Public Comment Form

Cascade County Public Works Department Planning Division
121 4th St N, Suite 2H-2I Great Falls, MT 59401
Phone: 406-454-6905 | Fax: 406-454-6919
Email: planningcomments@cascadecountymt.gov

Instructions

This form is for providing public comment to the Cascade County Planning Division for review by any one or more of the following review and/or approval boards: Zoning Board of Adjustment (ZBOA), Planning Board, or Board of County Commissioners. Only complete submissions will be included for board review. Please provide the relevant information for each section below. A complete submission provides all of the following: commenter name and address, comment subject, and commentary on the subject issue(s). If additional space is needed for commentary, please attach additional sheets to this form. Completed forms may be submitted in person at the Planning Division office or by email at planningcomments@cascadecountymt.gov.

Commenter Information

Name: Terra Davis

Complete Address: 729 27th ave NE

Comment Subject (please check one):

- ☒ Special Use Permit Application
- ☐ Subdivision
- ☐ Zoning Text and/or Map Amendment
- ☐ Growth Policy
- ☐ Variance
- ☐ Floodplain Regulation Amendment
- ☐ Subdivision Regulation Amendment
- ☐ County Road Abandonment/ Discontinuation of County Street
- ☐ Other (describe): _____

Comment

Big Sky Cheese, LLC-
I think the city of Great Falls should go ahead and give a clear yes to this one. Montana needs something to be proud of and Great Falls needs to be known for something other than the Air Base. It will also be very beneficial to everyone locally and around the state. Plus it will give local people a permanent important job where they know that every part of the business is enviornmentally good. Using clean energy to reduce gases and clean water coming in and going out. I have complete confidence in Mr Friesen and confidence that Big Sky Cheese will be an investment that will bring in consumers to the community of Great Falls. Businesses will thrive!

For Office Use Only					
Date Received:	5-24-19	Date Reviewed:	5-24-19	Complete:	☒ Yes ☐ No

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Commenter Information

Name: Renae Munson

Complete Address: Great Falls, MT 59401

Comment Subject (please check one)

- ☐ Special Use Permit Application
- ☐ Subdivision
- ☐ Zoning Text and/or Map Amendment
- ☒ Growth Policy
- ☐ Variance
- ☐ Floodplain Regulation Amendment
- ☐ Subdivision Regulation Amendment
- ☐ County Road Abandonment/ Discontinuation of County Street
- ☒ Other (describe): PHASE 1 of Massive Slaughterhouse - Big Sky Cheese.

Comment

See attached. NO to Phase I - Big Sky Cheese

NO

NO

NO

For Office Use Only						
Date Received:	5-21-19	Date Reviewed:	5-23-19	Complete:	☐ Yes	☒ No

May 21, 2019

Cascade County Courthouse
Attn: Commissioners Jane Weber, Joe Briggs, Jim Jay Larson
Great Falls, MT 59401

Re: Proposed Big Sky Cheese Plant – Phase I of Slaughterhouse

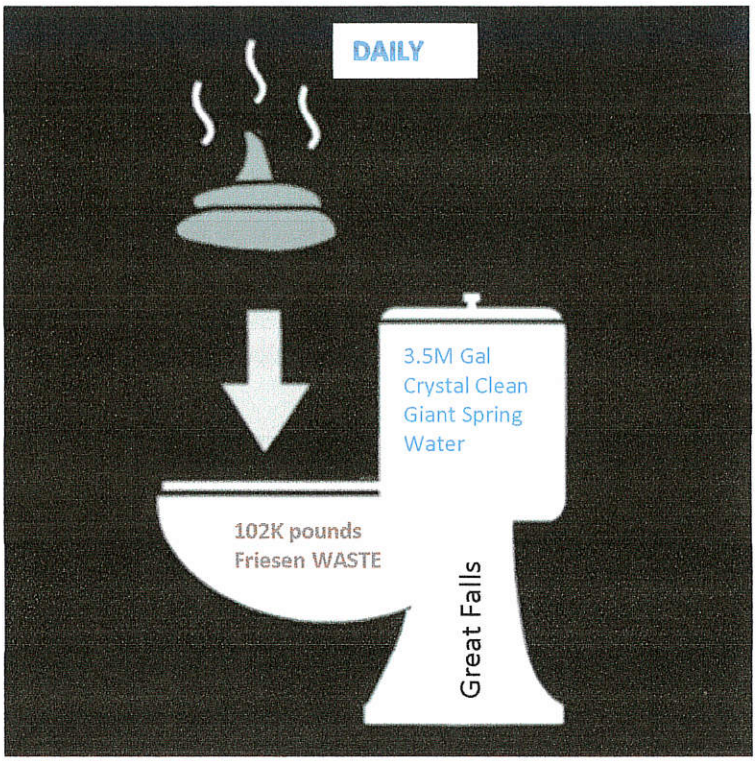
Hello,

I am writing to passionately protest and actively object to the planned slaughter plant known as Madison Food Park by Friesen Foods, LLC including Phase I, Big Sky Cheese. It is common knowledge that this industry offers low wage jobs that forces them to recruit and hire among the vulnerable population. The impact to the city of Great Falls will be DEVASTATING. Todd Hanson stated there would be 12K "New Residents" with 40% turnover that'll by 12K new residents every 3 YEARS. Studies show the larger the slaughterhouse the larger increase in VIOLENT CRIME. Due to violent desensitizing work environment where workers are given strenuous expectations to vulnerable workers who don't have many employment options due to language or skill issues.

Is Friesen going to pay for another jail and more law enforcement? Are you Jane Weber, Joe Briggs and Jim Larson going to bear the blame for our charming sweet community turning into a toilet with the smells and all.

CAFOs drive the price of livestock down eventually forcing longtime family farms and ranchers out of business. There are USDA charts that illustrate this scenario…where over time there are less farmers producing more livestock. Keyword…LESS farmers/ranchers.

Cascade County residents and taxpayers do NOT want to used as Friesen's toilet. Where he gets to use 3.5M gallons of our crystal clean water and we get 100K pounds of waste all the while asking Great Falls Citizens to supply the toilet paper (infrastructure, prisons, crime, roadways, potholes, 165 feces spewing semis a wk).



REMITTANCES: You can NOT grow our community with foreigners, any money they make …they send it to their home countries. Foreign owned business, employing foreign workers, to supply food to foreigners. All we are is the toilet. Great Falls is too nice to be someone's TOILET.

I urge you, as a concerned citizen whose family has lived here for 120 years, to protect our city and preserve our quality of life by passing zoning laws that will prevent any phases of one of the largest slaughterhouses in our nation along with CAFOs to be built in Cascade County.

Cordially,

Renae Munson
Great Falls, MT 59401

From: Kate Buckles <kate.a.buckles@gmail.com>
Sent: Tuesday, May 21, 2019 7:16 AM
To: Planning Comments <planningcomments@cascadecountymt.gov>
Subject: Cheese Processing Facility

Please do not make zoning changes that would allow Freisen to open a cheese processing facility into our community!!! Anyone who thinks this is a good has not done their homework!!! Currently Great Falls is a nice place to live. Letting this type of industry in would change all that. All you have to do is look at other communities where they have set up shop.

When they first announced their plans they said they would start with a cheese facility. Please DO NOT let them get a toenail in the door!

Our city is not the only thing that would change. Our small farmer/ranchers will be forced out of business. Just look at what happened to the dairy industry when industrial ag took that over! No little guys left today.

I am concerned that this has gone on this long and that you are even considering letting this monster in. This is the last best place! Let's keep it that way! Don't open the door!!!

Thank you
Kathy Buckles
5219 2nd Ave. North
Great Falls, MT. 59405

Sent from my iPhone

FOR OFFICE USE ONLY

Date Received: 5-21-19
Date Reviewed: 5-21-19
Complete: ☒ Yes ☐ No

1401 3rd West Hill Drive, Great Falls, MT 59404
406-315-1952
marilyncron@yahoo.com

Dear Commissioner Weber,

I consider the importance of great minds from the past who left a vision of a great legacy for future generations by some of the following actions; sustaining open spaces, landscapes, clean water and clean air. They did this without selling our health away to large industrialized animal production and other heavy industries. Personally I am wondering how you have lost this vision. We must not go down the broad path of swiftly selling our future away. You and the other Commissioners, as duly elected officials who represent our best interests, need to start walking the narrow path of saying 'NO' and protecting our citizens and the health of our land, water, and air that we all share.

Your own objectives, posted on line, state in multiple goals some of your job(s) are to: "Assure clean air, clean water, a healthful environment and good community appearance." And additionally state: "Protect surface and ground water quality from pollution." This will not happen by allowing a 'food park' in our county.

With this in mind, and other issues of road wear and abuse, school overcrowding, and lack of local people to employ, you must begin walking the narrow path of saying 'NO' to dollar bills and yes to clean air, clean water and a healthy environment for now and for the legacy of future generations. Common sense demands that you do this and nothing less to protect the great legacy we have been gifted with.

Regards,

Marilyn Cron

Copy to: jweber@cascadecountymt.gov, marilyncron@yahoo.com

FOR OFFICE USE ONLY

Date Received: 5-10-19

Date Reviewed: 5-10-19

Complete: ☒ Yes ☐ No

May 10, 2019

Planning Committee
planningcomments@cascadecountymt.gov

Dear Planning Committee,

I am so annoyed at the irresponsible behavior the commissioners are showing by even considering the impact of this so called food park. You haven't thought long term at all about the consequences of allowing this monstrosity into our county. You haven't researched the impact of the waste from animals on water quality, not to mention the smells that you want to encumber our city and county with.

The impact on the roads, on schools, on police, increasing taxes, and on cleaning the filth from animals being transported through our city is a negative and enormous consequence that you say we will all allow. This is not the truth at all, the truth is that someone has been offering something to benefit only a few at the expense of the rest of us in the county. This needs to stop now and you need to stop it. This irresponsible behavior is solidly being placed in your lap, like a pile of dung that you are trying to force us to have in our laps.

I plan on a negative vote in the next election for the commissioners that are trying to hide the truth behind this pollution.

Frank Cron

406-315-1952

cronpipe@yahoo.com

1401
3rd
West
Hill
Drive
Great
Falls,
MT

FOR OFFICE USE ONLY

Date Received: 5-10-19

Date Reviewed: 5-13-19

Complete: ☒ Yes ☐ No

Compiled 06/27/2019

RECEIVED
05/01/2019

820 47th Street South
Great Falls, Mt 59405
April 30, 2019

County Planning Division Office
121 4th Street North
Great Falls, MT 59401

To Whom It May Concern:

Upon reading about the proposed Big Sky Cheese Processing Plant/MFP, my husband and I are very concerned about this project going forward.

As an educator and home owner for fifty years on the East End of Great Falls, we DO NOT want a quiet life-style to be interrupted by 35 trucks a week on 10th Avenue South. The anticipation of a slaughterhouse, the affect on the environment, and the decrease in property evaluation are great concerns! Montana is big enough! Why do any of these projects have to be in Great Falls?

Please reconsider!

Sincerely,

Doug Clanin

Doug Clanin

Rachel Clanin

Rachel Clanin

FOR OFFICE USE ONLY

Date Received: 5-1-19
Date Reviewed: 5-1-19
Complete: ☒ Yes ☐ No

From: webfeedback@cascadecountymt.gov <webfeedback@cascadecountymt.gov>
Sent: Wednesday, June 05, 2019 2:51 AM
To: _commission <commission@cascadecountymt.gov>
Subject: [cascadecountymt.gov] Contact Form Submission

I am very disappointed to learn that a cheese factory has been approved.

1. This is a very bad business deal. Cow dairy is dying and plant based milks are increasing rapidly
https://www.theguardian.com/news/2019/jan/29/white-gold-the-unstoppable-rise-of-alternative-milks-oat-soy-rice-coconut-plant

https://www.forbes.com/sites/bethkaiserman/2019/01/31/dairy-industry-plant-based-milks/#13d4683f1c9e

2. You and now responsible for helping to kill the planet and all life on it. Give it a few more years and maybe then you will get it and by then it will be too late.
The life a dairy cow is 5 years. Where do you think those cows go when it is time to kill them?

--
Mary Sarumi
mary.sarumi@gmail.com
613-294-7146

FOR OFFICE USE ONLY

Date Received: 6-6-19
Date Reviewed: 6-6-19
Complete: ☐ Yes ☒ No

Great Falls Public Schools

District Offices • 1100 4th Street South • P.O. Box 2429 • Great Falls, Montana 59403
406.268.6052 • www.gfps.k12.mt.us

May 17, 2019

Cascade County Public Works Department, Planning Division
121 4th St. N, Suite 2H/I
Great Falls, MT 59401

Dear Sandor Hopkins,

Great Falls Public Schools has received your letter in regards to the Special Use Permit (SUP) application number 066-2019 to allow for a Value-added Agricultural Commodity Processing Facility: Cheese Processing Plant located in Section 34 in Township 20N, Range 5E, Cascade County, Montana.

Thank you for sharing this information with our school district. This plant is not located within the Great Falls Public School District boundaries.

Sincerely,

Brian Patrick
Director of Business Operations
Great Falls Public Schools

From: Linda Metzger <legm7481@msn.com>
Sent: Wednesday, June 19, 2019 5:24 PM
To: Planning Comments <planningcomments@cascadecountymt.gov>
Cc: Weber, Jane <jweber@cascadecountymt.gov>; Briggs, Joe <jbriggs@cascadecountymt.gov>; Larson, James <jlarson@cascadecountymt.gov>
Subject: Comment on Big Sky Cheese Special Use Permit Application

Dear County Officials:

I oppose the SUP application for Big Sky Cheese, LLC primarily because it's the camel's nose in the tent for the slaughterhouse, which I oppose more strenuously.

It takes one hundred and sixty-one gallons of water for a cow to produce one gallon of milk. It takes two hundred and sixteen gallons of cows' milk to produce one hundred and eighty-two pounds of cheese. That's a lot of water in an arid climate, which is what much of northcentral Montana is.

Like most people, I like the umami taste of good dairy cheese...but that taste is now present in award-winning nondairy cheeses made from cashews, which are easier on natural resources and easier on human arteries.

Thanks for your consideration.

Linda Metzger, R.N.
32 Windy Ridge Lane
Great Falls, MT 59404

FOR OFFICE USE ONLY

Date Received: 6-19-19

Date Reviewed: 6-20-19

Complete: ☒ Yes ☐ No

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Email: planningcomments@cascadecountymt.gov

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Commenter Information

Name: Guy Tabacco

Complete Address: 3400 5th Avenue South Great Falls, MT.

Comment Subject (please check one):

- ☒ Special Use Permit Application
- ☐ Subdivision
- ☐ Zoning Text and/or Map Amendment
- ☐ Growth Policy
- ☐ Variance
- ☐ Floodplain Regulation Amendment
- ☐ Subdivision Regulation Amendment
- ☐ County Road Abandonment/ Discontinuation of County Street
- ☐ Other (describe): _____

Comment

Big Sky Cheese
I feel this would be a Great Addition for Great Falls. It is an agri based product which this town has always been known for. It will bring jobs to our community which we need. with all the federal, state, city & country regulations I don't see any issues that anyone should have concerns about that would not get addressed by one or if not by all of these departments, and I know there is more like DEQ who would also weight in on this project.
I belive Great Falls needs to get more industry into our city and why not have an agri based product

Look at Montana Egg and how it has grown in this community and how people didn't want that in this town
It's been a great company

For Office Use Only					
Date Received:	6/19/19	Date Reviewed:	6/19/19	Complete:	☒ Yes ☐ No

FOR OFFICE USE ONLY

Date Received: 6-20-19
Date Reviewed: 6-20-19
Complete: ☐ Yes ☒ No

Compiled 06/27/2019

June 18, 2019

Cascade County Planning Office
121 4th St. N., Suite 2 H/I
Great Falls, MT 59401.

Re: June 27th meeting concerning Big Sky Cheese

On the 27th of June, there will be a public hearing on Madison Food Park's principal owners intent to develop Big Sky Cheese. This is being called a value added dairy/cheese processing facility. In part, the facility would operate 260 days per year and employ 5 to 10 employees. I vehemently oppose this project for the following reasons:

- A bridge loan of $2.27 million of taxpayers dollars has been given to a foreign owned corporation to hire 5 to 10 workers for 240 days a year.

Why is our taxpayer dollars being spent on a foreign for-profit corporation in order to build a so called infrastructure? Why isn't the cheese plant paying this themselves? Why is the cost being billed to the city and county taxpayers for a for-profit corporation? Being that this plant will operate 240 days a year, how will the workers make financial ends meet on days the plant is idle? Will the workers have to apply for unemployment benefits, food stamps, rent assistance? Is this a wise use of $2.27 Million of our taxpayer dollars to fund a business that will only hire 5 to 10 workers?

- It takes 668 gallons of water to make one pound of cheese.

How will the waste water be treated when used for cheese production? How will the cheese plant dispose of this and other waste? What guarantee that this waste will not contaminate or poison nearby creeks, Missouri river, private water wells and the Madison Aquifer?

- I am of the opinion that Big Sky Cheese is a con job and ruse by Madison Food Park to get their foot in the door to build the slaughter plant.

I strenuously object to the planned nightmare of a slaughter plant known

as Madison Food Park by Friesen Foods, LLC. This nightmare of a plant would be built just 8 miles east of Great Falls. And only 2 miles east of MAFB. This slaughter plant will forever ruin Great Falls and the surrounding area with toxic air, water and noise pollution. Not to mention the damage to our quality of life.

Yes, our area needs "planned" growth. But not by allowing an industry known for it's toxic air, water and noise pollution. You, the Great Falls Planning Board needs to get your heads out of your back sides, wise up and recognizes that Madison Food Park does not have the best interest of Great Falls in mind or represent the people of Great Falls. Tell Ed Friesen "NO THANKS." And have him take this unbelievable nightmare to his own backyard in Canada.

