production, export, and utilization in non-dairy agriculture or other uses.
- **Denitrification and Treatment:** Facilitate strategies for the removal or conversion of nitrogen in manure or manure effluent through physical, chemical, or biological processes that primarily convert reactive nitrogen to stable nitrogen gas (N₂).
- **Nitrogen Capture:** Explore innovative processes to help address nitrogen surplus on dairies by capturing and concentrating nutrients in a form that can be easily transported and sold off a dairy for use as crop nutrients (especially for non-forage crops).

Most of the Work Groups met three times from December 2021 to November 2022; the Compost Strategies Group met five times. A short description of each meeting, including key outcomes, is included in Table 2.2: Summary of MRIP Work Group Meetings.

Meeting Date/Group Name	Topics Discussed	Key Outcomes
12/15/21 Denitrification	Received presentations on denitrification technologies showing promise and developed initial recommendations.	Drafted initial recommendations for MRIP consideration.
1/11/22 Denitrification	Focused on two potential technologies for denitrification and defined questions to be answered for pilot project development.	Defined questions for pilot project implementation. Refined recommendations.
2/11/22 Denitrification	Continued refinement of recommendations based on 1/26 MRIP input.	Finalized recommendations for MRIP consideration on 2/23.
12/17/21 Conventional Strategies	Discussed a range of commonly used conventional strategies and the need for increased reporting and outreach on available strategies to dairy producers.	Drafted initial recommendations for MRIP consideration.
1/18/22 Conventional Strategies	Focused on two categories of conventional strategies: increasing application of liquid manure for contiguous on-farm acreage not currently receiving liquid manure, and diverting manure from liquid storage to drying and removal to off-site acreage.	Refined recommendations and identified study needs to maximize conventional strategy adoption where appropriate.
2/22/22 Conventional Strategies	Finalized recommendations based on 1/26 MRIP feedback.	Finalized recommendations for MRIP consideration on 2/23.

12/21/21 Compost Strategies	Reviewed commonly used manure composting practices and developed initial recommendations.	Defined key questions requiring answers to formulate composting recommendations.
1/20/22 Compost Strategies	Continued discussion of the composting regulatory environment and opportunities/barriers to increased manure composting.	Drafted initial recommendations for MRIP consideration.
2/11/22 Compost Strategies	Revised recommendations based on 1/26 MRIP input.	Finalized most recommendations for MRIP consideration on 2/23.
2/16/22 Compost Strategies	Discussed San Joaquin Valley Air Pollution Control District (APCD) regulations and began working on scenarios to better understand opportunities for increased manure composting.	Finalized APCD-related recommendations for MRIP consideration on 2/23
9/12/22 Compost Strategies	Discussed recent stakeholder meetings, updated science regarding dairy manure compost emissions factors, and potential updates to APCD emissions factors.	Informational only. Meeting participants were broadly supportive of the potential APCD emissions factor modifications.
12/22/21 Nitrogen Capture	Discussed the potential relative contribution of nitrogen capture to address nitrogen surplus. Focused on two potential capture technologies for implementation.	Drafted initial recommendations for MRIP consideration.
1/25/22 Nitrogen Capture	Focused discussion of two nitrogen capture technologies: evaporative liquid processing and polymer-based flocculant systems. Refined recommendations.	Refined initial recommendations.
2/18/22 Nitrogen Capture	Specified study needs and defined remaining questions for potential capture pilot project implementation.	Finalized recommendations for MRIP consideration on 2/23.

Table 2.2: Summary of MRIP Work Group Meetings

In addition to the formal MRIP Work Groups, a subset of MRIP Compost Work Group members – CDFA, APCD, and the co-chairs – met with a group of dairy industry representatives and consultants working to develop and permit composting projects. This group met three times and generated new information that resulted in an additional recommendation being presented to the Compost Work Group. More information is provided in Section 5 below.

4. Relative Contribution and Timeline of Strategies to Address Nitrogen Surplus

Determining the relative contribution of each strategy above to address nitrogen surplus will help ensure the most efficient and effective tools are used. For instance, if research determines conventional strategies pose the lowest cost method to address the majority of the surplus, additional funding and policies could be used to maximize their adoption. MRIP examination found that at this time, there is not sufficient information to determine the comparative roles of the strategies above in solving the nitrogen surplus. For example, to understand the role Conventional Strategies might play, more detailed surveys of available lands for manure application near dairies – land under the control of dairies or where animal forage is grown – would be helpful; research in this area is needed was under consideration by the dairy industry at the time of publication of this final report. Similarly, the magnitude of the role manure composting might play in addressing nitrogen surplus is highly dependent on future decisions related to emissions factors and permitting. Finally, as noted throughout this report, innovative technologies for denitrifying manure, or capturing manure nitrogen to produce innovative fertilizer products, are relatively early in their development – MRIP strongly recommends efforts to advance such technologies, but it is too soon to determine whether these will be successful at all, let alone how large they will scale in the ultimate set of solutions.

Similarly, the MRIP anticipates some strategies may be adopted sooner than others. Commonly used strategies such as extending pipelines to contiguous acreage on a single dairy or trucking manure for application to non-contiguous acreage (Conventional Strategies) or increasing manure composting (Compost Strategies) may be deployed relatively quickly. Others, such as vermifiltration (Denitrification) or evaporative liquid processing (Nitrogen Capture) may take longer to implement but could ultimately have a significant contribution to address the overall surplus. Although the MRIP does not have enough information to provide reliable estimates for a strategy adoption timeline at this time, the MRIP will have provided advice intended to help direct investments in research and development, policies and programs, and will continue to do so as much as possible as it convenes in the future.

5. MRIP Recommendations to Address Nitrogen Surplus

This section provides an overview of interim recommendations confirmed by the full MRIP at its March 23, 2022, meeting and updated between March and November, 2022.

It should be noted that some MRIP members representing regulatory agencies were not able to “vote” on issues without previous approval by their governing boards (as addressed in Section 4.6.3 of the MRIP Charter). These members nonetheless played an integral role by reviewing and discussing recommendations with a focus on any potential regulatory issues.

Recommendations are described under each corresponding strategy and include the level of MRIP member support, as well as outstanding questions for which answers are needed to implement the recommendation. No individual strategy is likely to address the entire dairy nitrogen surplus; rather, it is expected that a combination of tools and strategies will be needed to provide the necessary environmental and economic benefits.

MRIP members suggested that all studies associated with the recommendations below be conducted by neutral, third-party researchers and data/outcomes be made publicly available. Moreover, all recommendations to construct pilot facilities are expected to include a study component to investigate environmental and economic benefits/impacts associated with the technology in question. Whether explicitly stated or not, any activity that is expected to increase movement of material on or off dairies, increase use of conventional technologies and practices, or install new technologies and practices, should include an assessment of the potential impacts, such as those related to transportation, on adjacent communities.

Finally, although these recommendations are made in a report to CDFA, it is expected that the activities here will need to be accomplished collectively, with leadership from the dairy industry, and support and collaboration from multiple state agencies, academic/research institutions, private sector entrepreneurs, non-governmental organizations, and others.

Section 5.1: Conventional Strategies

The Work Group identified conventional strategies as the most immediate means of addressing nitrogen surplus by using currently available, commonly used technologies and practices. Increased use of conventional strategies to utilize surplus nitrogen is the overarching goal of the recommendations below, and these strategies should be considered before more complex and potentially difficult-to-implement strategies are adopted. Conventional strategies generally revolve around better utilization of liquid manure on farm or diverting manure away from liquid storage to dry storage, to facilitate its export to more distant forage crop fields (that is, crops not intended for human consumption).

Unlike some of the other strategies in this report, conventional strategies – practices like lengthening and improving pipeline systems that deliver liquid manure to forage fields – are better understood by and to some degree, already employed on many dairies. That said, this Work Group examined the possibility that a portion of surplus dairy manure can be better utilized on forage-growing lands already under dairy operator control; reducing the need for synthetic fertilizer on those lands in the process. The key will be adequate outreach and education to dairy operators to evaluate these opportunities, and presence of adequate systems to store, convey, and apply manure nutrients in a timely, accurate manner across those lands.

The Central Valley Dairy Representative Monitoring Program (CVDRMP) Summary Representative Monitoring Report (SRMR, April 2019)⁶ made recommendations about specific tactics and data needs to support achieving whole-farm balance on dairies. After reviewing this existing suite of recommendations, the Conventional Strategies Work Group focused on two strategy areas to increase the ability of dairies to use more on-site manure for feed and forage crop production while reducing the use of supplemental commercial fertilizer. The first strategy area is improving and extending access to contiguous, on-farm (or neighboring) acreage available for liquid manure delivery with proper metering and distribution to assure accurate application results (such as through extending pipelines). The second strategy area is aimed at reducing the amount of manure nutrients collected within flush systems and stored in liquid form, instead utilizing tools such as intermittent scraping and vacuuming of manure from

6

https://www.waterboards.ca.gov/centralvalley/water_issues/confined_animal_facilities/groundwater_monitoring/srmr_20190419.pdf

barns, combined with solar drying of that diverted manure, to facilitate export to more distant forage fields. Each of these strategy areas may employ a number of variations or combinations of tactics, which accomplish roughly the same goals. To facilitate increased awareness about when and how to employ these strategies, the following recommendations were developed:

1. Implement the Reporting Structure outlined in the SRMR, including whole-farm balance, to increase understanding of how each dairy's manure nitrogen is stored and applied, and whether surpluses exist in liquid or solid manure nitrogen or both. (Note: The Work Group recommendation is relevant to the entire Task Force, as it provides an important diagnostic for dairy operators to determine whether they have surplus manure nitrogen and informs consideration of different potential solutions).
2. Increase dairy industry and extension education and training (e.g., California Dairy Quality Assurance Program, UC Cooperative Extension, etc.), to promote producer and consultant understanding of when and how to apply conventional or innovative strategies to address nitrogen surplus.
3. Conduct near-term studies to better understand how much of the dairy industry's nitrogen surplus can be addressed using conventional strategies. At time of publication of this final report, the dairy industry was evaluating a research proposal covering this topic.

[Section 5.2: Compost Strategies](#)

Similar to conventional strategies, composting processes are relatively well understood and to some degree already employed among dairy producers. However, the impact of new landfill diversion requirements, gaps in research on environmental and food safety issues, and uncertainty and lack of awareness about existing air quality regulations and permitting requirements has created barriers to increasing production of dairy manure compost. In particular, air quality permitting requirements related to VOC emissions have deterred some dairy producers from composting surplus manure.

After the interim recommendations were approved, to begin implementing those recommendations, a subset of MRIP Compost Work Group members – CDFA, APCD, and the co-chairs – met several times with a group of dairy industry representatives and consultants seeking to develop and permit composting operations on dairies. During these meetings, it was learned that there were existing studies and data suggesting that actual VOC emissions were much lower than the APCD emission factor (EF) currently applied to dairy manure compost. This new information suggested that actual VOC emissions from compost could be significantly lower than the current APCD VOC emission factor. After several discussions with the lead researchers on the emissions studies, the APCD agreed to consider the new data toward developing a science-based VOC emissions factor specific to dairy manure compost. An MRIP Compost Work Group meeting was then held to share the updates and provide an opportunity for the Compost Work Group members to ask questions of the research scientists. All Compost Work Group members present on the call were supportive of APCD developing a new VOC emissions factor specific to dairy manure compost that reflects the most up-to-date research. This additional recommendation was added to the previous list of interim recommendations (see #1 below). Studies and data supporting this modification are included in Appendix D.

The Compost Work Group developed a suite of recommendations to address these uncertainties and increase the viability of compost as a standalone product providing both nutrient management and economic benefits. These include (#1-4 are in sequential order):

1. Develop a new APCD VOC emissions factor specific to dairy manure compost that reflects the most up-to-date research.
2. Develop scenarios to illustrate San Joaquin Valley Air Pollution Control District (APCD) volatile organic compound (VOC) permitting thresholds for different herd sizes and composting amounts using the APCD calculator. This information will help determine the cost of increased compost production discussed in Recommendation 2 below. These scenarios are also expected to include:
 - a. Identification of likely best available control technologies (BACT) required for different amounts of compostable material.
 - b. Determination of thresholds when offsets/more restrictive BACT are likely required.
3. Conduct an economic and supply/demand analysis of dairy manure compost, including:
 - a. Analysis of current compost (consumer) costs to identify pricing and demand.
 - b. Identification of current dairy manure compost costs based on existing regulations and control technology requirements.
 - c. Market forecasts for consumer prices of compost if significant amounts of dairy manure and other compost enter the market.
4. Develop a tool such as a guide or flow chart to educate dairy producers on regulations, permitting requirements and control technologies for composting manure.
5. Conduct a study/literature review to evaluate existing information and research gaps on environmental impacts (air quality, GHG, water quality, etc.), transportation impacts and cost, and food safety issues associated with dairy manure composting. This study should build on previous work from Sustainable Conservation,⁷ the California Dairy Research Foundation and others.

[Section 5.3: Denitrification and Treatment](#)

Denitrification represents some of the more advanced strategies examined by the MRIP, removing nitrogen entirely or converting it into stable nitrogen (N₂) gas through a variety of manure treatment processes.

The Denitrification Work Group focused on two primary technologies for further development and study, vermifiltration and algae raceway systems. These technologies are in use on a very limited basis in the United States generally and California specifically, but may offer potential to address nitrogen surplus issues. The economics (both cost to construct denitrification facilities and marketing post-treatment products such as carbon credits, vermiculture compost, or raw materials for products, such as bioplastics, require additional studies to confirm economic viability. Denitrification industry

⁷ https://suscon.org/wp-content/uploads/2017/10/Sustainable-Conservation_Manure-Compost-Report.pdf

representatives have provided descriptions and some environmental and economic data related to the performance of these technologies, but these must be independently confirmed at industry-scale facilities in California. Early but limited results suggest reduction in overall reactive nitrogen (potentially higher than 80%), and reductions in air pollution-related emissions, and GHG.