I ask that you do not vote for this ruse of a cheese plant.

Carl Jurenka
Great Falls, MT
carljurenka@yahoo.com

FOR OFFICE USE ONLY

Compiled 06/27/2019

Date Received: 6/24/2019

Date Reviewed: 6/27/2019

Complete: ☒ Yes ☐ No

June 16, 2019

To: Cascade County Planning Board, 121 4th St. N, Ste 2H-21 Gt. Falls, MT 59401

Re: Public Comment Form on the Cheese Factory

I, Judson F. Burrows, think you gentlemen have a workable plan if this Cheese Factory is placed in the right location. It needs to be built on the industrial sight in between Malmstrom Air Force Base and Giant Springs and use Great Falls water system from the Missouri River.

Our fear is that where its proposed location is now (east of Gt. Falls on Hwy 89's 3,080 acres - "Madison Food Park") is just a "back door maneuver to creating Madison Food Park & thereby draining the Madison Aquifer.

Also, I would like to know where they propose to purchase the raw product, milk. A 600-cow dairy stinks as bad as a slaughterhouse, but if smaller dairy herds are spread out from Cascade to Raynesford, it would be acceptable.

I would also like to know why Cascade County and the city of Great Falls would be guaranteeing a loan (our taxpayer dollars) on an industry Canada already kicked out of Canada? Please answer this if you can.

P.S. I am in agreement with Kate McManon's Comments from MT. for Responsible Land Use.

Sincerely,

Judson F. Burrows
111 Fife Road
Gt. Falls, MT 59405

Public Comment Form

Cascade County Public Works Department Planning Division
121 4th St N, Suite 2H-2I
Great Falls, MT 59401
Phone: 406-454-6905 Fax: 406-454-6919

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Commenter Information

Name: GLORIA BURROWS

Complete Address: 111 Fife Road, GREAT FALLS, MT 59405

Comment Subject (please check one)

- ☐ Special Use Permit Application
- ☐ Subdivision
- ☐ Zoning Text and/or Map Amendment
- ☒ Growth Policy
- ☐ Variance
- ☐ Floodplain Regulation Amendment
- ☐ Subdivision Regulation Amendment
- ☐ County Road Abandonment/ Discontinuation of County Street
- ☐ Other (describe):

Comment Request clarification of following aspects of Cheese Factory:

1. Location of Cheese Factory?
2. How much water will be required for daily operation?
3. Which water source is expected to be used?
4. Where is the milk coming from?

I am in agreement with comments submitted by Kate McMahon, AICP, of Montanan's for Responsible land use.

For Office Use Only					
Date Received:	6-20-19	Date Reviewed:	6-20-19	Complete:	☒ Yes ☐ No

Cascade County Planning Office
121 4th Street North, Suite 2 H/1P
Great Falls, MT 59401
June 19, 2019

Re: June 27 meeting concerning Big Sky Cheese

To Whom It May Concern:

Why didn't the citizens of Cascade County get to VOTE on this Monstrosity of a Project in the first place??? Why do we have about a dozen people deciding for all of Cascade County what is best??? Yes, Big Sky Cheese is just a foot in the door to the Madison Food Park/Friesen Slaughterhouse!!!. Are our leaders getting a huge financial kick-back???

If this project is so GREAT, then why not build all of it in Canada??? Mr. Edward Friesen, please go home!!!

Great Falls Concerned Citizens

FOR OFFICE USE ONLY

Date Received: 6-20-19
Date Reviewed: 6-20-19
Complete: ☐ Yes ☒ No

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Commenter Information

Name: Kathleen McMahon

Complete Address: 151 Wedgewood Ln., Whitefish, MT 59937

Comment Subject (please check one)

- ☒ Special Use Permit Application
- ☐ Subdivision
- ☐ Zoning Text and/or Map Amendment
- ☐ Growth Policy
- ☐ Variance
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Comment

See Attachments in regards to SUP Application #006-2019:
Memo 3: ZBOA - Big Sky Cheese SUP - Memo 3- Growth Policy
Memo 4: ZBOA - Big Sky Cheese SUP - Memo 4 - Fire Protection

For Office Use Only					
Date Received:	6/25/2019	Date Reviewed:	6/27/2019	Complete:	☒ Yes ☐ No

To: Cascade County Zoning Board of Adjustments

From: Kathleen McMahon, AICP
Montanans for Responsible Land Use (MFRLU)

Date: 6-24-19

Re: SUO #006-2019, Big Sky Cheese
Memo #3 – Growth Policy Consistency

The Cascade County Zoning Ordinance, Section 10.6 states the following:

10.6 (5) The Proposed Development will be consistent with the Cascade County Growth Policy

Considerations:
(a) Consistency with the Growth Policy objectives for the various planning areas, its definitions of the various land use classifications and activity centers, and its locational standards.

The SUP application and the staff report did contain an analysis of the Growth Policy objectives. There was no analysis, however, on the various land use classifications and locational standards contained within the Growth Policy.

7.5 Land Unit: Landscape Unit Benches & Dissected Benches

1. Since the existing land use of the benches and dissected benches landscape unit is predominately agriculture, special consideration should be given to protect this use.

2. Any development or change in the use of the land should be in a form suited to the natural lay of the land.

3. Since a wide variability of limitations exists, extensive on-site evaluations should be made before any proposed action is taken.

8.3: Prime Agricultural Soil Area

The prime agriculture soils resource preservation areas are intended to contain those soil areas where it is necessary and desirable, (because of their high quality, availability of water, and/or highly productive agricultural and grazing capability), to preserve, promote, maintain and enhance the use of such areas for agricultural purposes and to protect such land from encroachment by non-agricultural uses, structures or activities. Therefore, the prime agricultural soil preservation areas of Cascade County are those areas where the soils have been classified by the Natural Resources Conservation Service (NRCS), according to the NRCS definition of prime farmland or farmland of statewide importance.

MFRLU request that the BOA table the proposed matter until such analysis regarding prime farmland is included as part of the SUP application.

To: Cascade County Zoning Board of Adjustments

From: Kathleen McMahon, AICP
Montanans for Responsible Land Use (MFRLU)

Date: 6-24-19

Re: SUP #006-2019, Big Sky Cheese
Memo #4 – Fire Protection

The Cascade County Zoning Ordinance, Section 10.6 states the following:

10.6 "**Before the Board of Adjustment can approve any Special Use Permit**, it must **FIRST** reach each of the following conclusion."

(1) Conditions may be required that the Zoning Board of Adjustment determines if implemented , will mitigate potential conflicts in order to reach these conclusions.
(2) The proposed development will not materially endanger the public health or safety.

Considerations:
(b) Provision of services and utilities, including sewer, water, electrical telecommunications, garbage collections, and fire protection.

The SUP Applications states the following regarding fire protection:

"Water for the dairy operations, fire flows and domestic usage will be supplied to the dairy via onsite wells, a series of transmission mains and storage tanks.
&
The water and wastewater systems for the site must be reviewed and approved by the Montana DEQ. Fire protection will be provided via onsite storage tanks and booster pumps."

Staff report responded as follows:

"Fire protection will be provided by Sand Coulee Volunteer Fire Department, and the applicant intends to provide on-site water storage and booster pumps to provide onsite fire protection."

There is no information regarding the well capacity or capacity of onsite storage tanks and if these will be adequate for fighting structure fires associated with industrial buildings. The National Fire Protection Association (NFPA) has a publication with such standards. (https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=22)

Recommendation
MRFLU recommends the BOA require that such onsite storage tanks and associated equipment be constructed with the NFPA standards (or other comparable state/federal standards) and that the design for such facilities be approved by the Sand Coulee fire Department prior to approval of the SUP.

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121 4th St N, Suite 2H-2I
Great Falls, MT 59401
Phone: 406-454-6905 Fax: 406-454-6919

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Commenter Information

Name: Kathleen McMahon

Complete Address: 151 Wedgewood Ln., Whitefish, MT 59937

Comment Subject (please check one)

- ☒ Special Use Permit Application
- ☐ Subdivision
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- ☐ Other (describe): _____

Comment

See Attachments:
Memo 1: ZBOA - Big Sky Cheese SUP - Memo 1- Public Notice
Memo 2: BOA - Big Sky Cheese SUP - Memo 2 - Transportation

For Office Use Only					
Date Received:	6/24/2019	Date Reviewed:	6/27/2019	Complete:	☒ Yes ☐ No

To: Cascade County Zoning Board of Adjustments

From: Kathleen McMahon, AICP
Montanans for Responsible Land Use (MFRLU)

Date: 6-24-19

Re: Memo #1 – Legal Description & Public Notice SUP #006-2019 (Big Sky Cheese)

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1. Background

The public notice, staff report and application do not contain any legal description for the subject properties. These materials only reference the Montana Cadastral parcel numbers and geocodes for one parcel. (See Attachment 1) As properties are combined or subdivided, these reference numbers can, and frequently do, change. A legal description for the property is an actual reference to boundaries that are recorded at the County Clerk and Recorder and are more reliable than a Geocode or parcel number. The Cascade County Zoning ordinance in Section 10.2(1) requires an accurate legal description.

According to the Montana Uniform Standard for Certificates of Survey, a narrative legal description must meet one of the following standards:

- Be described as an aliquot part of a U.S. Section
- Reference a lot in subdivision plat or previously recorded certificate of survey
- Metes & Bound Description

Accurate boundaries described in a legal description are necessary in order to ensure compliance with public notice requirements, prevent encroachments on property, ensure compliance with setback requirements and other zoning requirements, and to clarify for members of the public which parcel(s) are under consideration for the special use application.

In response to questions regarding the legal description, Mr. Payton responded that, "The application is for the cheese processing plant. The proposed plant is located on the specified parcel 5348300. The legal description as provided in the associated L/C for this use is incorporated in the notice. The legal description is also located on the four L/C maps."

2. The legal description that is referenced on the Location Conformance permit is inconsistent with the parcel boundaries on the site plan as well as the geocode for the parcel in the public notice.

The legal description on the location conformance permit maps is stated as follows:

"E half of Section 34, T20N, R5E"

As noted in Attachment 2, the area shaded in blue are the boundaries for the parcel referenced in the legal notice. The black outline is the property described in the legal description on the location conformance permit maps. These boundaries are not contiguous. If boundaries are not clear, there can be problems with building encroachments and required setbacks that can be costly to remediate. It is essential that accurate boundaries be established at the outset of the permit process to avoid these problems. The legal notice should either reference a certificate of survey or include a metes and bound description as required by the Uniform Standard for Certificates of Survey.

3. **The geocode in the legal notice and the legal description do not encompass all parcels that are involved in the cheese plant operation.**

As noted on Exhibit E, of the Special use application, the operations for the cheese plant are spread out on four different parcels that encompass three different sections. The table below lists the parcels from Exhibit E involved in the cheese plant operation along with the sections where such operations are located. Since the operation of the cheese plant is reliant on an access road to Highway 89 and potential well, holding ponds, and spray irrigation areas located on other parcels, all parcels that are part of the cheese plant operation must be included in the special use application and legal notice. This is necessary in order to properly evaluate impacts and to make sure that the future operations will be in compliance with the site plan as represented in the special use permit application.

Parcel #	Comments
Parcels show on Exhibit E	
534830	Location of Cheese Plant/Potential Holding Ponds/Potential Spray Irrigation & Well Site (Section 34 East Half & portion on west half)
533930	Access road onto Highway 89 (Section 27)
534840	Potential Holding Pond & Well Site (Section 34 – West half)
529570	Potential Holding Pond/Potential Spay Irrigation (Section 3)

4. The public notice is insufficient

The public notice for the special use permit only references one parcel located in Section 34. As noted above, the cheese plant operations encompass four different parcels. Even if all of the operations were limited to parcel 534830 in Section 34, the only way to access this parcel is from an access road that crosses parcel 533930 in Section 27. At a minimum, the special use permit should include these two parcels and the public notice should be amended accordingly.

Section 10.3 of the public notice requires, "The owner of the property for which a special use is sought or their agent and **all adjacent land owners** shall be notified of the hearing by certified mail." Since Section 533930, which contains the access road, was mistakenly left out of the public notice, it is not clear if the adjacent land owners on the north side of Highway 89 were properly notified by certified mail. In order for the public to make meaningful comments, the applicant and county must clearly reference of the parcels are that are critical to operations of the proposed special use permit.

If the special use permit is just limited to the two parcels to encompass the building and access road, the conditions of approval must clearly state that if the operations expand to include future holding ponds, wells, or spay irrigation areas on the other parcels that are included in Exhibit E, this will require an amendment to the special use permit.

5. Recommendation

Due to the discrepancies described in this memo, we respectfully request that the public hearing on June 27th be continued to allow for the publication of a new public notice that provides accurate information for members of the public who desire to comment on this proposal.

Attachment 1: NOTICE OF PUBLIC HEARING

NOTICE IS HEREBY given that the Cascade County Zoning Board of Adjustment will hold a public hearing in the Family Living Center at Expo Park, 400 3rd Street Northwest, Great Falls, on Thursday, June 27, 2019, at 5:00 p.m. to consider Big Sky Cheese, LLC's application for a Value-added Agricultural Commodity Processing Facility: Cheese Processing Plant. The proposed use is located in the Agricultural zoning district. The proposal is located at 8346 US Highway 89, Great Falls. The parcel number is 0005348300 and Geocode is 02-3017-34-4-02-01-0000. The parcel is located in Section 34 Township 20 N Range 5 E, P.M.M., Cascade County, MT.

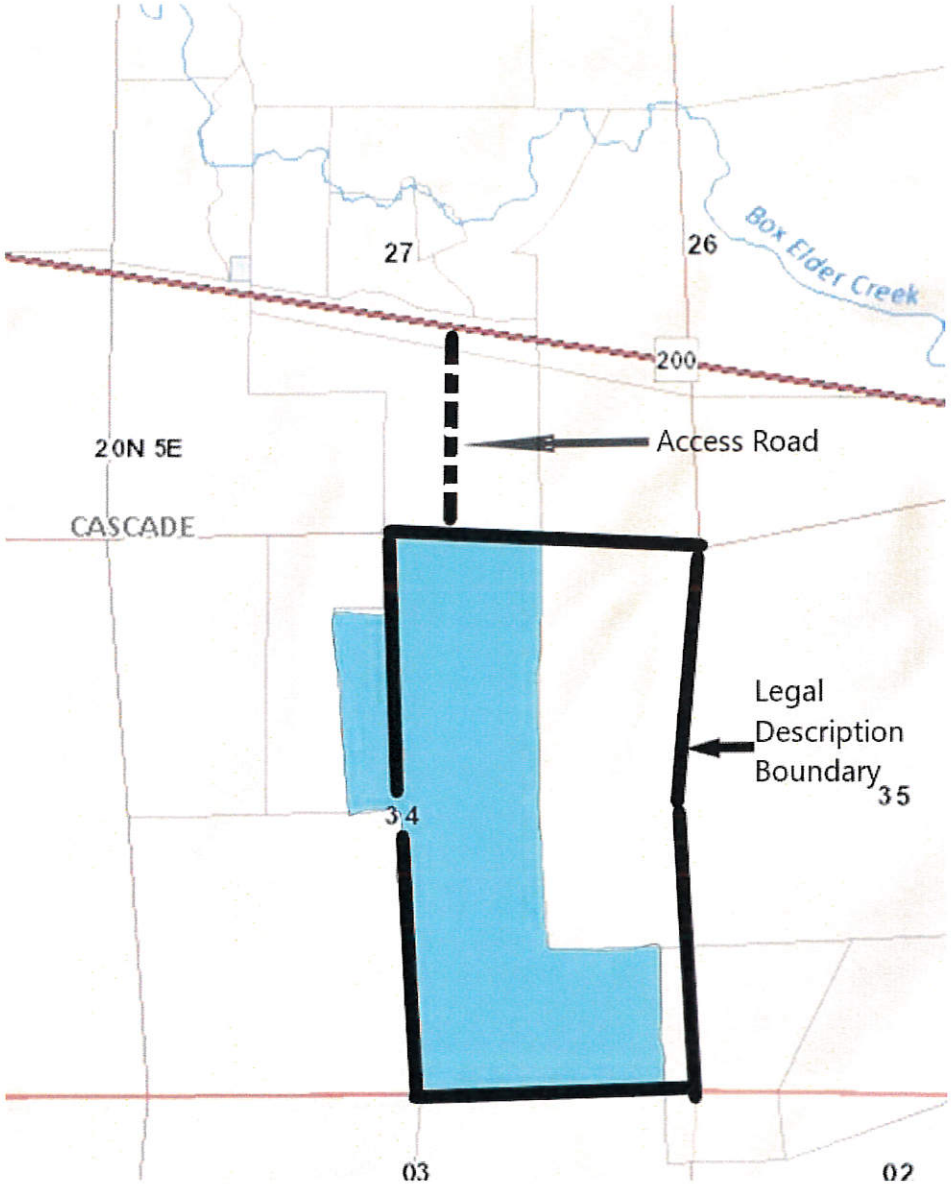
The application and supplementary materials are on file in the Planning Division's office, and any interested person may appear and speak for or against this proposal at the public hearing or submit in writing any comments to the Cascade County Planning office, 121 4th St N, Suite 2 H/I, Great Falls, MT 59401.

CASCADE COUNTY PLANNING DIVISION

Ian Payton, Dep. Dir.