The Work Group noted that additional information on the fate of dairy manure salts and any remaining nitrogen during and after treatment must be better understood to avoid any unintended consequences associated with these technologies. To that end, the following recommendations were developed:

1. Economic and environmental outcomes studies should be conducted on both the existing California and Washington locations for vermifiltration systems. Developers assert that the company and dairy farm owners are willing to partner on studies.
2. Two additional pilot projects utilizing vermifiltration systems should be constructed in California: one with a digester in front of the system, and one without a digester. In October 2022, CDFA awarded AMMP funding to a vermifiltration project in Tulare County. MRIP recommends that this already-funded project be approached as a potential site for environmental and economic research to identify and verify project and community benefits.
3. A communications campaign should be initiated to educate dairy operators on the availability of Alternative Manure Management Program (AMMP) funding for vermifiltration systems. (*Note: The California Dairy Quality Assurance Program has been made aware of this recommendation and is developing curriculum for dairy producers and consultants that will include this information. CDFA is already providing this information in its AMMP-related outreach.*)
4. A full-scale algae raceway should be constructed at a specific California dairy location, where a tank digester designed to work with that raceway is already planned and funded. Cost estimates to carry out such a pilot should be developed prior to finalizing this recommendation. The project should be accompanied by a separately funded, independent, third-party research study to verify economic and environmental performance.

No MRIP members opposed the Denitrification recommendations. However, one individual stressed the importance of conducting studies in advance of encouraging dairies to pursue specific funding for vermifiltration systems for the purpose of denitrification discussed in recommendation 3. These systems are already approved for AMMP funding for methane reduction purposes.

As with other workgroups, due to time and resource constraints, the Denitrification and Treatment Workgroup did not examine all possible innovative systems in this technology area, rather prioritizing those systems that appeared to already being used at full or pilot scale in the U.S. and/or California. Since the release of the interim recommendations in March 2022, MRIP has learned of other potential systems that are either being examined on a pilot scale in California, or may be studied here in the near future. The include technologies such as Sequencing Batch Reactors (a denitrification system commonly used in wastewater treatment that may be useful in treating dairy wastewater). Similarly, in October, a company known as FYTO hosted the MRIP Co-Chairs and CDFA at a research site in Petaluma, where nitrogen-rich dairy effluent is being used to grow duckweed, a possible alternative feed source for cattle, denitrifying the wastewater in the process. While MRIP has not been able to evaluate these technologies, we note them here as examples of continued innovation in real time that is occurring. This

supports our recommendation in Section 6 below that the MRIP continue to meet periodically and monitor the progress of potentially emerging technologies.

Section 5.4: Nitrogen Capture

Nitrogen capture systems represent a particularly innovative type of dairy manure management. The Nitrogen Capture Work Group focused primarily on these two technologies: evaporative liquid waste processing systems, and polymer flocculant-based solids/liquid separation systems. Evaporative technology processes dairy manure into solid and liquid nutrient products for sale as organic fertilizers or replacements for conventional liquid and solid fertilizer products. Polymer flocculant-based solids/liquid separation systems extract nutrients in the form of a sludge, which can be used much like raw manure.

Evaporative systems in particular appear to provide environmental benefits and pathogen-free solid and liquid fractions, which may be readily marketed as organic fertilizers or alternatives to conventional fertilizers. Polymer separation/flocculant-based systems likely also provide environmental benefits, such as improved water quality in discharge, reduced GHG emissions and higher capture rates of nitrogen and phosphorus during diversion of liquid manure to solid form to facilitate export. At this time however, polymer separation systems do not produce a pathogen-free or high-value marketable product. Nonetheless, polymer-based separation systems offer an alternative method to manage nutrients that is less capital-intensive than evaporative systems.

Neither of these systems are widely used for dairy manure management in California or the U.S., and thus will require development of pilot systems and study to understand their viability on California dairy farms. Recommendations to further expand the understanding and use of nitrogen capture systems include:

1. Fund construction of an evaporative liquid waste processing project in California (in addition to one already being planned) using the following criteria:
 - a) Develop pilot at a farm with high stocking (herd) density and a nitrogen surplus. Said farm should have an existing dairy digester.
 - b) Ensure the farm has an adequate land base (i.e., individual farm, adjacent lands, or nearby acreage under the same ownership/management) for additional crop trials of finished fertilizer products.
 - c) Ensure owner/operator of farm is willing to host third-party, independent research as a condition of receiving pilot funding.
 - d) Dairy should be representative of California dairy design and operations. It should also have at least 3,000 head of milking cows. The herd size guideline is intended to ensure enough economy of scale for the project to be economically viable.
2. Conduct crop trials, using processed manure/ammoniated liquid extract from an existing evaporative liquid waste processing facility (e.g., Indiana Sedron Varcor facility), to verify and support its use as an amendment in certified organic agriculture and to verify other agronomic benefits and environmental benefits/impacts. This should include trials on organics farms or

fields as needed. Short term: Work with California university researchers to define study variables and plan crop trials. In October 2022, Dr. Stephen Kaffka et al of UC Davis submitted a report to CDFA, “Manure Nutrient Recovery, Removal, and Reuse on California Dairies,” which details from results of laboratory testing of solids recovered from a Sedron system. Kaffka’s team recommended developing protocols for crop testing. Kaffka’s team did not test liquid ammoniated product from the Sedron system.

3. Conduct environmental and economic studies of an evaporative liquid waste processing system to ensure its viability in California. Conduct studies on existing systems and proposed new pilot system.
4. Conduct environmental and economic studies of existing polymer separation/flocculant-based systems including potential for economically viable finished products post-processing.
5. Work with developers to develop a concept and budget to construct a full-scale polymer-separation/flocculant-based California pilot facility including development of revenue streams and value-added products (e.g., Low Carbon Fuel Standard credits, pelletization, etc.)

6. Conclusions and Next Steps

The MRIP is grateful to the Secretary for convening the Task Force and hopes that these recommendations are useful to the variety of partners represented on the Task Force, from regulators, policy makers and funding agencies to the dairy industry itself, researchers and NGOs. We believe the convening of this Task Force generated needed attention and creative thought among various California leaders toward beginning to solve one of the dairy industry’s most significant challenges: achieving long-term environmental and economic sustainability. For California’s world-leading dairy industry to continue to be sustainable in decades to come, these challenges must be addressed. As noted earlier in this report, we believe this process has already borne significant fruit:

- An \$85 million grant from USDA – to the California Dairy Research Foundation, and to be administered by CDFA – to fund innovative practices to reduce methane and nitrogen surplus on dairies, such as those described in this report,
- The launch of CDFA’s CLIM3ATE-RP program, which will provide \$5 million in funding to demonstrate innovative projects that reduce methane and recycle manure nutrients to create valuable products,⁸
- Evaluation of new scientific data to support permitting of eco-friendly dairy manure composting operations,
- Funding of \$750,000 from AMMP for what will be a \$5.7 million vermifiltration project on a Tulare County dairy, and
- Increased interest in the research community and private sector in examining new ways to increase the value of dairy manure as a sustainable, renewable resource and economic engine for California agriculture.