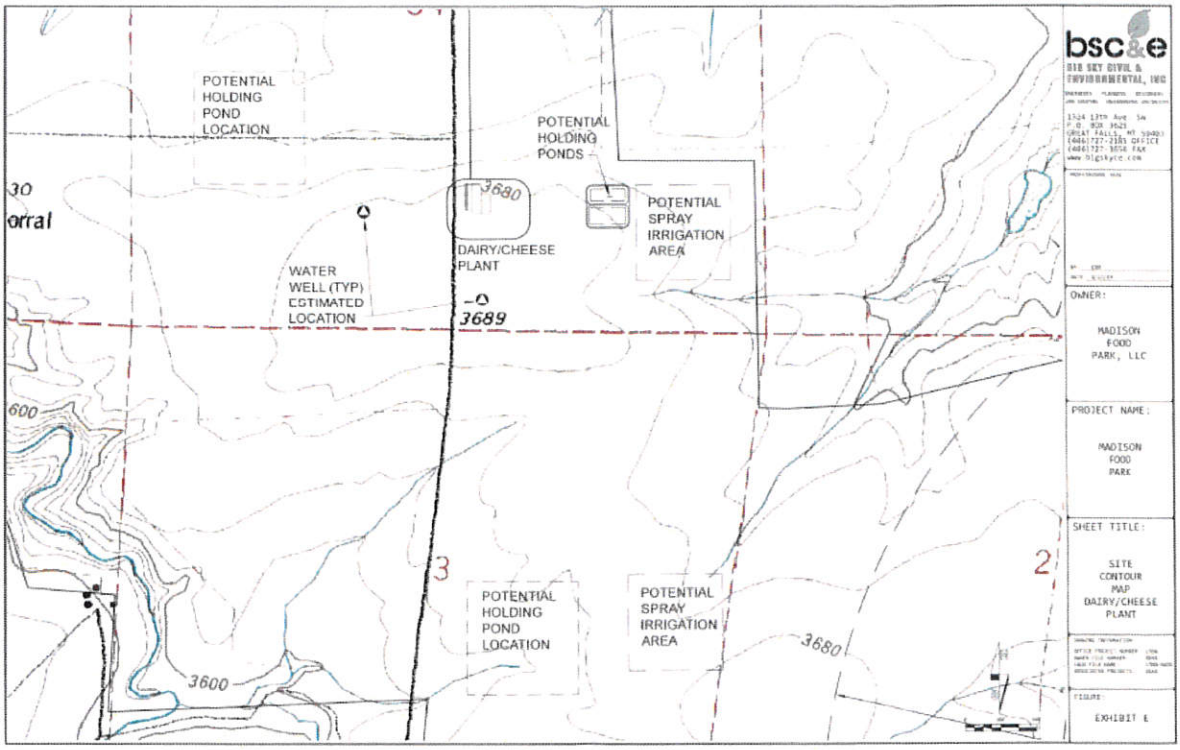
Publication Date: Sunday, June 16, 2019 & Sunday, June 23, 2019

Attachment 2: Vicinity Map



= Parcel Geocode: 02-3017-34-3-02-01-000

Attachment 3: Exhibit E



To: Cascade County Zoning Board of Adjustments

From: Kathleen McMahon, AICP
Montanans for Responsible Land Use (MFRLU)

Date: 6-24-19

Re: Memo #2 – Transportation & Public Access Issue

---

1. **The subject parcel is landlock and there is no mechanism to provide permanent public access to U.S. Highway 89**

The public notice and application for the special use permit indicated that the subject property is located in Section 34 (Geocode 534830). This section and specific parcel are landlocked and do not have any direct access to U.S. Highway 89. As indicated on Attachment 1, the site plan indicates that there will be an access drive that crosses the parcels to the north in Section 27 (Geocode 53393000). Currently, these two parcels are under the same ownership. Should there be a change in ownership, however, there is no provision to guarantee that access through Section 27 will be protected in perpetuity.

In such situations, it is standard planning practice that a condition of approval requires either a permanent access easement be recorded on the parcel in Section 27 or that the two parcels be combined as a single parcel. Permanent access to Highway 89 is critical for the landlocked subject parcel in the SUP application.

2. **The data on projected traffic volume attributed to the Special Use is not accurate**

The SUP Application states the following:

> "The dairy processing facility is estimated to generate additional traffic as follows: - Milk, liquid whey, delivery trucks, etc.: average seven (7) vehicle trips per day - Staffing/employees: average eleven (10) vehicle trips per day - Retail customers: average thirty (35) vehicle trips per day. The development is anticipated to generate an added 52 vehicle trips per day, a one-percent increase over the current ADT."

This information underestimates the number of trips that will be generated from this proposal. Traffic studies are based on peak traffic. Additionally, each employee or delivery represents at least two trips per day per vehicle(one trip to arrive to the site and one trip to depart from the site.) The projected traffic volumes only account for one trip per day. Based on information in the SUP application, the projected traffic volume should be adjusted to account for the following factors.

Traffic Generator	Comment	Revised ADT
Employees	The staff report notes that there will be 10 employees trips per day. This number only accounts for one trip to work and does not account for a second trip at the end of the work day. On pg. 3, the SUP application correctly notes that there will be employee trips will be generated twice per day.	20

Deliveries	The SUP application notes that there will be an average of seven trucks per day making deliveries, and collecting waste @ two trips per truck (arrival/depart) this amounts to 14 trips.	14
Retail customers	Pg. 3 of the staff report notes that at a peak, the projected # of customers is 50 per day. This equals 100 trips per day (arrival/depart) The SUP application does not indicate the square footage that will be devoted to the retail space.	100
Total		**134**

Note: MDT traffic impact studies require that projected traffic volumes be based the total amount of retail square feet and industrial square feet with multipliers from the Institute of Transportation Engineers (ITE). Consequently, it is likely that a Traffic Impact Study will have different calculations of projected traffic volumes. See MDT Traffic Design Manual: https://www.mdt.mt.gov/other/webdata/external/traffic/manual/chapter_41.pdf

Based on information provided in the SUP application the total amount of projected annual daily trips should be increased from 52 to at least 134. This number would likely need to be adjusted with a traffic impact study that uses ITE trip generation numbers.

3. The SUP application and staff report did not consider traffic safety factors such as sight distances and grade

The SUP application only provided information regarding projected traffic volumes. According to the The Cascade County Zoning Ordinance, section 10.6 (2) (a)

Considerations:

(a) Traffic conditions in the vicinity, including the effect of additional traffic on streets and street intersections, and **sight lines at street intersection and approaches.**

Furthermore, the proposed cheese plant will be accessing a state highway. According to the MDT Traffic Engineering Manual, the TIS evaluates not only traffic load, but also factors such as sight distance, grade, and on-site functions that may compromise off-site operations. The SUP application did not contain information on any of these factors.

4. A Traffic Impact Study should be submitted prior to issuance of the Special Use Permit

The staff report and SUP application states the following:

> "The Montana Department of Transportation will require an approach permit to connect the access roads to Hwy 89 and may require a traffic impact study (TIS) for the purpose of identifying any/all requirements for mitigating traffic impacts, including dedicated turn lanes at the proposed project approach, or the use of other mitigating measures as may be required by the review authority (Montana Department of Transportation). The TIS will be completed by a Montana-licensed professional engineer with the appropriate qualifications and experience. If any improvements to Hwy 89 are required as a result of the TIS (turning lanes, signalization, etc.), MFP will be responsible for the cost of such improvements."

The Cascade County Zoning Ordinance criteria for special uses require that, "**Before the Board of Adjustment can approve any Special Use Permit**, it must **FIRST** reach each of the following conclusion."

(1) Conditions may be required that the Zoning Board of Adjustment determines if implemented , will mitigate potential conflicts in order to reach these conclusions.
(2) The proposed development will not materially endanger the public health or safety.

Considerations:

(b) Traffic conditions in the vicinity, including the effect of additional traffic on streets and street intersections, and **sight lines at street intersection and approaches.**

The BOA can only reach such conclusions after they review a Traffic Impact Study that has been completed in accordance with MDT requirements. Furthermore, Section 10.9 of the zoning ordinance requires that the findings and conclusion be based on factual evidence. The factual evidence regarding traffic counts is incorrect and there has been no factual evidence regarding sight distances. Such evidence MUST be submitted prior to approval of a conditional use. As noted in the MDT Traffic Engineering Manual, local governments routinely require that such studies be submitted as part of the development review process.

> "Local governments may require a developer to submit such a study before zoning variances, subdivision maps, site plans or new driveways are approved." And ".. it is very important that the developer coordinate with the local governing jurisdictions during the preliminary site planning phase."

Furthermore, the Montana Constitution states that ,

> **Section 8. Right of participation.** The public has the right to expect governmental agencies to afford such reasonable opportunity for citizen participation in the operation of the agencies prior to the final decision as may be provided by law. Public has a right to know and review all documents that are part of the decision making process.

Once a TIS is completed, it may identify safety issues and mitigation measures that would be of concern to adjacent land owners and members of the public. The only reasonable opportunity for the public to participate in decisions based on the TIS is at the public hearing stage for the special use. For this reason, the TIS should be submitted as part of the SUP application and should be available for public review and comment prior to the public hearing before the BOA.

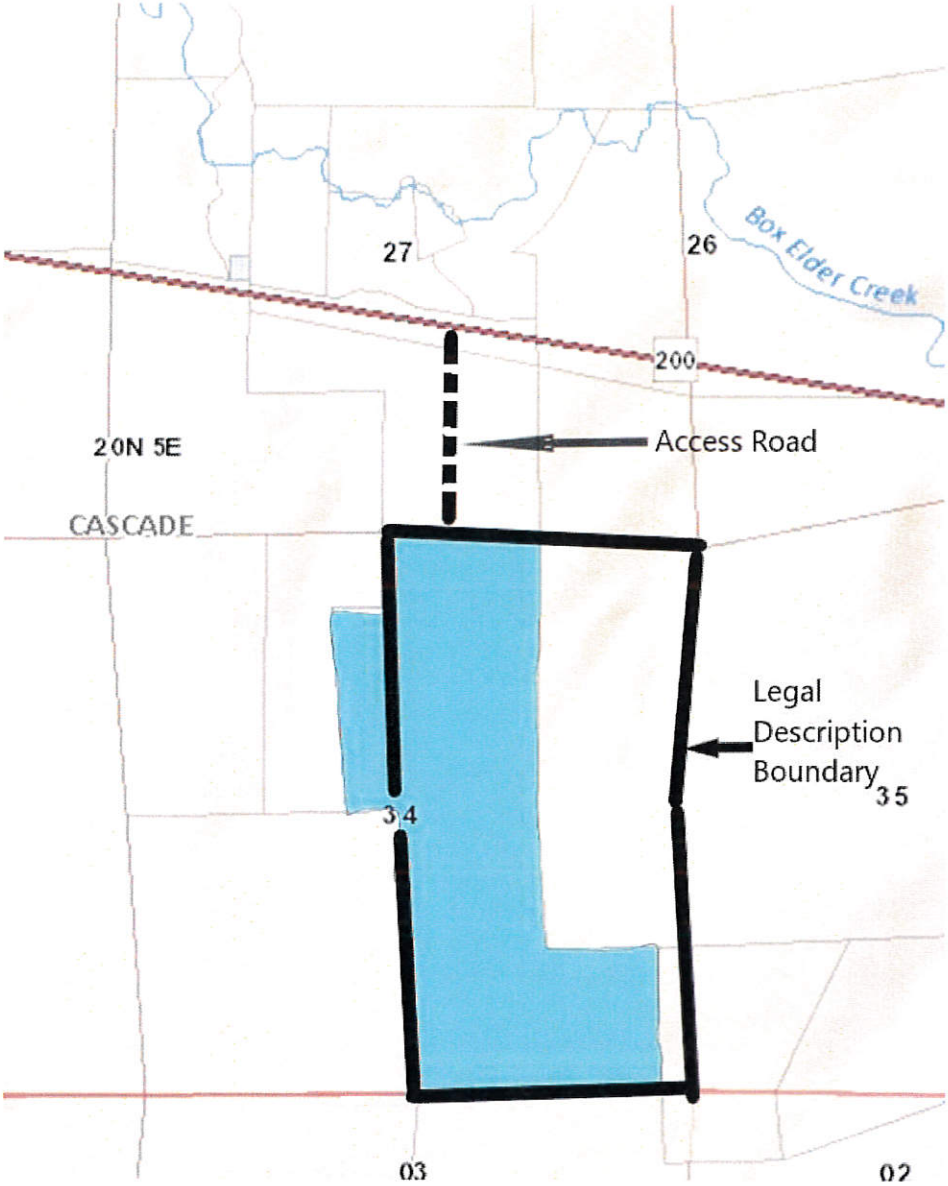
5. Recommendations

a. To ensure public access to the landlocked parcel, require a condition of approval that prior to issuance of a location conformance permit, either a permanent access easement be recorded on the parcel in Section 27 or that the two parcels be combined as a single parcel and recorded with the clerk and recorder.

b. The BOA should table this matter until a Traffic Impact Study approved by the Montana Department of Transportation has been submitted. This recommendation is support by the following reasons.

- The existing SUP application does not contain any analysis of traffic safety concerns regarding site distances and grade as required by Section 10.6 of the zoning ordinance.
- The projected traffic volumes were not based on standard procedures in the MDT Traffic design manual and the numbers that were provided were miscalculated.
- The Cascade County Zoning Ordinance requires that consideration and mitigation of traffic safety issues must be resolved BEFORE approval of a special use
- The proposed access for the SUP is on a state highway and such TIS and proposed mitigation measures must meet the requirements of MDT Traffic Design manual.
- MDT Traffic Design manuals recommends that such TIS be completed during the preliminary planning stages and notes that local governments routinely requires such studies as part of the development review process.
- The Montana Constitution states that members of the public have a right to reasonable participation prior to the final decision and such reasonable opportunity can only be afforded if they have an opportunity to review the Traffic Impact Study as part of the pubic hearing process.
- Conditions of approval should require that if the TIS identifies potential improvements, that these be completed prior to issuance of the location conformance permit.

Attachment 1: Vicinity Map



= Parcel Geocode: 02-3017-34-3-02-01-000

Public Comment Form

Cascade County Public Works Department Planning Division
121 4th St N, Suite 2H-2I Great Falls, MT 59401
Phone: 406-454-6905 | Fax: 406-454-6919
Email: planningcomments@cascadecountymt.gov

Instructions

This form is for providing public comment to the Cascade County Planning Division for review by any one or more of the following review and/or approval boards: Zoning Board of Adjustment (ZBOA), Planning Board, or Board of County Commissioners. Only complete submissions will be included for board review. Please provide the relevant information for each section below. A complete submission provides all of the following: commenter name and address, comment subject, and commentary on the subject issue(s). If additional space is needed for commentary, please attach additional sheets to this form. Completed forms may be submitted in person at the Planning Division office or by email at planningcomments@cascadecountymt.gov.

Commenter Information

Name: J.Casselli

Complete Address: 11 Red Coulee Belt, MT 59412

Comment Subject (please check one):

- ☒ Special Use Permit Application
- ☐ Subdivision
- ☐ Zoning Text and/or Map Amendment
- ☒ Growth Policy
- ☐ Variance
- ☐ Floodplain Regulation Amendment
- ☐ Subdivision Regulation Amendment
- ☐ County Road Abandonment/ Discontinuation of County Street
- ☒ Other (describe): Zoning- Big Sky Cheese

Comment

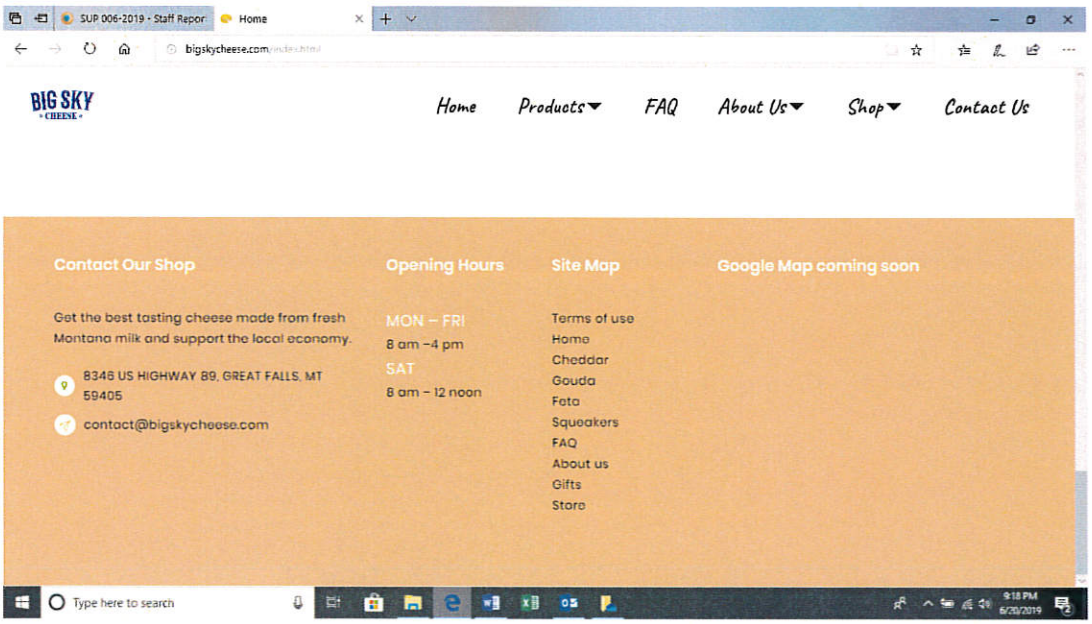
In review of staff report and other information please accept the following comments and attachment:
The idea of this type of value added Agricultural production facility would add economic value to the county and provide additional employment. I do however question the location of this facility when the county and city have focused on attracting development business to the north park (malt plant, ADF) area and the new Agritec park development area (off River Drive). The county should be looking at incentives to spur this type of development where it already approved and planned for and the infrastructure is in place.
Just because property is purchased is not a given that everyone rolls over for something that may not be a compatible use of good ag Ag ground especially when other areas are already reviewed, approved and have been through a public process.
Specific issues and items of concern that shoare as follow also
1.. Traffic flow and types/amount will these estimates increase over time. We do not need more stoplights, consider turnlanes, and other co if considering more use winter road conditions and snow removal along with cost of this on this section of highway 87/200/89 is a concern.
2. Require all outdoor night lighting needs to be dark-sky complaint including parking lots, building, roads and sign lighting. This will help protect the rural character at night (growth policy) and reduce light/night sky impacts to surrounding land owners.
3.Water use and processing is a concern for large amounts of well water use , also onsite water treatment and stormwater control given proximity to antelope coulee and other small drainageways. Has proponent applied and will DNRC approve a water rights for expected amount of water use? Again this type of development would be better sited in area already having a water source in place.
4. Educational learning opportunities should be required by BSC for school groups, 4H, FFA etc to tour and learn from this business model given the Ag value added nature of the business.
5.Tourism- staff report notes this however there could be an opportunity for additional benefit of this with tours, gift shops etc.
page 1of 2 (see attached)

For Office Use Only					
Date Received:	6/23/2019	Date Reviewed:	6/27/2019	Complete:	☒ Yes ☐ No

- From an economic standpoint and for reference below is information from the now famous Tillamook Cheese and although a different demographic in OR but there are similarities and the Great Falls Area could over time expect to see this type of employment. With current low unemployment rates of local labor, a facility like this could likely see jobs filled by relocation from within or outside MT to the area.

We rely on and embrace diverse perspectives, thoughts, backgrounds, and cultures to inform our work. We are committed to creating a climate of inclusion and conditions where all employees feel valued and a sense of belonging. At the end of 2017, 38% of our total workforce was female and 44% of our managers were female, and 26% of our workforce are racially and ethnically diverse. Tillamook County Creamery Association (TCCA) is a Drug-Free Workplace. EEO/AA (Source: www.Tillamook.com)

- Below is from the current Big Sky Cheese webpage: Please note the address and current information for a facility that currently has no county or other state approvals. The website appears fully functioning with a product line etc. This appears to be somewhat disingenuous and should be questioned by the CC Planning Board, Staff and Commissioners.



- In addition, the development authority should not be approving loans for projects not yet approved by the county. This can compromise or put pressure on the county to approve something because everything is in place and not from an objective standpoint or will of the county citizens.

Public Comment Form

Compiled 06/27/2019

Cascade County Public Works Department Planning Division
121 4th St N, Suite 2H-2I
Great Falls, MT 59401
Phone: 406-454-6905 Fax: 406-454-6919

Instructions

This form is for providing public comment to the Cascade County Planning Division for review by any one or more of the following review and/or approval boards: Zoning Board of Adjustment (ZBOA), Planning Board, or Board of County Commissioners. Only complete submissions will be included for board review. Please provide the relevant information for each section below. A complete submission provides all of the following: commenter name and address, comment subject, and commentary on the subject issue(s). If additional space is needed for commentary, please attach additional sheets to this form. Completed forms may be submitted in person at the Planning Division office or by email at planningcomments@cascadecountymt.gov.

Commenter Information

Name: Claire Reichert Baiz

Complete Address: (temporary address) 117 W Grove Street, Apt. 204, Mishawaka IN 46545

Comment Subject (please check one)

- ☐ Special Use Permit Application
- ☐ Subdivision
- ☐ Zoning Text and/or Map Amendment
- ☐ Growth Policy
- ☐ Variance
- ☐ Floodplain Regulation Amendment
- ☐ Subdivision Regulation Amendment
- ☐ County Road Abandonment/ Discontinuation of County Street
- ☒ Other (describe): Proposed Zoning Policy Changes

Comment

Please see attached letter (also in body of email). Thank you.

For Office Use Only					
Date Received:	6/22/2019	Date Reviewed:	6/27/2019	Complete:	☒ Yes ☐ No

June 22, 2019

Dear Cascade County Planning Board,

The US has a 1.39 billion pound cheese surplus. Why would investors be interested a cheese factory in Cascade County, Montana?

Perhaps it's because US taxpayers have to buy surplus cheese. Dairy sales are bound by an unfair system of subsidies, quotas, and supports, part of a convoluted attempt to save the dairy industry back in the 1980s.

These regulations simply reinforced the credo established by former Secretary of Agriculture Earl Butz: "Get big or get out." My dad grew up on a family farm near Laurel. None of the Grandpa Reichert's thirty-odd grandchildren remain on family farms. It's not all Earl Butz's fault. But those policies didn't help matters — and neither do the larger plans for the Madison Mega-slaughterhouse.

Family dairies, like Cascade County's Ayrshire Dairy, have been displaced by huge industrial operations, where cattle are cogs in a consolidated supply chain. So much for happy cows — and so much for healthy capitalism.

.

This Big Sky Cheese Factory, if approved, would further consolidate an already captive market.

The business interest behind the Madison Mega-slaughtherhouse and this cheese plant currently control, according to a 2017 publication from Development Counsellors International, 90 percent of Montana's hog production, 98 percent of our egg production, and they are a "driving force" in the dairy industry.

I don't care who is behind this business endeavor — Dow Chemical, Whole Foods or your Aunt Mary — it is dangerous for a single consortium to control Montana's animal-based protein production.

Big Sky Cheese's SUP does not merit support. In private, people in power sometimes admit that the Friesen/Madison project is a lousy idea, but they claim there is nothing in their power to stop it. "All we can do is look at ____."

They are wrong. There is always a chance to do the right thing by ourselves, our neighbors, and our grandkids.

As one former Wisconsin dairy farmer told the *Washington Post*, "The situation is great for the processors … but it will never give the farmers a fair price." In the case of the Madison Mega-slaughterhouse and its related endeavors, the supply chain is vertically integrated — the producers are controlled by the processors, and the government is over a (cheese) barrel, leaving taxpayers with the bill, our economic health at risk, and the environment with increasingly unacceptable consequences.

I am all for added value for Montana ag, but not when the funds come out of my pocket and go directly to a monopoly.

We have other options to grow our agricultural economy.

Montana is the top pulse crop producer in the US. Despite recent challenges, we are planting more, and the long-term outlook is very good. https://www.northernag.net/farmers-planting-more-pulse-crops-despite-market-challenges/

I'm grateful to see a new oilseed production facility in my hometown, and to see the GFDA learn about chickpea snacks, etc, on a recent trip to NYC. Let's encourage these endeavors, along with hemp products and grass-fed animal operations.

"The plant-based food market is … estimated to reach $4.63 billion in 2019 and this figure will increase to $6.43 billion by 2023," according to a report quoted by the former dairy farmer, in his *Washington Post* article.

GFDA touts their group's "engagement in the alternative protein space." If this SUP is approved, it would send a signal that Cascade County is open for resource-intensive, monopolistic agricultural endeavors. This is a short-sighted approach. I am not okay with a decision that's rigged against the family farms and consumers it's supposed to support.

Sincerely,

Compiled 06/27/2019

June 22, 2019

Claire Reichert Baiz
117 W Grove Street, Apt. 204
Mishawaka IN 46545

Stone, Michael

From: kate@appcom.net
Sent: Tuesday, June 25, 2019 11:47 AM
To: Planning Comments; Payton, Ian; Stone, Michael; Hopkins, Sandor R.; Haight, Carey
Subject: RE: ZBOA Public Comment Form 6-25-19
Attachments: Public Comment Form - 6-25-19 Memo 5.pdf; 20190624_10545110130_69 _Disposal_of_Wastewater_by_Irrigation 6-24-19.pdf; 20190624_11275611310_1 _Slow_Rate_Treatment_of_Wastewater 6-24-19.pdf; ZBOA - Big Sky Cheese SUP - Memo 5- Wastewater.pdf

Attn: Zoning Board of Appeals,

On behalf of the Montana's for Responsible Land Use, I am submitting the following public comments regarding the Big Sky Cheese SUP public hearing scheduled for 6-27-19

Kate McMahon
Applied Communications
406-863-9255

Public Comment Form

Cascade County Public Works Department Planning Division
121 4th St N, Suite 2H-2I
Great Falls, MT 59401
Phone: 406-454-6905 Fax: 406-454-6919

Instructions

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Commenter Information

Name: Kathleen McMahon

Complete Address: 151 Wedgewood Ln., Whitefish, MT 59937

Comment Subject (please check one)

- ☒ Special Use Permit Application
- ☐ Subdivision
- ☐ Zoning Text and/or Map Amendment
- ☐ Growth Policy
- ☐ Variance
- ☐ Floodplain Regulation Amendment
- ☐ Subdivision Regulation Amendment
- ☐ County Road Abandonment/ Discontinuation of County Street
- ☐ Other (describe): _____

Comment

See Attachments in regards to SUP Application #006-2019:
Memo 5: ZBOA - Big Sky Cheese SUP - Memo 5 - Wastewater

For Office Use Only					
Date Received:	6/25/2019	Date Reviewed:	6/27/2019	Complete:	☒ Yes ☐ No

To: Cascade County Zoning Board of Adjustments

From: Kathleen McMahon, AICP
Montanans for Responsible Land Use (MFRLU)

Date: 6-25-19

Re: SUP #006-2019
Memo #5 – Wastewater

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1. Background

The Cascade County Zoning Ordinance, Section 10.6 states the following:

10.6 "**Before the Board of Adjustment can approve any Special Use Permit**, it must **FIRST** reach each of the following conclusion."

(1) Conditions may be required that the Zoning Board of Adjustment determines if implemented , will mitigate potential conflicts in order to reach these conclusions.
(2) The proposed development will not materially endanger the public health or safety.

Considerations:
(b) Provision of services and utilities, including sewer, water, electrical telecommunications, garbage collections, and fire protection.

The SUP applications state the following regarding wastewater and sewer.

"The dairy processing facility will be served by onsite water and wastewater facilities. Wastewater treatment will be completed onsite using Montana DEQ-approved wastewater treatment system(s). Commonly practiced treatment technologies will be used for managing both domestic and process waste streams, and beneficial reuse of treated effluent will be performed in a manner that is compliant with DEQ and local government regulations. The overall volume of process wastewater generated from dairy operations is estimated at approximately 13,000 gallons per day (gpd). With the 5 day/week operation, this will result in approximately 339,000 gallons of process wastewater each year.

The process wastewater will be pretreated using nutrient reduction/removal technologies, then seasonally stored in treatment/holding cells, followed by beneficial reuse in the form of land application of treated effluent on approximately 10-15 acres of cropland, either onsite or on adjacent farmland.

MFP may employ a technology called acidification to treat process wastewater before seasonal storage and beneficial reuse via land application / irrigation. Acidification is a robust, automated process commonly at dairy processing facilities and primarily consists of the following:

- Equalization
- pH adjustment
- Dissolved Air Floatation
- Sedimentation

• Solids dewatering (as needed)

The acidification process equipment, if deemed necessary, will be housed inside the processing facility before exiting to the seasonal storage ponds. All liquid whey will be stored onsite until it can be hauled away and used as feed by area ranchers. The total liquid whey production is estimated at approximately 9,720 gpd.

Domestic wastewater generation is expected to be the equivalent of approximately a single residence, or less than 300 gpd. Domestic wastewater will be treated and disposed via a conventional septic tank and drainfield, all in strict compliance with DEQ and local standards and regulations."

The staff report did not contain any analysis of this information and there was no indication that the Montana Department of Environmental Quality reviewed or commented on the above information.

2. **The SUP application miscalculates the amount of wastewater that will be generated by the proposed cheese plant.**

The SUP application estimates that annual wastewater production will be "339,000 gallons of process wastewater each year." (pg. 2 of SUP Criteria Response) Based on information in the SUP application, calculations indicate that the projected wastewater output is ten times as high.

5 x 52 = 260 potential processing days per year.

260 days x 13,000 gpd = **3,380,000** gallons of wastewater per year.

This is a significant error that is misleading to both the ZBOA and public.

3. **Soil reports indicate that the location of the potential holding ponds and potential spray irrigation areas are rated as "very limited" or "somewhat limited" for these uses.**

According to the USDA Soil survey, "Soil properties are important considerations in areas where soils are used as sites for the treatment and disposal of organic waste and wastewater. Selection of soils with properties that favor waste management can help to prevent environmental damage."

The soil survey rates soils for specific uses. The ratings have the following meaning:

- "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected.

- "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Exhibit E from the SUP Permit application, indicates the location of the potential holding ponds and spray irrigation areas for the wastewater treatment system. As indicated by the attached soil reports, the locations of the two spray irrigation areas are on soils that are partially rated as "Very limited" and "Partially rated as Somewhat limited" for spray irrigation.

The potential holding ponds that are on the subject property is located on soils that are entirely rated as "Very limited" for holding ponds that are described in the "Slow Rate Treatment of Wastewater" method of treatment. The location of the potential holding ponds on the parcel to the south of the cheese plant is also rated as "Very Limited". The potential holding ponds to the west of the proposed cheese plant are on soils partially as "Somewhat limited" and partially as "Very Limited"

Given the potential soil limitations, it is important that the applicant provide more analysis regarding the potential location of wastewater facilities and suitability of soils. Additional analysis may result in relocating the areas designated for potential holding ponds and irrigation areas. This could also affect the overall location and layout of the cheese plant on the site plan.

Such information should be available prior to approval of the special use in order for the BOA to properly evaluate the impacts. Additionally, according to Section 10.9 of the Zoning Ordinance:

> "The petitioner has the burden of presenting sufficient factual evidence to support findings of fact that allow the Board to reasonably reach each of the required conclusions."

While the petitioner submitted a soil report with general soil characteristics, the petitioner did not present any information on soil suitability for the specific wastewater systems. Lacking such information, the application fails to present sufficient factual evidence to support the findings of fact to allow the Board to reach the required conclusion regarding the adequacy of the proposed wastewater system. As noted in the Section 10.6, such conclusions must be reached BEFORE the SUP is approved.

4. Impact of Wastewater Treatment System has not had adequate review.

The Department of Environmental Quality requires an "Engineering Report" be submitted prior to final project plans and specifications. The engineering report is described below.

> The Engineering Report or Facility Plan: identifies and evaluates wastewater related problems; assembles basic information; presents criteria and assumptions; examines alternate projects with preliminary layouts and cost estimates; describes financing methods, sets forth anticipated charges for users; reviews organizational and staffing requirements; offers a conclusion with a proposed project for client consideration and outlines official actions and procedures to implement the project. The planning document must clearly describe the benefits and purpose of the proposed project and must include sufficient detail to demonstrate that the proposed project meets applicable criteria. The concept (including process description and sizing), factual data and controlling assumptions, and considerations for the functional planning of wastewater facilities are presented for each process unit and for the whole system."

Source: http://deq.mt.gov/Portals/112/Water/WQInfo/Documents/Circulars/Circulars/2018DEQ-2.pdf

According to the SUP application, the proposed cheese plant will generate 13,000 gallons per day of wastewater related to food processing. The amount of wastewater is equivalent approximately a 50-lot residential subdivision. The type of effluent is described by the USDA Soil Survey as follows, "Food-processing wastewater results from the preparation of fruits, vegetables, milk, cheese, and meats for public consumption. In places it is high in content of sodium and chloride. The effluent in lagoons and storage ponds is from facilities used to treat or store food-processing wastewater" (See soil report)

Given the amount of wastewater that will be generated, along with the type of wastewater associated with food processing, the ZBOA should require that a preliminary engineering report be submitted with the SUP application to evaluate potential wastewater related problems per the DEQ Circular. This

information should be available prior to approval in order to determine that the proposed system will not materially endanger public health and safety.

5. Public right to know

The Montana Constitution states the following:

> **"Section 8. Right of participation.** The public has the right to expect governmental agencies to afford such reasonable opportunity for citizen participation in the operation of the agencies prior to the final decision as may be provided by law. Public has a right to know and review all documents that are part of the decision making process."

A preliminary engineering report and review by the Department of Environmental quality may identify water quality issues and other environmental concerns that would require a change in the design of the wastewater treatment system or other mitigation measures that would be of concern to adjacent land owners and members of the public. The only reasonable opportunity for the public to participate in such decisions is to have more detailed information available at the public hearing stage for the special use. In accordance with Section 10.9 of the Cascade County Zoning Ordinance, such information should be submitted as part of the SUP application and should be the basis for "factual" evidence to support findings of fact BEFORE the BOA can approve a SUP.

6. Recommendations

MRFLU request that the ZBOA either (1) denies the SUP due to lack of "competent, substantial and material factual evidence" to address the concerns in this memo or (2) table the proposed SUP pursuant to Section 10.9 of the zoning ordinance in order for the applicant to submit a preliminary engineering report or comparable document with sufficient information for the Department of Environmental Quality to evaluate wastewater related problems. Below are reasons for this recommendation.

- The SUP application had significant calculation errors. There may be other errors or corrections in the underlying assumptions that a DEQ review would discover.

- The soil survey indicates limitations with soils for the wastewater system that is being proposed. A preliminary engineering study would rely on soil testing that may suggest changes in the wastewater system design and/or site layout that would impact other elements of the SUP.