⁸ After this report was finalized in December 2022, funding for the CLIM3ATE-RP program was limited to \$5 million dollars, and approximately \$2 million of the reduced total was directed towards Manure Recycling and Innovative Products Development projects.

We believe MRIP's deliberations and recommendations were helpful and in some cases integral in achieving the progress noted above. While the submittal of this Final Report marks the conclusion of the duties originally envisioned by CDFA, we respectfully suggest that the Secretary consider the following:

- Continuing convening the MRIP periodically to continue momentum and progress in this space.
- Utilize annual or semi-annual MRIP meetings to monitor progress on the existing recommendations, on new and important developments, and to perhaps provide additional future advice to CDFA and other stakeholders.

The co-chairs of MRIP thank CDFA staff and each and every member of the Task Force for their numerous contributions to this report, and look forward to our continued collaboration.

Appendix A: MRIP Guiding Principles

Manure Recycling and Innovative Products Task Force

FINAL Guiding Principles

December 2, 2021

The Manure Recycling and Innovative Products (MRIP) Task Force (MRIP or Task Force) is a diverse group of stakeholders convened by the California Department of Food and Agriculture (CDFA) to address the following goals in the State of California:

- Increase the understanding of the scale and distribution of nitrogen surplus on dairies and potential demand from other crops for nitrogen and other manure nutrients.
- Identify research, technical and policy actions that encourage innovations to recycle surplus nutrients for use in agriculture; creating a circular fertilizer/soil amendment economy that builds healthy soils, conserves and protects water, and makes our state's agriculture more sustainable.
- Organize short, mid, and long-term potential solutions and create a roadmap for continued progress, including estimates of time and resources necessary to achieve research, policy, technology development, and education/outreach objectives.

To support this effort and to ensure shared expectations, interests and aspirations among Task Force Members (Members), the following "Guiding Principles" have been prepared and are categorized by the following topics.

GENERAL

1. For the purpose of the Task Force's work, "manure" is limited to manure generated on dairy operations, and "products" are focused on fertilizers and soil amendments.
2. The amount of manure produced by dairies in California cumulatively exceeds the amount that can be used on current dairy forage crop acreage throughout the state without negatively impacting water quality. Pending research data is expected to better quantify regional manure nutrient surpluses and areas of potential demand for such nutrients, and will be provided to the Task Force once available (likely early 2022).
3. Task Force recommendations will address the interests of all stakeholders. These include, but are not limited to, dairies, environmental groups, environmental justice groups, general agriculture, associated agricultural industries and regulatory agencies.

PROCESS / APPROACH

1. Per the Secretary of CDFA, the Task Force will complete interim recommendations by March 2022. To achieve this target, all Members understand that work between October 2021 and March 2022 must be conducted in a timely, expedited manner. To that end, Members understand and commit that:

- Through March 2022, the Task Force will create and seek consensus (see bullet #2 below) on a list of options to present as interim recommendations.
 - The Task Force functions in an advisory capacity. The Task Force does not have decision authority over state, federal, and local government technical, economic and regulatory policies, nor the policies of any advocacy and private sector organizations.
 - Before and after March 2022, the Task Force will focus on practical, feasible recommendations that can be actionable at various scales and locations throughout California.
2. Members are committed to a consensus-seeking approach based on the principle of “consensus with accountability.” All Members agree to work toward agreement on recommendations. On issues when unanimous consensus is not attainable, Members that cannot support a proposal because their interests are not met, agree to provide a counter proposal that strives to meet their interests and the interests of all other Members.
 3. In the context of the above principle, Members commit to listen to, learn from and help achieve each other’s interests whenever possible.
 4. Regarding Task Force problem solving, Members commit to focus on available data to make science-based recommendations (including recommendations that support further scientific inquiry if deemed necessary).

ENVIRONMENTAL / SOCIAL

1. Task Force recommendations will have the goal to reduce negative environmental impacts and to minimize creating new negative environmental impacts.
2. If Task Force recommendations result in existing and future environmental regulations and policies being integrated or streamlined (as administered by various resource trustee agencies), such modifications should seek to provide overall environmental and human health benefits to communities.

REGULATORY

1. Within the limits of respective public trust responsibilities and in the context of all other principles stated herein, State and federal agencies will work together to minimize conflicting factors within their regulations, policies, and guidelines that may impede innovative manure management solutions.
2. In the context of the above principle, Task Force recommendations will not place State and federal agencies in a position where they support or accommodate non-compliant behavior by regulated parties.

ECONOMIC

1. CDFA recognizes the dairy industry as an important component of the overall agri-business sector that contributes significant economic benefits to other parts of California agriculture and the overall

state economy. Task Force recommendations should strive to maintain the economic viability of the dairy industry.

2. Task Force recommendations may include proposed changes to dairy industry manure management practices, and wherever feasible, will provide multiple options for dairies over the short, mid and long-term to achieve water quality protection and maximize resource recovery. It is an overall Task Force goal to identify solutions that are cost-effective and create revenue streams and economic opportunities, but it is also recognized that some necessary management options may generate net costs for dairy operations.
3. Consistent with CDFA goals, Task Force recommendations should identify financial incentives (and mechanisms to minimize financial risks) for dairies and allied agricultural industries.
4. To enhance the likelihood of private and public sector participation and investment in solutions, Task Force recommendations should identify feasible opportunities for research, technology, and innovation.
5. Task Force recommendations must identify a range of funding sources to support long-term sustainability of innovative manure management practices. Future innovations will require a diverse combination of investment from the dairy industry, private sector, government and others.
6. Financial value associated with innovative manure management can and should take many forms (e.g., revenue generation, regulatory cost offsets, cooperative product sharing, etc.). To make Task Force recommendations most likely for long-term implementation, said recommendations should identify a diverse range of value streams that result from innovative manure management as a means to provide dairies and associated agricultural users a menu of options that incentivize new practices.

TECHNICAL

1. The Task Force will consider all applicable data to inform their technical recommendations. That said, geologic, hydrogeologic, soil and climatological differences in California may limit implementation feasibility of manure management practices used in other parts of the United States.
2. Task Force recommendations should identify feasible time frames and funding options that support field trialing, data collection and analysis, and mechanisms to quantify environmental and economic benefits.

Appendix B: MRIP Roster

Title	First	Last	Organization
Dr.	Rizaldo	Aldas	California Energy Commission
Mr.	Michael	Boccardo	Dairy Cares
Dr.	Martin	Burger	California Department of Food and Agriculture
Mr.	J.P.	Cativiela	Central Valley Dairy Representative Monitoring Program
Mr.	Scott	Couch	State Water Resources Control Board
Mr.	Ryan	Flaherty	Sustainable Conservation
Mr.	Justin	Gioletti	Robert Gioletti and Sons Dairy
Mr.	Matt	Harrison	California Air Resources Board
Mr.	Caleb	Harper	Dairy Management, Inc.
Dr.	Sean	Hurley	California Polytechnic University
Mr.	Kyle	Jones	Community Water Center
Dr.	Steven	Kaffka	University of California, Davis
Mr.	Chris	Kopman	Newtrient
Ms.	Manjeet	McCarthy	GoBiz
Ms.	Jennifer	Morales	California Department of Water Resources
Mr.	Ramon	Norman	San Joaquin Valley Air Pollution Control District
Mr.	Greg	Norris	Natural Resources Conservation Service
Mr.	Clay	Rodgers	Central Valley Regional Water Quality Control Board
Ms.	Renee	Pinel*	Western Plant Health Association
Ms.	Emily	Rooney*	Agricultural Council
Mr.	Paul	Sousa	Western United Dairies
Ms.	Sarah	Standiford	California Department of Food and Agriculture
Mr.	Aaron	Wickstrom	Wickstrom Dairies/Valsigna Farms

*Unable to participate after the first MRIP meeting on October 26, 2021, or participate in subsequent recommendation development, discussion, or polls.

MRIP Work Group Membership

Conventional Strategies	Compost Strategies	Denitrification/Treatment	Nitrogen Capture
Clay Rodgers Greg Norris J.P. Cativiela* Justin Gioletti Paul Sousa Scott Couch Stephen Kaffka	Aaron Wickstrom Jennifer Morales Kyle Jones Martin Burger* Ramon Norman Ryan Flaherty Sarah Standiford Scott Couch	Chris Kopman Clay Rodgers Greg Norris J.P. Cativiela Justin Gioletti Martin Burger Paul Sousa* Sean Hurley	Aaron Wickstrom Caleb Harper* J.P. Cativiela Kyle Jones Manjeet McCarthy Michael Boccardo Sarah Standiford

*Denotes Work Group Lead

MRIP Staff and Consultant Team:

Title	First	Last	Organization
Ms.	Alyssa	Louie	California Department of Food and Agriculture
Ms.	Roberta	Franco	California Department of Food and Agriculture
Mr.	Dave	Ceppos	Consensus and Collaboration Program, Sacramento State University
Mr.	Sam	Magill	Consensus and Collaboration Program, Sacramento State University

**California Department of Food and Agriculture
Manure Recycling and Innovative Products Task Force**

Appendix C: FINAL CHARTER

December 2, 2021

Section 1 - Introduction

This Charter defines the Manure Recycling and Innovative Products (MRIP) Task Force (Task Force or MRIP) convened by the California Department of Food and Agriculture (CDFA). It describes the Task Force’s purpose, structure, membership, staff, roles and responsibilities, decision-making procedures (as applicable), communication protocols and operating guidelines.

Section 2 - Project Background

CDFA has convened the Task Force to develop recommendations on how to recapture and enhance the value of dairy manure while supporting healthy soils, protecting water quality and reducing agriculture’s carbon footprint in California. By March 2022, the Task Force will develop and deliver to CDFA, interim recommendations. The Task Force will continue work through spring and summer 2022 and will prepare and present a final report to CDFA in fall 2022. As defined by CDFA, interim and final Task Force recommendations are expected to:

- Increase the understanding of the scale and distribution of nitrogen surplus on dairies and potential demand from other crops for nitrogen and other manure nutrients.
- Identify research, technical and policy actions that encourage innovations to recycle surplus nutrients for use in agriculture; creating a circular fertilizer/soil amendment economy that builds healthy soils, conserves and protects water, and makes our state’s agriculture more sustainable.
- Organize short, mid, and long-term potential solutions and create a roadmap for continued progress, including estimates of time and resources necessary to achieve research, policy, technology development, and education/outreach objectives.

NOTE: This Charter does not carry any regulatory or legal authority. Although participation in the MRIP is voluntary at all times, MRIP Members agree to abide by the stipulations set forth in this Charter.

Section 3 – Draft Schedule [In production]

Date	Meeting Description
10-26-21	MRIP kickoff meeting. Confirm governance/decision-making structure, guiding principles, and key content/topics for recommendation development.
12-2-21	Introduce and refine work group process; begin developing work group questions to shape MRIP recommendations.
1-26-22	Introduce initial recommendations and refine.
2-23-22	Review revised recommendations and discuss next steps for submittal to Secretary.

Section 4 - Task Force Organization

This section of the Charter describes the Task Force organization and Member (Member) selection methods, responsibilities, replacement protocols, staff/consultant responsibilities, public participation methods, and decision-making protocols for the MRIP.

4.1 – Task Force Membership.

The MRIP represents a comprehensive cross-section of stakeholders directly affected by and/or involved in the production, use, research, marketing, and regulation of dairy cattle manure products. Time, budget, and size considerations mandate that a stakeholder group such as the MRIP must be a representative and manageable cross-section of interests rather than an exhaustive collection of all parties invested in the utilization of manure-derived products. No stakeholder group can be completely inclusive. As such, the Secretary of CDFA approved a cross-section of stakeholders for MRIP membership. The complete membership list of the MRIP (and associated staff) is presented in Appendix A.

4.2 – MRIP Topic Workgroups

In addition to the full Task Force, it is expected that the MRIP will form topic-specific workgroups. The purpose of workgroups will be for a subset of Members and/or recommended subject matter experts to review information and formulate recommendations and reports for consideration by the full MRIP. These workgroups are not vested with any formal decision-making authority but will assist in the development of recommendations between plenary MRIP meetings as a means to expedite the MRIP process. Detailed descriptions of a workgroup’s responsibilities (as assigned by the full MRIP) will be developed by the Co-Chairs (described below) in consultation with MRIP Members and with support from the facilitation team (described below). Said assignments will be defined as “Charges” and will be delivered by the Co-Chairs to a convened workgroup as the binding guidance for their work.

Workgroup membership will be limited to the following parties:

- MRIP Members
- Subject Matter Experts recommended by MRIP Members and approved by the Co-Chairs.

4.3 MRIP Member Responsibilities

MRIP Member Participation: Members will attend all meetings as feasible; report back to the constituencies / colleagues they represent; and communicate these constituencies’ interests, concerns, and recommendations to the MRIP. Members are expected to review materials and provide comments in a timely manner. By being aware of their constituency’s concerns and providing comments on applicable MRIP materials, Members will greatly enhance the efficiency of the MRIP process and will minimize time delays, constraints and impacts on themselves and fellow Members.

As stated above, consistent representation from all organizations involved in the MRIP is essential for the success of the effort and Members will participate in all meetings as feasible. However, it is reasonable to assume Members may need to occasionally miss an MRIP meeting (including providing official decision-making input on behalf of his or her organization). If a Member cannot attend a meeting, they are responsible to review the relevant materials and notes, and then provide their perspectives to the Co-Chairs and/or facilitators prior to the next meeting and/or decisions being made. Members may assign someone to attend any meeting in a “listen only mode”, take notes, and report back the outcomes to the Member (in addition to the formal meeting summaries that will be prepared by the facilitation team).