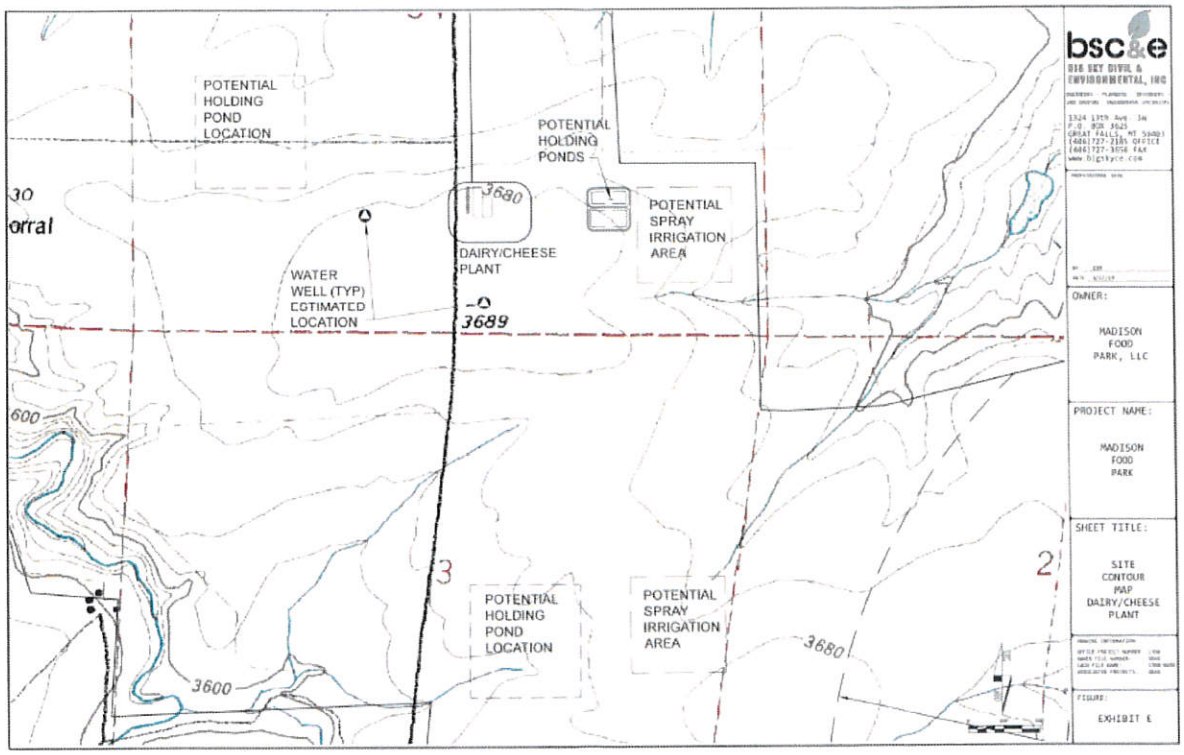
- DEQ has the expertise to conduct an independent evaluation the proposed wastewater treatment system.

- Treatment of wastewater is a critical public health concern. The Cascade County Zoning ordinance requires that the ZBOA must reach a conclusion that the proposal will not endanger public health **BEFORE** it can approve any Special use Permit. (Section 10.6)

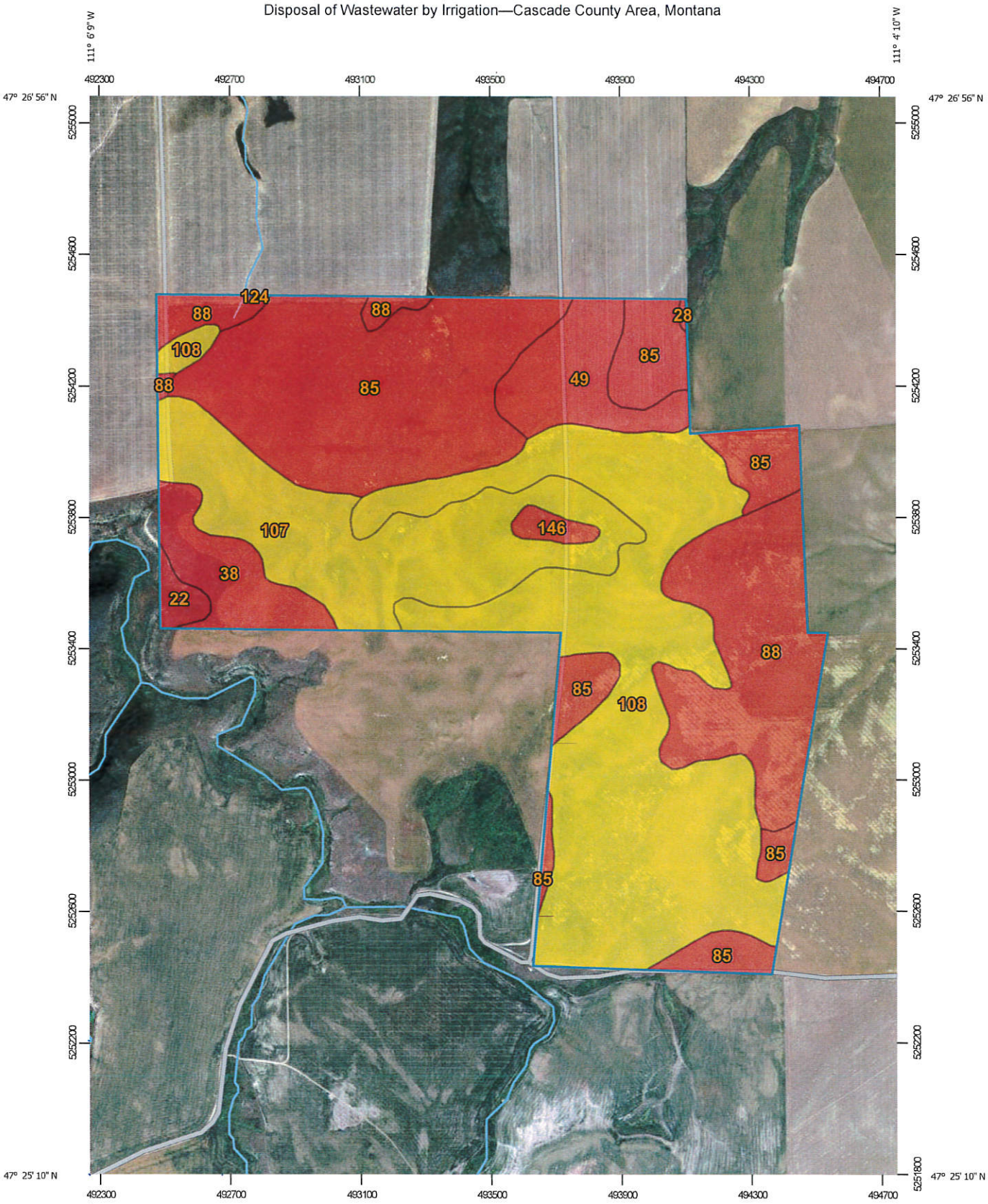
- The zoning ordinance requires that SUP Approval must be based on "competent, substantial and material factual evidence" (Section 10.9) A preliminary engineering study reviewed by DEQ is the only way to meet this standard of review.

- Such preliminary engineering analysis should also be required in relation to water usage to verify information in the SUP and provided the basis of fact necessary for SUP approval.

Attachment 1: Exhibit E



Disposal of Wastewater by Irrigation—Cascade County Area, Montana



Map Scale: 1:16,000 if printed on A portrait (8.5" x 11") sheet.

Meters: 0 200 400 800 1200

Feet: 0 500 1000 2000 3000

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

Very limited

Somewhat limited

Not limited

Not rated or not available

Soil Rating Lines

Very limited

Somewhat limited

Not limited

Not rated or not available

Soil Rating Points

Very limited

Somewhat limited

Not limited

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Cascade County Area, Montana
Survey Area Data: Version 14, Sep 5, 2018

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

Date(s) aerial images were photographed: Jul 9, 2010—Feb 15, 2017

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

Compiled 06/27/2019

Disposal of Wastewater by Irrigation

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
22	Big Timber-Castner complex, 30 to 70 percent slopes	Very limited	Big Timber (55%)	Droughty (1.00)	5.4	0.8%
				Too steep for surface application (1.00)		
				Too steep for sprinkler application (1.00)		
				Depth to bedrock (1.00)		
				Slow water movement (0.22)		
			Castner (25%)	Droughty (1.00)		
				Too steep for surface application (1.00)		
				Too steep for sprinkler application (1.00)		
				Depth to bedrock (1.00)		
			Roy (5%)	Too steep for surface application (1.00)		
				Too steep for sprinkler application (1.00)		
				Droughty (0.25)		
				Slow water movement (0.22)		
				Cobble content (0.05)		
28	Bitton and Roy soils, 10 to 65 percent slopes	Very limited	Bitton (45%)	Too steep for surface application (1.00)	0.5	0.1%

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Too steep for sprinkler application (1.00)		
				Cobble content (0.75)		
			Roy (45%)	Too steep for surface application (1.00)		
				Too steep for sprinkler application (1.00)		
				Droughty (0.25)		
				Slow water movement (0.22)		
				Cobble content (0.05)		
			Castner (5%)	Droughty (1.00)		
				Too steep for surface application (1.00)		
				Too steep for sprinkler application (1.00)		
				Depth to bedrock (1.00)		
			Sinnigam (5%)	Droughty (1.00)		
				Depth to bedrock (1.00)		
				Too steep for surface application (1.00)		
				Cobble content (0.75)		
				Too steep for sprinkler application (0.22)		
38	Castner-Sinnigam complex, 2 to 15 percent slopes	Very limited	Castner (65%)	Droughty (1.00)	27.2	4.1%
				Depth to bedrock (1.00)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Too steep for surface application (1.00)		
				Too steep for sprinkler application (0.22)		
			Sinnigam (15%)	Droughty (1.00)		
				Depth to bedrock (1.00)		
				Too steep for surface application (1.00)		
				Cobble content (0.75)		
				Too steep for sprinkler application (0.22)		
			Roy (7%)	Too steep for surface application (1.00)		
				Droughty (0.25)		
				Slow water movement (0.22)		
				Too steep for sprinkler application (0.10)		
				Cobble content (0.05)		
			Reeder (6%)	Too steep for surface application (1.00)		
				Depth to bedrock (0.71)		
				Droughty (0.47)		
				Too steep for sprinkler application (0.40)		
49	Darret-Castner complex, 2 to 8 percent slopes	Very limited	Darret (60%)	Slow water movement (1.00)	33.2	5.0%

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Depth to bedrock (0.65)		
				Droughty (0.40)		
				Too steep for surface application (0.32)		
			Castner (25%)	Droughty (1.00)		
				Depth to bedrock (1.00)		
				Too steep for surface application (0.32)		
			Big Timber (8%)	Droughty (1.00)		
				Depth to bedrock (1.00)		
				Slow water movement (0.22)		
				Too steep for surface application (0.08)		
			Sinnigam (7%)	Droughty (1.00)		
				Depth to bedrock (1.00)		
				Cobble content (0.75)		
				Slow water movement (0.22)		
				Too steep for surface application (0.08)		
85	Gerber silty clay loam, 0 to 4 percent slopes	Very limited	Gerber (90%)	Slow water movement (1.00)	177.5	26.8%
			Acel (4%)	Slow water movement (1.00)		
			Abor (3%)	Slow water movement (1.00)		
				Depth to bedrock (0.46)		
				Droughty (0.42)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
			Lawther (3%)	Slow water movement (1.00)		
88	Gerber-Lawther silty clays, 4 to 8 percent slopes	Very limited	Gerber (55%)	Slow water movement (1.00)	93.3	14.1%
				Too steep for surface application (0.68)		
			Lawther (35%)	Slow water movement (1.00)		
				Too steep for surface application (0.68)		
			Acel (10%)	Slow water movement (1.00)		
				Too steep for surface application (0.32)		
107	Ipano-Ticell loams, 0 to 4 percent slopes	Somewhat limited	Ipano (55%)	Depth to bedrock (0.16)	102.7	15.5%
				Droughty (0.00)		
			Absarokee (8%)	Slow water movement (0.22)		
				Depth to bedrock (0.07)		
				Droughty (0.06)		
			Work (7%)	Slow water movement (0.22)		
108	Ipano-Ticell loams, 4 to 10 percent slopes	Somewhat limited	Ipano (55%)	Too steep for surface application (0.92)	218.2	32.9%
				Depth to bedrock (0.16)		
				Too steep for sprinkler application (0.03)		
				Droughty (0.00)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
			Absarokee (8%)	Too steep for surface application (0.32)		
				Slow water movement (0.22)		
				Depth to bedrock (0.07)		
				Droughty (0.06)		
			Work (7%)	Too steep for surface application (0.68)		
				Slow water movement (0.22)		
124	Lawther-Gerber complex, 8 to 15 percent slopes	Very limited	Lawther (65%)	Too steep for surface application (1.00)	0.1	0.0%
				Slow water movement (1.00)		
				Too steep for sprinkler application (0.78)		
			Gerber (25%)	Too steep for surface application (1.00)		
				Slow water movement (1.00)		
				Too steep for sprinkler application (0.78)		
			Hillon (10%)	Too steep for surface application (1.00)		
				Slow water movement (1.00)		
				Too steep for sprinkler application (0.78)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
146	McKenzie silty clay loam	Very limited	McKenzie (90%)	Slow water movement (1.00)	5.0	0.8%
				Ponding (1.00)		
				Depth to saturated zone (1.00)		
				Salinity (0.13)		
			Acel (10%)	Slow water movement (1.00)		
Totals for Area of Interest					**663.1**	**100.0%**

Rating	Acres in AOI	Percent of AOI
Very limited	342.3	51.6%
Somewhat limited	320.9	48.4%
Totals for Area of Interest	**663.1**	**100.0%**

Description

Wastewater includes municipal and food-processing wastewater and effluent from lagoons or storage ponds. Municipal wastewater is the waste stream from a municipality. It contains domestic waste and may contain industrial waste. It may have received primary or secondary treatment. It is rarely untreated sewage. Food-processing wastewater results from the preparation of fruits, vegetables, milk, cheese, and meats for public consumption. In places it is high in content of sodium and chloride. The effluent in lagoons and storage ponds is from facilities used to treat or store food-processing wastewater or domestic or animal waste. Domestic and food-processing wastewater is very dilute, and the effluent from the facilities that treat or store it commonly is very low in content of carbonaceous and nitrogenous material; the content of nitrogen commonly ranges from 10 to 30 milligrams per liter. The wastewater from animal waste treatment lagoons or storage ponds, however, has much higher concentrations of these materials, mainly because the manure has not been diluted as much as the domestic waste. The content of nitrogen in this wastewater generally ranges from 50 to 2,000 milligrams per liter. When wastewater is applied, checks should be made to ensure that nitrogen, heavy metals, and salts are not added in excessive amounts.

Disposal of wastewater by irrigation not only disposes of municipal wastewater and wastewater from food-processing plants, lagoons, and storage ponds but also can improve crop production by increasing the amount of water available to crops. The ratings are based on the soil properties that affect the design, construction, management, and performance of the irrigation system. The properties that affect design and management include the sodium adsorption ratio, depth to a water table, ponding, available water capacity, saturated hydraulic conductivity (Ksat), slope, and flooding. The properties that affect construction include stones, cobbles, depth to bedrock or a cemented pan, depth to a water table, and ponding. The properties that affect performance include depth to bedrock or a cemented pan, bulk density, the sodium adsorption ratio, salinity, reaction, and the cation-exchange capacity, which is used to estimate the capacity of a soil to adsorb heavy metals. Permanently frozen soils are not suitable for disposal of wastewater by irrigation.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect agricultural waste management. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations

between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

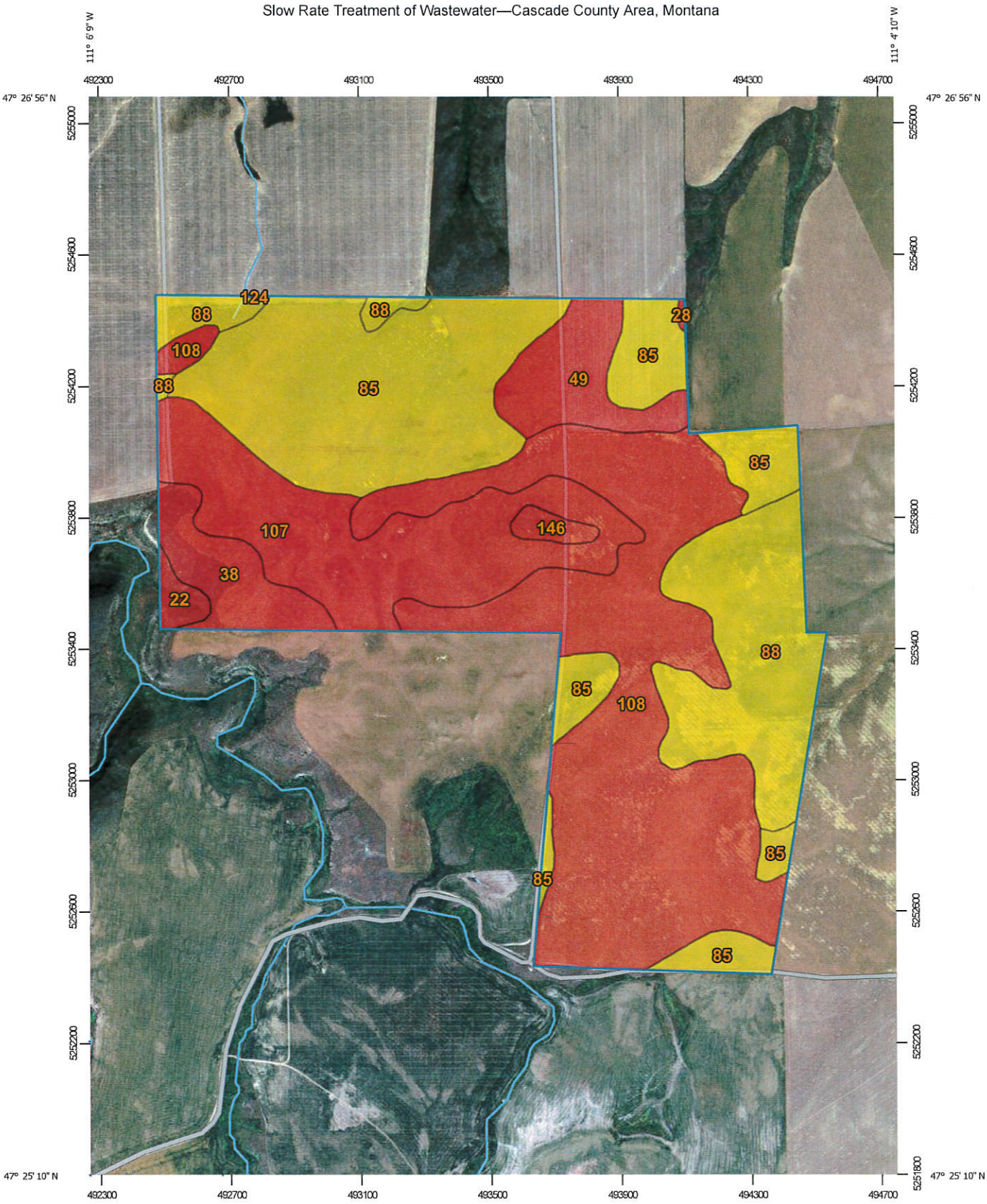
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Slow Rate Treatment of Wastewater—Cascade County Area, Montana



Map Scale: 1:16,000 if printed on A portrait (8.5" x 11") sheet.