MRIP Member Replacement: Due to the urgent nature of the MRIP’s work and its charge set forth by CDFA, it is not optimal to replace Members once the process has started. That said, if a Member is no longer able to participate in MRIP activities, he or she will notify in writing, their appointing entity, the MRIP Co-Chairs and CDFA of their resignation and will recommend a replacement. CDFA will evaluate the recommended replacement and will either work with the appointing entity of the replacement to seat said new Member, or will reject said recommendation and select a different representative to serve the same or similar interests as the Member that resigned. In either circumstance, the CDFA Secretary will contact the proposed replacement in writing, requesting their participation in the process.

In coordination with the MRIP Co-Chairs, the facilitator will coordinate new Member orientation utilizing the process for new appointments listed below. All Members should maintain a comprehensive record of their activities and personal work to be passed along to a replacement, if necessary. All new Members will be added in accordance with this Charter and will serve at the direction of their appointing organizations and in the context of Task Force operations and governance defined in this Charter.

The facilitator will work with the new Member during the orientation process to ensure that the replacement agrees to:

- Commit the time necessary to be an active Member of the MRIP.
- Accept all MRIP recommendations to date and acknowledge that items previously agreed on by the MRIP will not be revisited.

4.4 Co-Chair Assignments and Responsibilities

CDFA has assigned the following Members to be the MRIP Co-Chairs:

- J.P. Cativiela, Administrator of the Central Valley Dairy Representative Monitoring Program
- Ryan Flaherty, Director of Business Partnership at Sustainable Conservation

The Co-Chairs or facilitator will circulate meeting materials and agendas. Agendas will be sent out five (5) working days prior to a pending meeting, and pre-read materials will be sent out in accordance with length of the materials, ensuring adequate time for Members to review. In addition to the above, the Co-Chairs will:

- Call attention to and differentiate between their Co-Chair leadership roles and as active subject matter experts / Task Force Members when participating in MRIP discussions, straw polls or final decisions (see below for further descriptions).
- Serve as liaison between the MRIP, CDFA Secretary and staff and will act as a conduit of information between the two.
- Provide editorial review and oversight of MRIP recommendations in the interim and final MRIP reports.
- Provide regular updates on the research, policy priorities, and other factors impacting the work of the MRIP.
- Make time critical decisions supporting the MRIP process, as advised on by representative MRIP Members (when feasible).

4.5 Facilitator Responsibilities

Additionally, CDFA has contracted the Sacramento State, Consensus and Collaboration Program (CCP) to serve as neutral facilitator in administrative and meeting support to the Co-Chairs and the Task Force writ large. The facilitator will support the Co-Chairs to develop agenda topics and other materials in advance of each meeting. CCP will also provide broader facilitation services to support the MRIP process. The facilitator and facilitation team serve as a “professional neutral” whose primary responsibility is to ensure a process where all participants’ interests, views, and opinions are heard and thoughtfully considered. Specific responsibilities of the facilitator include:

- Design and conduct a consensus-seeking decision-making process (see Section 4.6).
- Support the Co-Chairs to facilitate meetings and generate draft and final agendas and meeting summaries.
- Work with meeting presenters and presentations to ensure they are timely and informative to MRIP needs.
- Capture the range of views and ideas presented by Members and report on where there are areas of agreement and differences.
- Assure that MRIP Members have adequate time to respond to information or requests submitted between meetings.
- Coordinate development of the interim and final recommendation reports.
- Assist CDFA staff to coordinate MRIP activities with other organizations and programs (if needed).
- Facilitate regular, standardized updates at all MRIP meetings from other agencies and activities impacting the MRIP’s work. These updates will be a standing agenda item at all MRIP meetings.
- Faithfully capture all MRIP comments and recommendations in summaries and other work products.

4.6 Decision-Making Protocols

As stated in Section 2, the MRIP will prepare and deliver interim recommendations to CDFA by March 2022. It will then continue work through the spring and summer of 2022 and will prepare and deliver final recommendations to CDFA in fall 2022. In the context of the expedited time period between MRIP inception and March 2022 and the further work thereafter, the MRIP will employ a two-phase discussion and decision-making process as described below

4.6.1 – Phase 1 - Discussion and Decision Methods from October 2021 to March 2022

Consistent with the MRIP Guiding Principles (see Appendix B), during Phase 1, the Task Force will focus on initial discussions about policies and regulations, financial, technical and environmental impact topics with an intent to define initial recommendations. In this context, the MRIP's work will focus on developing topic-specific workgroups and their associated Charges, and subsequent plenary discussions by the MRIP to prepare its interim recommendations. Limited if any, use of decision-making protocols will be for administrative decisions and the selection of and direction to, topic workgroups. Should decision-making be conducted, the MRIP will use the protocols described below in Section 4.7.2.

4.6.2 – Phase 2 - Discussion and Decision Methods from April to September 2022

The long-range goal of the MRIP is to develop recommendations for CDFA to use to support innovative, financially feasible, environmentally compliant development of manure-based fertilizer and soil amendment products in the near and long-term. These recommendations should be arrived at by consensus whenever possible as a means to clearly reflect for State agency and legislative decision-makers, the level of support MRIP recommendations carry. For the purpose of the MRIP, consensus is defined as unanimous agreement by all voting MRIP members. Given the timeframe of the process, the complexity of the associated topics and the diversity of the MRIP, consensus may not be feasible on some topics. Therefore, the MRIP will *seek* consensus, rather than be mandated to *achieve* consensus on all topics. The decision to proceed with a recommendation absent a consensus will be based on discussions between the Co-chairs, CDFA staff and the MRIP; however, final determination on whether to continue seeking consensus will be made by the Co-Chairs. If consensus is not reached on a given topic, the range of recommendations supported by different Members will be documented in meeting summaries and the interim and final reports. To achieve this approach, the MRIP is expected to use the following decision-making protocols in Phase 2 (NOTE: This will be subject to discussion and decision by the MRIP in March 2022 as a means to either confirm its intent to use such protocols, or to proceed with Phase 2, absent the use of said protocols)

The consensus decision rule is based on principles of "consensus with accountability." Consensus with accountability requires all MRIP Members try to reach consensus, while always supporting and expressing the interests of their appointing entities. In the event a Member must reject a proposal, that Member must provide a counter proposal that legitimately attempts to achieve their interest and the interests of the other Members. The MRIP will not seek to identify numeric "winners and losers" on key topics. Rather, the MRIP will seek mutually acceptable conclusions. In seeking consensus on any interim or final recommendations, Members will voice their opinions with specific proposals along the way, rather than waiting until a final recommendation has been developed. The basic decision-making process will be as follows:

- Quorum: No decisions will be made unless a quorum of MRIP Members is present. A quorum is defined as 50% of the full membership of the MRIP plus one additional Member.
- Straw Polls: Members will use straw polls to assess the degree of preliminary support for an idea before it is submitted to the MRIP for a formal action / decision as described below. Straw polls will be conducted by the facilitator by asking each Member for tentative approval and initial support/concern without taking a formal “vote.” Members may indicate only tentative approval for a preliminary proposal without fully committing to its support and are not expected to provide an alternative beyond their reason for concern in the event they are unable to provide tentative approval.
- Draft and Final Decisions: The MRIP will use the following four positions to indicate Member’s degree of support for any proposal being considered and to determine if consensus has been achieved.
 - Do Not Support: I do not agree with the proposal. I feel the need to block its adoption *and* propose an alternative.
 - Conditionally Support: I am not enthusiastic about the proposal, but I can accept it.
 - Support: I support the proposal.
 - Abstention: At times, a Member may wish to abstain from a decision milestone. Rationale for abstention could include but may not be limited to: a topic that has statutory implications that an agency representative cannot be on record conflicting with; a Member cannot get a consensus of his/her appointing agency or organization. Any abstention will be documented. Providing that a quorum of the MRIP is present, abstention does not prohibit reaching consensus.

The goal in pursuing “consensus with accountability” is for all Members to be in the ‘Support’ or ‘Conditionally Support’ levels of agreement. The MRIP will be considered to have reached consensus if all Members participating in a decision are at those two levels. If any Member is at a ‘Do Not Support’ level, that Member will provide a counter proposal that legitimately attempts to achieve their interest and the interests of the other Members. If consensus is not reached, the differing alternatives and perspectives will be documented in the meeting summary and subsequently in the interim and final reports. Members abstaining from particular proposals are encouraged to explain why abstention is in their best interest. The MRIP will not revisit previously agreed to recommendations or alternatives unless new information would likely affect the MRIP’s previous work.

4.6.3 Agency Member Role

To accommodate agency protocol needs, it is assumed (unless otherwise noted) that all State and federal agency representatives will either defer to an “Ex Officio” status for the MRIP process or will collectively agree to simply abstain from all MRIP content-related proposals and recommendations. Said agency staff are expected to vote on any administrative items such as process scheduling, workgroup charges, workgroup participant recommendations and similar. All agency staff are expected to nonetheless fully participate and speak to their agencies’ interests at all times as a means to fully inform the full MRIP on agency perspectives.

All other MRIP Members are expected to vote on all items.

4.7 Communication Protocols

MRIP Members will make a concerted outreach effort to communicate regularly with their agencies and/or constituencies and colleagues to keep them informed about the process and the issues under discussion. Constituents wanting to provide input to the process are encouraged to communicate through their MRIP Member. MRIP Members are not prohibited from speaking with the media but must indicate that they are not speaking for the entire MRIP unless specifically asked or directed to do so by the MRIP through a consensus-seeking decision. Members should neither characterize the positions and views of any other Member and CDFA, nor should they ascribe motives or intentions to the statements or actions of other MRIP Members and/or CDFA.

4.8 Meeting Summaries

Meeting summaries serve as a critical record of recommendations and decisions made by the MRIP and will be an important tool to compile the interim and final reports. The facilitators will develop DRAFT meeting summaries and distribute to the MRIP for comment within two (2) weeks of each meeting. MRIP Members will have an additional week to provide comments. Facilitators, the Co-Chairs and CDFA will review comments, revise the summary, and distribute a DRAFT FINAL version to the MRIP with the agenda packet for the next meeting. To ensure consistency, summaries will not be considered FINAL until formally adopted by the full MRIP at its next meeting.

Section 5 – MRIP Operating Guidelines

All MRIP Members, staff, the facilitator, and public participants of a meeting agree to:

- Arrive promptly to all meetings and be prepared to participate in all items on the meeting agenda.
- Stay for the duration of the entire meeting.
- Turn cell phones to silent.
- Minimize actions that could be distracting to MRIP discussions. Should any meeting attendee behavior (Members or public participants) become distracting to the MRIP as a whole, individuals noticing such behavior should communicate with the facilitator to intervene.
- Participate in a problem-solving approach based on respectful and constructive dialogue, where the interests of all Members and the public are considered in developing proposals and recommendations.
- Openly discuss issues with other Members who hold diverse views and acknowledge and seek clarification of other perspectives,
- Verify assumptions impacting the MRIP's work through the Co-Chairs when necessary.
- Assure that all Members are heard, and that one person speaks at a time. Refrain from side conversations. Address all comments through the Co-Chairs or facilitator.
- Keep commitments once made.
- When appropriate, distinguish between personal and organizational perspectives.

Appendix D: Recent Dairy Manure Compost Research and Data

Technical **MEMORANDUM**

Environmental Management Consulting

41125 278th Way SE, Enumclaw, WA 98022 USA

Phone: 360-802-5540 trcard@EnvManCon.com

TO: Milk Producers Council
FROM: Tom Card
Chuck Schmidt
DATE: August 29, 2022
SUBJECT: Dairy Manure Composting
Air Emissions

Draft

Background

Two Technical Memoranda have been prepared (attached) that provide a summary of previous air emission data on two dairy manure source types from California. The first type are separator solids. This is essentially the cellulose left over from the cattle feed. It is very inert and very homogeneous. The second source are 'corral scrapings'. This is the manure removed from turnout paddocks. It is periodically removed, varying from weekly to semi-annually. It is very dry for most of the year.

Likely Air Emissions from Composting Dairy Manure

Based on the data shown in the attached Memoranda, the likely emission factor from dairy manure composting will range from

- 0.01 to 0.25 lb VOC/ton compost mix and
- 0.003 to 1.5 lb ammonia/ton compost mix.

Facilities that compost predominantly separator solids will be at the low end of this range and facilities that compost mostly corral scrapings will be at the higher end of this range. Based on our experience evaluating compost air emissions, we are confident that over 90% of the facilities will land in this range if they employ traditional composting Best Management Practices.

None of the data was taken shown in the attached Memoranda was taken from full scale commercial composting facilities. However, the data is of very high quality and consistent from dairy to dairy as well as stockpile conditions to pilot scale composting. These are some the reasons why we are anticipating that this data will be representative of full scale operation include:

- One the primary causes of high emissions from composting is poor mixing. The manure material is very homogeneous, therefore mixing, one of the major composting operational challenges, is not a concern.
- It consistently shows low VOC emissions in all measured conditions.
- The material is very consistent from day to day/year to year allowing for very consistent compost operations.
- The composting process rate can easily be controlled by water addition.

TO: Milk Producers Council
FROM: Tom Card
Chuck Schmidt
DATE: August 29, 2022
SUBJECT: Dairy Manure Corral Scrapings
Air Emissions

Draft

Background

Many dairies have turnout paddocks that accumulate dry manure. This manure is colloquially called ‘corral scrapings’. The material is removed periodically, from weekly to semi-annually. The material is very dry for most of the year in California.

Existing Data on Corral Scrapings Emissions

There are two existing data sets that quantify emissions from corral scrapings. They are reported below. All data quantified for VOC was by SCAQMD Method 25.3 and ammonia by SCAQMD Method 207.1.