Meters: 0 200 400 800 1200

Feet: 0 500 1000 2000 3000

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- Very limited
- Somewhat limited
- Not limited
- Not rated or not available

Soil Rating Lines

- Very limited
- Somewhat limited
- Not limited
- Not rated or not available

Soil Rating Points

- Very limited
- Somewhat limited
- Not limited
- Not rated or not available

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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Compiled 06/27/2019

Slow Rate Treatment of Wastewater

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
22	Big Timber-Castner complex, 30 to 70 percent slopes	Very limited	Big Timber (55%)	Depth to bedrock (1.00)	5.4	0.8%
				Too steep for surface application (1.00)		
				Too steep for sprinkler irrigation (1.00)		
				Slow water movement (0.15)		
			Castner (25%)	Depth to bedrock (1.00)		
				Too steep for surface application (1.00)		
				Too steep for sprinkler irrigation (1.00)		
			Roy (5%)	Too steep for surface application (1.00)		
				Too steep for sprinkler irrigation (1.00)		
				Slow water movement (0.15)		
				Cobble content (0.05)		
28	Bitton and Roy soils, 10 to 65 percent slopes	Very limited	Bitton (45%)	Too steep for surface application (1.00)	0.5	0.1%
				Too steep for sprinkler irrigation (1.00)		
				Cobble content (0.75)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
			Roy (45%)	Too steep for surface application (1.00)		
				Too steep for sprinkler irrigation (1.00)		
				Slow water movement (0.15)		
				Cobble content (0.05)		
			Castner (5%)	Depth to bedrock (1.00)		
				Too steep for surface application (1.00)		
				Too steep for sprinkler irrigation (1.00)		
			Sinnigam (5%)	Depth to bedrock (1.00)		
				Too steep for surface application (1.00)		
				Cobble content (0.75)		
				Too steep for sprinkler irrigation (0.50)		
				Slow water movement (0.15)		
38	Castner-Sinnigam complex, 2 to 15 percent slopes	Very limited	Castner (65%)	Depth to bedrock (1.00)	27.2	4.1%
				Too steep for surface application (1.00)		
				Too steep for sprinkler irrigation (0.50)		
			Sinnigam (15%)	Depth to bedrock (1.00)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Too steep for surface application (1.00)		
				Cobble content (0.75)		
				Too steep for sprinkler irrigation (0.50)		
				Slow water movement (0.15)		
			Absarokee (7%)	Depth to bedrock (1.00)		
				Too steep for surface application (0.32)		
				Slow water movement (0.15)		
			Roy (7%)	Too steep for surface application (1.00)		
				Too steep for sprinkler irrigation (0.22)		
				Slow water movement (0.15)		
				Cobble content (0.05)		
			Reeder (6%)	Depth to bedrock (1.00)		
				Too steep for surface application (1.00)		
				Too steep for sprinkler irrigation (0.78)		
49	Darret-Castner complex, 2 to 8 percent slopes	Very limited	Darret (60%)	Depth to bedrock (1.00)	33.2	5.0%
				Slow water movement (0.94)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Too steep for surface application (0.32)		
			Castner (25%)	Depth to bedrock (1.00)		
				Too steep for surface application (0.32)		
			Big Timber (8%)	Depth to bedrock (1.00)		
				Slow water movement (0.15)		
				Too steep for surface application (0.08)		
			Sinnigam (7%)	Depth to bedrock (1.00)		
				Cobble content (0.75)		
				Slow water movement (0.15)		
				Too steep for surface application (0.08)		
85	Gerber silty clay loam, 0 to 4 percent slopes	Somewhat limited	Gerber (90%)	Slow water movement (0.94)	177.5	26.8%
			Acel (4%)	Slow water movement (0.94)		
			Lawther (3%)	Slow water movement (0.94)		
88	Gerber-Lawther silty clays, 4 to 8 percent slopes	Somewhat limited	Gerber (55%)	Slow water movement (0.94)	93.3	14.1%
				Too steep for surface application (0.68)		
			Lawther (35%)	Slow water movement (0.94)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Too steep for surface application (0.68)		
			Acel (10%)	Slow water movement (0.94)		
				Too steep for surface application (0.32)		
107	Ipano-Ticell loams, 0 to 4 percent slopes	Very limited	Ipano (55%)	Depth to bedrock (1.00)	102.7	15.5%
			Ticell (20%)	Depth to bedrock (1.00)		
			Castner (10%)	Depth to bedrock (1.00)		
				Too steep for surface application (0.68)		
			Absarokee (8%)	Depth to bedrock (1.00)		
				Slow water movement (0.15)		
108	Ipano-Ticell loams, 4 to 10 percent slopes	Very limited	Ipano (55%)	Depth to bedrock (1.00)	218.2	32.9%
				Too steep for surface application (0.92)		
				Too steep for sprinkler irrigation (0.06)		
			Ticell (20%)	Depth to bedrock (1.00)		
				Too steep for surface application (0.92)		
				Too steep for sprinkler irrigation (0.06)		
			Castner (10%)	Depth to bedrock (1.00)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Too steep for surface application (0.68)		
			Absarokee (8%)	Depth to bedrock (1.00)		
				Too steep for surface application (0.32)		
				Slow water movement (0.15)		
124	Lawther-Gerber complex, 8 to 15 percent slopes	Very limited	Lawther (65%)	Too steep for surface application (1.00)	0.1	0.0%
				Too steep for sprinkler irrigation (1.00)		
				Slow water movement (0.94)		
			Gerber (25%)	Too steep for surface application (1.00)		
				Too steep for sprinkler irrigation (1.00)		
				Slow water movement (0.94)		
			Hillon (10%)	Too steep for surface application (1.00)		
				Too steep for sprinkler irrigation (1.00)		
				Slow water movement (0.94)		
146	McKenzie silty clay loam	Very limited	McKenzie (90%)	Slow water movement (1.00)	5.0	0.8%
				Ponding (1.00)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Depth to saturated zone (1.00)		
				Salinity (0.13)		
Totals for Area of Interest					**663.1**	**100.0%**

Rating	Acres in AOI	Percent of AOI
Very limited	392.3	59.2%
Somewhat limited	270.9	40.8%
Totals for Area of Interest	**663.1**	**100.0%**

Description

Slow rate treatment of wastewater is a process in which wastewater is applied to land at a rate normally between 0.5 inch and 4.0 inches per week. The application rate commonly exceeds the rate needed for irrigation of cropland. The applied wastewater is treated as it moves through the soil. Much of the treated water may percolate to the ground water, and some enters the atmosphere through evapotranspiration. The applied water generally is not allowed to run off the surface. Waterlogging is prevented either through control of the application rate or through the use of tile drains, or both.

Soil properties are important considerations in areas where soils are used as sites for the treatment and disposal of organic waste and wastewater. Selection of soils with properties that favor waste management can help to prevent environmental damage.

Municipal wastewater is the waste stream from a municipality. It contains domestic waste and may contain industrial waste. It may have received primary or secondary treatment. It is rarely untreated sewage. Food-processing wastewater results from the preparation of fruits, vegetables, milk, cheese, and meats for public consumption. In places it is high in content of sodium and chloride. The effluent in lagoons and storage ponds is from facilities used to treat or store food-processing wastewater or domestic or animal waste. Domestic and food-processing wastewater is very dilute, and the effluent from the facilities that treat or store it commonly is very low in content of carbonaceous and nitrogenous material; the content of nitrogen commonly ranges from 10 to 30 milligrams per liter. The wastewater from animal waste treatment lagoons or storage ponds, however, has much higher concentrations of these materials, mainly because the manure has not been diluted as much as the domestic waste. The content of nitrogen in this wastewater generally ranges from 50 to 2,000 milligrams per liter. When wastewater is applied, checks should be made to ensure that nitrogen, heavy metals, and salts are not added in excessive amounts.

The ratings are based on the soil properties that affect absorption, plant growth, microbial activity, erodibility, and the application of waste. The properties that affect absorption include the sodium adsorption ratio, depth to a water table, ponding, available water capacity, saturated hydraulic conductivity (Ksat), depth to bedrock or a cemented pan, reaction, the cation-exchange capacity, and slope. Reaction, the sodium adsorption ratio, salinity, and bulk density affect plant growth and microbial activity. The wind erodibility group, soil erosion factor K, and slope are considered in estimating the likelihood of wind erosion or water erosion. Stones, cobbles, a water table, ponding, and flooding can hinder the application of waste. Permanently frozen soils are unsuitable for waste treatment.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect agricultural waste management. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and

moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Stone, Michael

From: Erin Tingey <emtingey@gmail.com>
Sent: Wednesday, June 26, 2019 2:09 PM
To: Planning Comments
Subject: Big Sky Cheese SUP

I am writing with concerns for the Big Sky Cheese LLC SUP. We live at 8359 US Highway 89, directly across the highway from proposed facility. As we are constantly coming and going many times a day, whose five children are picked up and dropped off by their school bus on the highway, we are extremely worried about the increase of traffic. This section of the 89 is single lane. We witness cars passing trucks and slower traffic all the time, especially going west towards Great Falls coming up the hill close by. There are semi trucks all the time, especially at night. Beginning with the construction traffic to build the facility, then continuing with employees coming and going, delivery trucks, maintenance trucks, visitors, to all the constant flow from industrial facilities, traffic will increase dramatically. Add winter weather conditions and darkness at 5pm during the winter we see unsafe traffic conditions putting many at risk, and not just during winter. Please strongly consider what road improvements are needed before this factory is allowed to create dangerous driving situations.
We also feel this type of industry is at odds with the surrounding lands, which are residential and agricultural fields and grazing land.
We also agree with all the points Kathleen McMahon has submitted. She has extensive knowledge and experience regarding land use, which we do not. We have read all the information provided by Big Sky LLC, but again are busy with our daily lives of six kids and work and cannot become experts on cascade county zoning and Montana zoning regulations. We are worried for the safety of our children as three will be driving in the next 4 years. We also worry about the value of our home decreasing, being across the street from an industrial cheese factory and whatever else will follow it.
Thank you for reading and considering our concerns.
John and Erin Tingey

FOR OFFICE USE ONLY
Date Received: 6/26/2019
Date Reviewed: 6/27/2019
Complete: ☑ Yes ☐ No

Public Comment Form

Cascade County Public Works Department Planning Division
121 4th St N, Suite 2H-2I Great Falls, MT 59401
Phone: 406-454-6905 | Fax: 406-454-6919
Email: planningcomments@cascadecountymt.gov

Compiled 06/27/2019

Instructions

This form is for providing public comment to the Cascade County Planning Division for review by any one or more of the following review and/or approval boards: Zoning Board of Adjustment (ZBOA), Planning Board, or Board of County Commissioners. Only complete submissions will be included for board review. Please provide the relevant information for each section below. A complete submission provides all of the following: commenter name and address, comment subject, and commentary on the subject issue(s). If additional space is needed for commentary, please attach additional sheets to this form. Completed forms may be submitted in person at the Planning Division office or by email at planningcomments@cascadecountymt.gov.

Commenter Information

Name: THOMAS BAIZ, JR

Complete Address: 117 W. GROVE STREET #204 MISHAWAKA IN 46544

Comment Subject (please check one):

- ☒ Special Use Permit Application
- ☐ Subdivision
- ☐ Zoning Text and/or Map Amendment
- ☐ Growth Policy
- ☐ Variance
- ☐ Floodplain Regulation Amendment
- ☐ Subdivision Regulation Amendment
- ☐ County Road Abandonment/ Discontinuation of County Street
- ☐ Other (describe): _____

Comment

SEE ATTACHED LETTER

For Office Use Only					
Date Received:	6/26/2019	Date Reviewed:	6/27/2019	Complete:	☒ Yes ☐ No

Stone, Michael

From: Tom Baiz <tombaizjr@gmail.com>
Sent: Wednesday, June 26, 2019 7:47 AM
To: Planning Comments
Subject: Big Sky Cheese SUP Comment
Attachments: img012.jpg

26 June 2019

Thomas Baiz, Jr.
117 W Grove Street, Apt. 204
Mishawaka IN 46545

Dear Cascade County ZBOA:

Back in the 1970s, I chose Great Falls to be my home. I was attracted by this clean, open city, on the cusp of the Rockies. It's my wife's hometown. It's where my kids were born and raised.

I am a strong opponent of what my wife calls "the Madison Mega-Slaughterhouse." Like her, I believe Big Sky Cheese is a way for Friesen Co. to create momentum and diffuse opposition for their massive, incongruent development east of Great Falls.

Big Sky Cheese's Special Use Permit (SUP) is misleading, inadequate, and not in the best interests of Cascade County.

Their application indicates Big Sky Cheese "will process fresh milk supplied by local and regional dairy producers." Which local dairies are they referring to? To my knowledge, there are no independent dairies remaining in the area.

The SUP estimates the factory will produce 9716 gallons of whey PER DAY, and will discharge 12,960 gallons of wastewater per day. Estimates like these, given to other communities, have been misleading. (https://www.wsj.com/articles/lowville-had-lots-of-water-then-string-cheese-came-to-town-11559753552). Is there a way to present an economic disincentive in advance, if the factory exceeds estimated water use? Is there a way their use can be capped? If not, is this project worth the water gamble?

It is unclear if Big Sky Cheese's water use in addition to the massive water use estimates of the proposed mega-slaughterhouse provided in the initial (withdrawn) SUP?

The SUP claims Big Sky Cheese will "foster and stimulate well-planned entrepreneurship among the county's citizenry." Please ask the applicant for specifics. It's my understanding that the driving force behind Friesen already controls 90% of Montana hog production, and 98% of Montana egg production. How much Montana dairy production will be controlled by this entity, if this factory is built?

Big Sky Cheese, if it's built by this same entity, will aggravate monopoly and captive market issues.

The SUP states this project is "committed to green technology in the near future where possible and if deemed feasible."

As a retired attorney, I assure you this claim is worse than meaningless. Being "committed" is not a plan. "Green technology" is ambiguous. The "near future" could be decades away. The words "if possible" and

"deemed feasible," neuter any intent. Please ask Big Sky Cheese about the specifics, and ask them to provide successful examples, instead of broad statements.

The questions asked in this letter are not rhetorical. If the applicant cannot provide reasonable answers to legitimate concerns, please postpone approval of the SUP, or deny it outright.

Sincerely,

Tom Baiz

Public Comment Form

Cascade County Public Works Department Planning Division
121 4th St N, Suite 2H-2I Great Falls, MT 59401
Phone: 406-454-6905 | Fax: 406-454-6919
Email: planningcomments@cascadecountymt.gov

Instructions

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Commenter Information

Name: TAMMIE LYNNE SMITH

Complete Address: 397 HIGHWOOD ROAD, GREAT FALLS, MT 59405

Comment Subject (please check one):

- ☒ Special Use Permit Application
- ☐ Subdivision
- ☐ Zoning Text and/or Map Amendment
- ☐ Growth Policy
- ☐ Variance
- ☐ Floodplain Regulation Amendment
- ☐ Subdivision Regulation Amendment
- ☐ County Road Abandonment/ Discontinuation of County Street
- ☒ Other (describe): SUP #006-2019 BIG SKY CHEESE, LLC - State Agency Approvals and Permits

Comment

TO: PLANNING STAFF, ZBOA MEMBERS, COUNTY ATTORNEY

I have reviewed SUP #006-2019 for Big Sky Cheese LLC, the corresponding Staff Report, and Sections 10 Standards for Special Use Permits and Section 12 Zoning Board of Adjustments.

The Cascade County Special Use Application includes criteria applicants must discuss and submit supporting information and documents for indicating sufficient compliance for ZBOA approval. I have contacted the state agencies responsible for many of the criteria concerns.

To date:

Applicant has not contacted MDOT regarding traffic permits, ingress/egress, or a traffic impact study for this application.

I request the ZBOA not approve the SUP with conditions that applicant secure the necessary MDOT permits and traffic impact study, but delay the SUP approval pending the receipt of a MDOT preliminary review and assessment of the application.

Applicant has not contacted DNRC regarding extensive water supply needed for this application.

I request the ZBOA not approve the SUP with conditions that applicant secure the necessary DNRC approvals, but delay the SUP approval pending the receipt of a DNRC preliminary review and assessment of the application.

Applicant has not contacted MT DEQ regarding the many environmental concerns related to this application.

I request the ZBOA not approve the SUP with conditions that applicant secure the necessary DEQ permits related to wastewater, storm water discharge during construction, and storm water runoff, but delay the SUP approval pending the receipt of a DEQ preliminary review and assessment of the application.

For Office Use Only					
Date Received:	6/26/2019	Date Reviewed:	6/27/2019	Complete:	☒ Yes ☐ No

Public Comment Form

Cascade County Public Works Department Planning Division
121 4th St N, Suite 2H-2I Great Falls, MT 59401
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Commenter Information

Name: TAMMIE LYNNE SMITH

Complete Address: 397 HIGHWOOD ROAD, GREAT FALLS, MT 59405

Comment Subject (please check one):

- ☒ Special Use Permit Application
- ☐ Subdivision
- ☐ Zoning Text and/or Map Amendment
- ☐ Growth Policy
- ☐ Variance
- ☐ Floodplain Regulation Amendment
- ☐ Subdivision Regulation Amendment
- ☐ County Road Abandonment/ Discontinuation of County Street
- ☒ Other (describe): SUP #006-2019 BIG SKY CHEESE, LLC - MT MILK INDUSTRY

Comment

TO: PLANNING STAFF, ZBOA MEMBERS, COUNTY ATTORNEY

I have reviewed SUP #006-2019 for Big Sky Cheese LLC, the corresponding Staff Report, and Sections 10 Standards for Special Use Permits and Section 12 Zoning Board of Adjustments.

Further, I have spent significant time researching cheese processing facilities and the Milk Industry in Montana. I contacted the MT Milk Control Bureau and the Milk & Egg Bureau, both within the MT Dept of Livestock, and was surprised to hear that the applicant has not contacted either bureau to discuss the permitting and regulatory requirement for the development of a cheese processing facility in the state of MT. MIlk is one of the most restrictive and regulated industries in Montana.

Both bureau's have reviewed the SUP and find it's information related to milk supply interesting. The milk supply requirement for this plant will not be satisfied by local or regional dairy producers. Likely milk will be imported from Idaho. In Montana, value added milk product manufacturer's can buy directly from dairies or can purchase milk from Marigold or other approved milk product producers. The regulations differ significantly between direct dairy purchase or product producers.

Applicants claims that the proposed development will be consistent with Cascade County Growth Policies specifically related to sustaining local economic well being, stimulating well planned entrepreneurship in the county, supporting local business environment, improving local trade capture, to name just a few are inconsistent with the current state of the milk industry in Montana. I have attached the Montana Milk Market Regulation Study, dated June 2018, that I think will provide good insight to the viability of such a facility and its impact to the county.

I request the ZBOA not approve the SUP with conditions but delay the SUP approval pending further economic review.

For Office Use Only					
Date Received:	6/26/2019	Date Reviewed:	6/27/2019	Complete:	☒ Yes ☐ No

Montana Milk Market Regulation Study
Final Report

To assist the
Montana Board of Milk Control
with Future Policy Development

June 4, 2018

Submitted by:
Dairy Technomics
Corey Durling
Karol Szot
Bob Cort
Bud Cary

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1. EXECUTIVE SUMMARY

1.a. Purpose of Study

The stated purpose of the study is to provide information and insight to support future policy development by the Montana Board of Milk Control. To accomplish this, we evaluated the dairy industry in Montana, and incorporated regional and national aspects to develop options and recommendations intended to:

- Improve the viability and sustainability of the dairy industry in Montana
- Ensure that revenues and costs are fairly and equitably treated among participants
- Position the Montana Dairy Industry to compete effectively in the region and create and realize opportunities for growth and investment

Throughout this report most of our empirical analyses and calculations use calendar year data provided by the Montana Department of Livestock Milk Control Bureau rather than fiscal year figures. This allowed us to evaluate more recent data based on the calendar year ended December 31, 2017 as opposed to the last fiscal year ended June 30, 2017. On occasion, where it was necessary or appropriate, we used fiscal year data and identified it as such.

1.b. Summary of Key Findings and Recommendations

Overall, the recommendations which follow are intended to strengthen the Dairy Producers in Montana, so they are in a position to adapt to future growth and Processor needs. We believe this can be accomplished by modifications to the existing Quota and Pooling structures. These changes are intended to create a pricing structure that provides a return to the Producers and improves their financial position, while at the same time provides Processors with the volume of milk needed and allows them to earn a reasonable return on their facility investments.

The following summarizes our Recommendations, some of which were selected from multiple options. Where there are multiple options, the Analysis and Findings section of this report contains detailed discussions of the options considered.

<u>Study Task 1 – Price Formula Analysis & Recommendations</u>

1) Use the Federal Milk Marketing Order Advanced Class pricing as the basis for Montana in-State milk (see detailed discussion in Section 4.a. ii. Montana Class I Pricing on page 27)
   a) Dairy processing plants in most states and Orders in the country, including the states near Montana, use Federal Order pricing as their basis, even if the state is not regulated
2) Montana should maintain the Montana Differential of $2.55 for Class I milk for the immediate future
   a) We found no compelling reason to revise it at this time, and it supports the Producers
   b) Should the fluid milk market in Montana change or become threatened by out-of-State Processors, it may make sense to revise the Montana Differential

   c) It may make sense to lower the Montana Differential, once our recommended changes are fully implemented and Producers are in a better and more stable financial position, to strengthen Montana's competitiveness
      i) If such a move is considered, the impact on remotely located Producers should be evaluated as part of the analysis
3) Class II should be based on the Federal Order, with Class II butterfat based on Advanced pricing (see detailed discussion in Section 4.a. iii. Montana Class II on page 29)
4) Montana Class III pricing should be the lower of Federal Order Class III and Class IV but calculated from Advanced pricing (see detailed discussion in Section 4.a. iv. Montana Class III on page 30)
   a) This should increase value to Producers
   b) It may be necessary to incorporate some discounts to Processors, at least for a period of time, to allow the impact of a change in Class III pricing to be absorbed
      i) We recommend a $0.25 per pound (approximately 10%) reduction to the butterfat price that reduces to around $0.10 (approximately 4%) over three years
   c) Setting the Class III skim price at the lower of the Federal order Class III or Class IV skim price supports the potential for Class III milk manufacturing in Montana. The butterfat discount provides additional incentive
5) The pricing structure for raw milk that is sold out-of-State as Surplus Bulk milk can remain substantially the same
   a) At present, Surplus Bulk is sold to balancing plants, and through the Pool, Montana Producers are effectively paid whatever the receiving plant is willing to pay for the milk, less the cost of hauling
6) Do not institute seasonality incentives (see detailed discussion in Section 4.a. vi. Variable Class I Price Formula to Manage for Seasonality on page 33)
   a) Given Montana's size, and the lack of successful models for managing seasonality, we do not believe seasonality incentives are appropriate
7) Component Pricing would have no immediate benefit and is not necessary at this time since Montana Pool Processors currently do not make Class III products (see detailed discussion in Section 4.a. vii. Component Pricing on page 37)
   a) However, given that Component Pricing provides benefits to Class III Processors, Montana could establish Component Pricing to support investment interest, and to have it in place in the event that a Class III plant is looking to locate in Montana

<u>Study Task 2 – Recommendations for Adjustments to Utilization of Class I Packaged Milk Sold as Surplus Milk</u>

8) The discount for Packaged Milk sold out-of-State should continue with some modifications (see detailed discussion in Section 4.b. i. Surplus Packaged Milk on page 37)
   a) The concept of discounting Packaged Milk that is sold out-of-State works well, but the level of discount should depend on where the milk is being sold and be justified by the Processor by calculating the difference in the local market Class I price as well as the cost of delivery to that specific market

b) These calculations should be verified by the Milk Control Bureau
c) The discount will be different for different geographic markets

Study Task 3 – Hauling Unprocessed Milk Between Plants

9) The practice of charging the state-wide Pool for the cost of hauling unprocessed milk between plants should be discontinued either on a stand-alone basis or in conjunction with other Pool related recommendations (see detailed discussion in Section 4.c. Study Task 3 – Hauling Unprocessed Milk Between Plants on page 41)
   a) Charging Producers for the cost of hauling milk that is "diverted" between Class I plants does not exist in any other Order in the country to our knowledge
   b) This practice enables certain inefficiencies in the system and results in certain Producers subsidizing costs for which they do not always receive equal value in return
      i) Our experience is that hauling charges for transporting milk between Processors is typically borne by the Processor, but the Producer pays for the portion of the hauling cost that represents the cost of delivery to the closest plant if the milk had not been diverted
   c) In Study Task 4 we recommend splitting the current state-wide Pool and establishing two separate Pools by Processor (see Recommendation 14) on page 8)
      i) Under separate Processor Pools, the Producers in each Pool could decide whether and how to allocate this cost within their Pooled group

Study Task 4 – The Montana Quota System

10) We believe the Montana Quota system should be modified so that the state-wide volume of issued Quota ("Quota") is approximately equal to the Montana Class I volume that is packaged and sold in Montana (see detailed discussion in Section 4.d. iii. Options for Setting the Amount of Quota Going Forward on page 53). We considered three options:
   a) **Quota Option 1:** Our recommendation is that total state-wide Quota be set at approximately 107% of Class I Montana volume
      i) This is the approximate volume of milk necessary to adequately supply in-State Class I sales, given that a portion of the raw milk required for Class I ends up as cream and shrink as part of the normal bottling process
      ii) If total Quota is set at 107% of Class I volume and Producers stay strictly within their individual Quota, a situation could arise where there may not be enough milk to meet Class I needs. We believe this is unlikely and could be addressed at the appropriate time
   b) **Quota Option 2:** A second option would be to maintain Quota at its current level, but increase the Differential significantly above the current $1.50 to provide a strong, even uneconomic, disincentive for producing Excess
      i) Because state-wide issued Quota is greater than current production, this may have little effect in reducing over-production and Surplus milk. Although Producers may reduce or eliminate their Excess, other Producers, who currently produce under

their Quota, could easily make up the difference without going over state-wide Quota

c) **Quota Option 3:** A third option would be to eliminate Quota entirely
   i) We do not believe this option would be appropriate because of its impact on the asset value of assigned Quota to farms

11) Other rules that we believe would support a revised Quota system include:
   a) Adjust Quota up or down as appropriate on an annual basis to stay in line with Class I in-State volume
   b) Allocate any revisions or adjustments in Quota on a pro-rata basis among Producers currently holding Quota
   c) Reduce the Quota of any Producer, whose average monthly production did not meet their full monthly Quota volume during the same annual period, to what they actually produced over that period, in concert with the annual Quota adjustment
      i) The difference would be dropped from the system
      ii) At the next annual Quota adjustment, the proper volume of Quota would be established and reallocated on a pro-rata basis
   d) Relinquish and drop from the system any Quota held by a Producer who has shut down operations and has been unable to sell the Quota within a year
      i) Currently the rule provides 90 days to sell, but unsold Quota is reallocated to all remaining Producers on a pro-rata basis
      ii) Since lost Quota would be dropped from the system, it seems reasonable to provide potential buyers more time to decide or arrange any financing necessary to purchase additional Quota

12) We evaluated three methods for pricing Quota Volume (See discussion in Section 4.d. v. Options for Pricing Quota Milk on page 59)
   a) **Quota Pricing Option 1:** Our recommendation would be to price Quota milk based on the calculated value of the highest value utilizations of the volume required to make up Quota
      i) If Quota is equal to or less then Class I sales, the Quota milk price will be the Class I price
      ii) If Quota is greater than Class I sales, then some of the utilization value of the next highest value product will be included in the Quota milk price calculation.
      iii) This structure is similar to the Cascading Tier structure, but just for Quota
   b) **Quota Pricing Option 2:** A second option is to price all Quota milk at Class I regardless of the actual Class I volume
      i) This maximizes revenue for holders of Quota and if Class I volume is less than Quota, the Class I utilization value of the difference would be drawn from Excess utilization value of the Pool
   c) **Quota Pricing Option 3:** A third option is to incorporate Class I pricing with an appropriate percentage of Class III pricing to derive a net weighted average price for Quota milk
      i) Since bottling Class I milk generates cream and shrink, the percentage of raw milk that is generated as cream and shrink as part of the bottling process should be

valued at its Class III price and combined with the Class I value of the bottled milk to derive a net weighted average price for Quota milk

d) Under any of these options the current fixed Excess Differential of $1.50 would become unnecessary and somewhat counterproductive to a certain extent
   i) If the Excess Differential is maintained it should be increased to an appropriate level to reflect the impact of Pricing and other Pooling recommendations (see discussion in section 4.d.vi. Pricing Excess Volume on page 60)

e) The estimated incremental cost of production in Montana would allow many Producers to produce a reasonable amount of Excess on a profitable basis, so long as Excess was not valued too much below Class III

13) Once the method for pricing Quota Volume is determined, there are a number of methods for pricing the Excess Volume. We believe the most equitable approach for pricing both Quota and Excess is to establish a "Cascade" pricing methodology so that each Producer participates in lower value utilizations (below Class I) only to the extent that they have remaining unutilized Excess (see detailed discussion in Section 4.d.vii. Cascading Tiered Pricing on page 60)

a) Each lower value "tier" of utilization would be allocated only to those Producers who generated sufficient Excess to participate in that tier

b) At each tier the allocation of value would be based on the proportion of Quota owned by the Producers whose un-utilized Excess falls into that tier and the Producers with the highest percentage of production in excess of Quota production would fall to the lowest tier. In determining the pro-rata allocation within a given tier, Quota ownership of just those Producers falling to that tier would be the basis of allocation.
   i) For example, if total Quota across the Pool is 160 million pounds, then the allocated share of the first tier would be based on each Producer's pro-rata share of the total Quota of 160 million pounds
   ii) However, if the total Quota ownership associated with just those Producers whose Excess production fell into the third tier amounted to a total of 40 million pounds of Quota, then the allocated share of that tier would be based on those Producers pro-rata share of the 40 million pounds of total Quota, regardless of the actual volume in that tier

c) The tier with the lowest value of utilization (e.g., Bulk Surplus) would end up allocated to those Producers with the highest percentage of Excess production

d) This approach increases return to those Producers who have more Quota and minimize their Excess and lowers return to Producers with less Quota and higher Excess and works regardless of how the Pool is structured
   i) The resulting Excess milk price paid to the Producers would depend on which Pool they deliver to assuming the Pool is no longer state-wide

14) As part of our evaluation of Study Tasks 1-4 we evaluated whether the Pool structure itself needs to change to help address the broader range of issues and in conjunction with other recommendations made in this report. Our conclusion is that the Pool should change (see detailed discussion in Section 4.d. viii. The Pool Structure on page 66)

a) Pool Option 1: Our recommendation is that the state-wide Montana Pool, as well as Quota, should be separated into two Pools aligned with the current Pool Processors Darigold and Dean/Meadow Gold. Separate Pools, in addition to addressing the inter-Plant hauling issue, would eliminate other offsetting values or costs incurred by each group of Producers that are currently allocated across the state-wide Pool. These include Bulk Sales hauling charges, out-of-State Packaged Sales discounts, and Bulk Sales price reductions
   i) Pool Option 1-A: Associating Quota by Processor through the Producers who supply that Processor, along with the segmented Pools, would create some initial alignment issues, where each Pool would have more or less Quota than its Class I sales, but we believe these could either be resolved during the initial implementation or allowed to evolve and be re-evaluated over time as appropriate
   ii) Pool Option 1-B: A second approach for addressing Quota under a segmented Pool structure would be to maintain Quota on a state-wide basis, but handle Excess within the segmented Pools
      (1) When Quota volume exceeds Class I sales, the additional utilization value assigned to Quota could come from either Pool, whichever has the highest value utilization
   iii) Pool Option 1-C: The third approach under a segmented Pool structure would be to eliminate Quota altogether
      (1) We do not believe this option would be appropriate because of its impact on the asset value of assigned Quota to farms
b) Pool Option 2: The second option in regard to the Pool would be to eliminate it completely
   i) A significant issue that would need to be addressed, if the Pool is eliminated but the Quota system is kept, would be how handle unaffiliated Producers (not members of a cooperative) who hold Quota
   ii) However, the Milk Control Bureau's interpretation of 81-23-302(15), MCA is that the statewide Quota systems is an optional add-on of the statewide Pool. If the statewide Pool system is eliminated, the statewide Quota system would be eliminated by default. Producers delivering to a common distributor could petition for a Quota plan under that distributor under 81-23-302(14), MCA.
c) Pool Option 3: The third option would be to maintain the state-wide Pool essentially as it is but make minor adjustments to address individual issues

Study Task 5 - Expansion

15) In addition to addressing the specific individual Tasks of this report, the recommendations provided above should help to stabilize and strengthen the core foundation and financial viability of the dairy industry in Montana. This in turn should help create an environment to attract investment and growth in the industry by:
   a) Incentivizing ongoing efficiency improvement throughout the dairy value chain
   b) Aligning pricing with market conditions

c) Enabling greater opportunities and flexibility for milk from Montana
d) Making Montana more attractive as a state for dairy investment
e) Providing a structure that enables production of a sufficient supply of milk at a price that is attractive

16) Beyond that, the state could consider measures that would address the factors and priorities investors in dairy related projects evaluate when comparing locations and making investment decisions:
   a) Sufficient supply and pricing of milk
      i) Cost of dairy farm inputs
      ii) Milk production regulations and permitting
   b) Capital and operating cost of Processing
      i) Availability and cost of land and infrastructure
      ii) Ease and cost of permitting and regulatory compliance
      iii) Cost of construction
      iv) Cost of manufacturing inputs – power, labor, materials, disposal
   c) Programs and incentives designed to create and promote an entrepreneurial environment for dairy processing and specifically targeted at attracting smaller, niche and branded production of dairy products

17) Certain products may be more attractive than others
   a) Montana's milk supply is either too small or too large depending on the type of product desired
      i) Producing commodity cheese requires a plant with a very low production cost. This requires large volumes of milk (minimum of 1 million to 2 million pounds per day). Montana is not currently in a position to do this
      ii) Alternatively, smaller facilities produce smaller quantities of product at a higher cost, but this requires a branding strategy to be profitable. Typical plants of this size might start out between 3,000 and 30,000 pounds of milk per day. This will not have a very large effect on the Surplus Milk situation in the State
   b) Yogurt has been a trending product. If a local yogurt plant could supply 20% of the current Montana consumer usage, that would be 3.5 million pounds per year which would make for a viable plant and would use a good amount of Montana Surplus milk. A modest plant could be built on its own or added to an existing milk plant. However, there is a lot of competition, and it would be difficult to take share from established companies
   c) Cheese may be the easiest product to develop. For under $1 million, a modest plant could be built to supply specialty cheese to the local market
   d) Other potential products include butter, ghee (a butter product) and carbonated and other new milk products

2. STUDY APPROACH AND CONSIDERATIONS

The purpose of this study was to provide information and insight to support future policy development by the Montana Board of Milk Control. Our approach involved gaining an understanding of the Montana Dairy industry and then analyzing the regulations with an eye towards strengthening the industry and providing a framework for growth.