[SJVAPCD/CARB Dairy Emissions Study](#)

This study was the foundation of the dairy emissions policy for SJVAPCD. It occurred between 2004 to 2008. Regarding corral scrapings, Table 1 shows the data obtained.

Table 1. Relevant Corral Scrapings Data from the SJVAPCD/CARB Dairy Study.

	VOC		Ammonia
	Raw Flux		Raw Flux
Item	ug/m2-min		ug/m2-min
Turnout; wet	341		7,931
Turnout; urine	133		45,777
Turnout; Rep 4"	497		2,310
Turnout; Rep 6"	1,147		11,127
Turnout; fresh	378		693
Turnout; Rep 1"	183		3,042
Scraped, 1"	149		212
Scraped, 1"	100		46
Scraped, 1"	84		169
Harrowed, 2"	115		1,001
Harrowed, 3"	167		924
Harrowed, 2"	138		732
Unscraped #1	96		258
Replicate	103		227
Unscraped #2	144		655

SJVAPCD/UC Davis-Tulare Cow Mortality Management Study

This study conducted in 2009 quantified the air emissions from composting livestock carcasses. For control purposes, dairy corral scrapings were composted without carcasses. Table 2 summarizes the relevant data from that study.

Table 2. Relevant Dairy Corral Scrapings Composting Data from the 2009 Cow Mortality Study.

Item	VOC	Ammonia
Average Flux (ug/m2-min)	550	2,530
Corral Scrapings (lbs/ton composted)	0.25	1.53

Discussion

Table 3 shows the current composting emission factors for SJVAPCD (note there is none for composting corral scrapings). The VOC emission factor values for composting dairy corral scrapings are significantly lower, by about a factor of 15, than the Organic Material Composting Emission Factor of 3.58 lb/wet ton greenwaste and about a factor of 7 lower than the Manure composting emission factor of 1.78. This is due to the inert nature of the corral scrapings material.

Using the operating scenario as provided (windrow 650' by 10' at 8' high, over a three week drying/composting process) and using the provided flux data for corral scrapings, the emission factor (estimate) for composted corral scrapings could be as low as 0.11 lb/wet ton (approx. 16 times lower than the SJVAPCD manure emission factor using this operational scenario).

Table 3. Current Composting Emission Factors for SJVAPCD.

Operation Type	Emission Factors	
	VOC	NH ₃
Organic Material Stockpile*	0.2 lb/wet ton/day	0.02 lb/wet ton/day
Biosolids, Manure, Poultry Litter, and Co-Compost Stockpile	0.02 lb/wet ton/day	0.001 lb/wet ton/day
Organic Material Composting**	3.58 lb/wet ton	0.78 lb/wet ton
Biosolids, Manure, and Poultry Litter, and Co-Composting**	1.78 lb/wet ton	2.93 lb/wet ton

* The organic material stockpile EF shall be used for the following types of organic material stockpiles: green waste, 15% food waste, and grape pomace.

**Emission Factors represent the entirety of the composting cycle, i.e. start of the active phase through completion of the curing phase.

Conclusions

Dairy corral scrapings are very inert and have very low air emissions. When composted, they are about a factor of up to 16 times lower than the current SJVAPCD VOC emission factor for manure. When dairy corral scrapings are co-composted with green waste, it is anticipated that the combined material will have lower emissions than composting green waste alone.

TO: Milk Producers Council

FROM: Tom Card
Chuck Schmidt

DATE: August 29, 2022

SUBJECT: Dairy Manure Separator Solids
Air Emissions

Draft

Background

Flush lane dairies pass the flush lane drainage stream through a screening system prior to discharge into a holding lagoon. These solids from the screening process are known as separator solids. These solids are mostly cellulose fiber from the livestock feed.

Existing Data on Separator Solids Emissions

There are two existing data sets that quantify emissions from separator solids. They are reported below. All data quantified for VOC was by SCAQMD Method 25.3 and ammonia by SCAQMD Method 207.1.

SJVAPCD/CARB Dairy Emissions Study

This study was the foundation of the dairy emissions policy for SJVAPCD. It occurred between 2004 to 2008. Regarding separator solids, Table 1 shows the data obtained. Note that this is all in situ data for wet separator solids stockpiles adjacent to the separator screen.

Table 1. Relevant Separator Solids Data from the SJVAPCD/CARB Dairy Study.

Item	VOC	Ammonia	Notes
	Raw Flux ug/m2-min	Raw Flux ug/m2-min	
Sep Solids #2	113	54	54 was the MDL, the sample was non-detect
Sep Solids #3	117	54	54 was the MDL, the sample was non-detect
Loc #3 Replicate	178	166	
Average	136	91	

[SJVAPCD/UC Davis-Tulare Cow Mortality Management Study](#)

This study conducted in 2009 quantified the air emissions from composting livestock carcasses. For control purposes, dairy separator solids were composted without carcasses. Table 2 summarizes the relevant data from that study.

Table 2. Relevant Dairy Separator Solids Composting Data from the 2009 Cow Mortality Study.

Item	VOC	Ammonia
Average Flux (ug/m2-min)	58	15
Emission Factor (lbs/ton composted)	0.041	0.011

Discussion

Table 3 shows the current composting emission factors for SJVAPCD (note there is none for composting separator solids). The VOC emission factor values for composting dairy separator solids are significantly lower, by about a factor of 90, than the Organic Material Composting Emission Factor of 3.58 lb/wet ton greenwaste and about a factor of 40 lower than the Manure composting emission factor of 1.78. This is due to the inert nature of the separator solids material.

Using the operating scenario as provided (windrow 650' by 10' at 8' high, over a three week drying/composting process) and using the provided flux data for separator solids, the VOC emission factor (estimate) for composted separator solids could be as low as 0.011 lb/wet ton (approx. 160 times lower than the SJVAPCD Manure emission factor using this operational scenario).

Table 3. Current Composting Emission Factors for SJVAPCD.

Operation Type	Emission Factors	
	VOC	NH ₃
Organic Material Stockpile*	0.2 lb/wet ton/day	0.02 lb/wet ton/day
Biosolids, Manure, Poultry Litter, and Co-Compost Stockpile	0.02 lb/wet ton/day	0.001 lb/wet ton/day
Organic Material Composting**	3.58 lb/wet ton	0.78 lb/wet ton
Biosolids, Manure, and Poultry Litter, and Co-Composting**	1.78 lb/wet ton	2.93 lb/wet ton

* The organic material stockpile EF shall be used for the following types of organic material stockpiles: green waste, 15% food waste, and grape pomace.

**Emission Factors represent the entirety of the composting cycle, i.e. start of the active phase through completion of the curing phase.

Conclusions

Dairy separator solids are very inert and have very low air emissions. When composted, they are about a factor of up to 160 times lower than the current SJVAPCD VOC emission factor for manure composting. When dairy separated solids are co-composted with green waste, it is anticipated that the combined material will have lower emissions than composting green waste alone.