Broadly, our approach was to address the general structure of regulations, rules and procedures governing the Dairy Industry by the Montana Legislature and the Milk Control Bureau and the overall philosophy and structure of regulation. In doing so, there appeared to be two broad sets of options:

- Generally continue under the current structure and rules and tweak certain elements
- Change the fundamental structure; possibly towards a model that incorporates partial or total deregulation

In general, we looked to move Montana towards a model that provides more flexibility and decision making, especially at the Producer level, that would allow the broader industry to respond to changes in the market and region. This would allow more flexibility in making changes that reflect market conditions and help speed up the process of change when change is warranted.

In addressing the pricing structure (Study Tasks 1 and 2) of Montana's various Classes of utilization we considered a number of questions:

- What should Class pricing formulas be based on?
- Would component pricing be useful?
- Would it be beneficial to implement policies to manage seasonality of milk?
- Should the Montana Differential be adjusted and what are the implications to competition from out-of-State as well as the impact on Producers and Processors?
- How should the disposition of Cream, Surplus and packaged milk currently going out-of-State be handled and what is the impact on Producers and Processors?

In our evaluation of the structure of the Dairy Pool (incorporating the Quota system and Inter-Plant Hauling, Study Tasks 3 and 4) a number of options were considered that included:

- Continue but tweak the current shared Pool approach state-wide
- Eliminate the Pool entirely and directly assign revenues and costs to individual entities
- Segment the state-wide Pool into certain sub-groups (either Producer or Processor based), then share as agreed within each sub-group
- Change how transport costs for inter-Plant (Task 3) and out-of-State hauling are handled
    - Should inter-Plant hauling cost be charged to Pool or other?
    - Should out-of-State bulk transport cost be charged to Pool or other?

In considering whether revisions should be made in how other components within the state-wide Pool are handled we addressed the following broad questions:

- Should out-of-State packaged milk differentials be shared in the Pool or otherwise?
- Should bulk milk sales utilization value be shared in the Pool?
- If the Pool is restructured into sub-Pools, and milk is shipped between the sub-Pools, how should these inter-Plant milk deliveries be priced or valued?
- Should there be a cap on any of the amounts that are charged to the Pool?

In our evaluation of options for setting and allocating Quota (Study Task 4) we addressed the following questions and issues:

- Should the Quota system be eliminated altogether?
- Should the Quota system be changed to create a different volume basis for Quota?
    - What classes of utilization in Montana should be included in Quota?
    - How often should Quota be adjusted?
    - Should mechanisms be established to revise Quota volume down as well as up?
- How should Quota be priced?
- Should the Excess pricing Differential be changed?
- What should Producer requirements be for meeting Quota?

Finally, in evaluating the feasibility of expanding dairy processing and manufacturing within Montana (Study Task 5) to support and generate growth in Montana milk production we addressed such questions as:

- Is there a defined market for dairy products that would support a basis for new investment?
- What state incentives and policies outside of what the Milk Control Bureau controls could be made available including:
    - Incentives to promote feed crop farming, dairy farming, processing plants and consumption
    - Financial and tax incentives, establishing economic development zones
    - Environmental incentives or policies
    - Land and use permits, access to utilities and other requirements
    - Creating an environment to attract commercial investment in dairy

3. GENERAL OBSERVATIONS AND FINDINGS

3.a. Summary Overview of the Montana Dairy Industry

The dairy industry in Montana reflects trends that are occurring nationally. Overall, the consumption of fluid milk has been consistently trending downwards, although recently there has been increased interest in higher fat content in fluid milk. There is an oversupply of milk that, in concert with declining consumption, has the natural effect of pushing prices down and creating a certain level of volatility, although it should be noted that many factors contribute to the movements of pricing.

Many dairies are ceasing operations but the average herd size of those that remain has increased to generally take up the slack. The economics of dairy farming favors farms with sufficient size to realize economies of scale. Per a USDA report titled "Changing Structure, Financial Risks, and Government Policy for the U.S. Dairy Industry", released in March 2016, farms with herds larger than 2,000 cows realize cost efficiencies of up to 25% per cwt compared to the dairies with 500 or fewer cows that represent the bulk of Montana's farms. These trends of lower demand for fluid milk and consolidation of farms and Processors are expected to continue.

Montana operates in a somewhat unique environment. Within the United States, Montana ranks 4th in terms of land area, 44th in terms of population and 48th in terms of population density. Data regarding Montana's per capita consumption of dairy products was not readily available for this report but given Montana's population ranking it is assumed that it's dairy consumption rank would be comparable.

Montana ranks at or near the bottom regionally, as well as nationally, in terms of milk production and the net price its dairy farmers receive for their milk despite having the highest price in its region for Class I milk. Montana provides nearly 85% of the fluid milk sold within the state but less than 10% of all other dairy products sold. This low net price results primarily from the fact that nearly 40% of Montana milk production is sold out-of-State at greatly discounted prices that, along with other factors and adjustments including high transport costs, lower the average price of milk that Producers receive.

Montana operates under a state-wide Pool system for pricing whereby all dairy Producers receive the same blended price for the milk they produce, adjusted for butterfat and whether the milk is part of their Quota volume or Excess (as described below). The blended price is based on the utilization of all the milk received by Montana's three in-State Pool Processors located in Great Falls, Bozeman and Billings, and includes certain freight and other pricing-related adjustments that are made based on how and where the milk is sold. This Pool-based blended price per cwt received by all Producers in the state is, in concept, the same regardless of how much milk an individual farmer produces, although there is a fixed difference of $1.50 per cwt between Quota volume and Excess volume.

Each Montana-based farm has a specific defined daily volume of milk they may produce, their Quota, to obtain the best price. Any milk produced in excess of their Quota volume is penalized with an Excess Differential of $1.50 per cwt as described in the following.

Milk produced by a farm within its individual Quota is paid for based on the Producer's actual skim and butterfat content, with each component paid based on a Quota skim price and a Quota butterfat price. This results in a Quota blend milk price for the individual farm that differs based on each farm's butterfat content. Conceptually, if all farms had the exact same butterfat content, the result would be a common state-wide blend Quota price.

Milk produced in Excess of a farm's individual Quota is priced at the individual Producer's Quota blend price less a fixed $1.50/cwt reduction. This Differential was established to discourage Excess production. As with Quota, the Excess blend price is paid based on actual skim and butterfat content, but again, if all farms had the exact same butterfat content, the result would be a common state-wide Excess blend price that would be $1.50/cwt less than Quota under the same assumption. Although Quota is defined as a daily production allotment, Quota and Excess production are calculated on a monthly basis for purposes of pricing.

The total volume of Montana production allowed by the Quota system was established years ago based on the then volume of milk that was being processed in-State for the Montana market. Since then, the Quota volume has remained relatively the same, but milk processed and sold within the State has declined to the point where now almost 40% of the volume produced within Quota represents Surplus milk over what can be processed and sold within the State.

In fiscal 2017 total state-wide Quota volume among all Producers was greater than total production by nearly 6.5% despite the fact that a number of dairy farms produced well in Excess of their individual Quota volumes, meaning that the other farms collectively produced less than their individual Quota volumes. The volume of milk produced by those farmers who exceeded their individual Quota represented 3.94% of total production in calendar year 2017, down from 4.87% in 2016 and 6.14% in 2015, reflective of a general reduction in the total state herd size over that period.

Regardless of their individual Quota, farmers are free to produce at whatever volume they choose so long as their Processor will accept it. The Processor will either utilize the milk itself or divert it to another plant. Alternatively, farmers can find a home for the Excess milk on their own.

The combination of Pooling and Quota systems has contributed to a situation in Montana whereby farmers have sustained a level of production that far exceeds what is needed for in-State utilization. This over-production has resulted in downward pressure on prices. Within the current structure farmers have little to no effective incentive or means to manage the amount

of milk they produce in order to affect the price they receive. Since they will receive the same price per cwt, based on their butterfat content, regardless of how much milk they individually produce, many farmers continue to produce as much as allowed by their individual Quota volumes, and in some cases much more.

Technically, if all Producers reduced or increased production enough there would be an impact on the net blended price, but the impact of a volume change by any individual Producer has negligible effect. It would take an unlikely concerted effort to have all Producers reduce volume by an equal percentage on a state-wide coordinated basis.

The impact to Processors is somewhat more favorable in that sales out-of-State allow them to maintain a higher volume going through their plants. This helps their efficiency somewhat and provides additional sales, but the cost impact of this tends to be borne by the farmers. Without available Surplus milk, certain plants may potentially be hard pressed to maintain profitable operations. This could potentially lead to shutting down operations.

The current combination of Pooling and Quota systems also has the effect of masking certain logistical and operational inefficiencies within the state's dairy value chain that makes Montana's milk and related products less competitive in the region. It should be noted that Montana's rules for Pooling, Quota and pricing have been in place for a long period of time, in some cases for decades, and pre-dates the tenures of the current Board of Milk Control and staff.

The majority of Montana's Producers are relatively small, and many are located significant distances from the nearest Processor. Nearly half operate as independent Producers. This geographic dispersion of Producers results in a higher cost in the raw milk supply to cover transportation costs. Additional transportation cost is incurred transferring milk primarily from Great Falls and Bozeman Producers to the Billings plant to meet its demand.

Producers have been shutting down steadily over the last 20 years. The current number of dairies represents about half of the dairies that were in operation in the year 2000, although an increase in average herd size, and increased production per cow, have taken up a fair portion of the slack. These same trends exist in other parts of the country. However, all of the states in Montana's region other than North Dakota and Wyoming, the States closest in size to Montana, have more than offset a reduction in the number of herds by an increase in total cows and production per cow. This has resulted in net growth in their dairy industry, which for certain states has been significant over the period 2006-2016 (see Comparison of State Dairy Industries in Section 4.a. i. on page 24).

The three primary processing plants are relatively old, somewhat small and currently run below their capacity, which lowers their general efficiency. In addition, they are owned by large national and regional concerns that have multiple plants in neighboring states, many of which could serve Montana.

Several neighboring states and the region collectively dwarf Montana in all respects; production, processing, and assumed efficiency and lower cost. There are bottling plants in neighboring states that are sufficiently close enough, within several hundred miles, to conceivably supply Montana with finished product.

In summary, the Montana dairy industry is in a somewhat fragile and vulnerable position:

- Montana is one of the smallest dairy consuming states in the nation and its Class I fluid milk consumption has declined in line with the national trend
- Overall the Montana dairy industry is small, geographically dispersed for its size, and almost entirely concentrated on commodity Class I fluid products. Montana already serves 85% of the Class I in-State market. Nearly all other dairy products are brought in from out-of-State
- With the exception of Idaho in 2017, the net price for milk per cwt paid to the Producers in Montana is the lowest in the region and at or near the bottom in the country
- The Pool in Montana was initially established to benefit Montana's Producers as a group, but it currently has the effect of subsidizing costs incurred by certain portions of the system across the entire system. Revenues and costs do not flow directly to where earned or incurred

3.b. Detailed Information on the Montana Dairy Industry

The Montana Dairy Industry has been steadily declining over the period of fiscal 2000 through 2017 and is challenged by a number of factors. The number of Montana Dairy Producers declined by 60% but this was offset somewhat by a doubling of the average herd size from 92 to 184 (See "Montana – Number of Cows and Dairies-Trend" in Appendix C). The total number of cows declined by 15% but was offset somewhat by an increase in production per cow of 12%.

Montana total milk production varied over the period, but calendar 2017 production was the lowest over the period and nearly 5% less than in the year 2000. Montana supplies 85% of the 22 million gallons, or 190 million pounds, of Class I milk consumed in Montana. Approximately 60% of the milk produced in-State was utilized for in-State consumption and nearly 95% of Montana milk utilized in-State was used as Class I. 80% of the remaining 5% was for Ice Cream which represented approximately 40% of Montana's Ice Cream consumption. The remaining 40% of Montana milk production leaves the State as packaged and Bulk Surplus Milk and this has a significant negative effect on the net blended price paid to Producers.

Total processing capacity within Montana has declined as plants have been shut down over the last 20 years but still represents a significant level of over-capacity for the volume of milk products being processed.

The mix of farm size, location, nature of roads and weather creates logistical challenges and higher cost to deliver raw milk to plants and elsewhere. Freight costs related to bulk milk

transported between Montana plants and all bulk and packaged milk shipped out-of-State is fairly significant. Additionally, out-of-State bulk shipments incur brokerage and other fees, all of which negatively affects the economic return to the Producers. Certain farms are located distances up dirt roads that can present significant challenges just to reach, especially in winter or during bad weather.

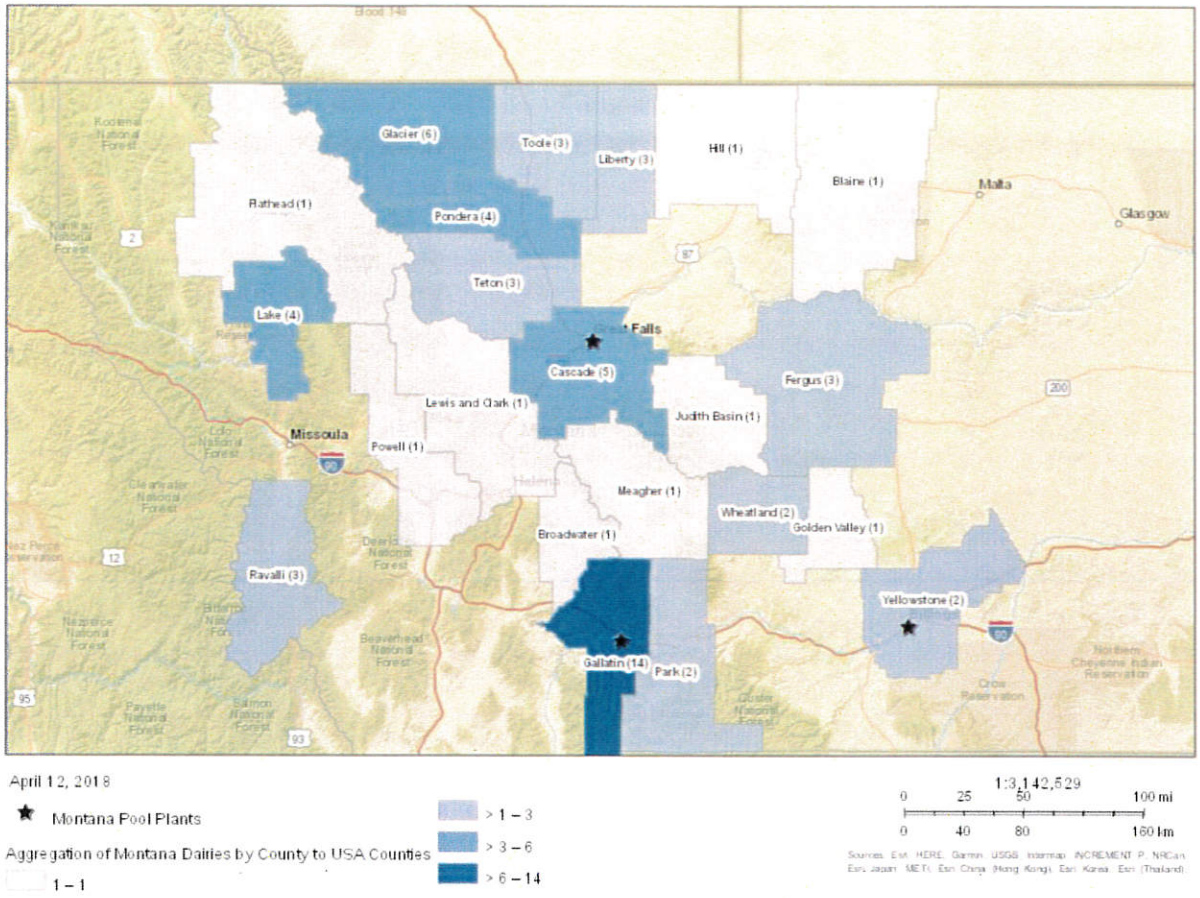
Montana dairy farms are generally small. 64% have herds fewer than 150 cows representing 32% of total cows. 22% have between 150-300 cows, representing 27% of total cows, and just 8, or 14% of farms, are larger than 300 cows and represent 40% of total cows in the state.

Many Montana dairy farms are located fairly significant distances from the processing plant they supply, especially given their size. 40% of farms, representing 53% of total cows, are fewer than 50 miles one way from their processing plant. 21% of farms, representing 16% of total cows, are 50-100 miles one way. 33% of farms, representing 17% of total cows, are 100-200 miles one way while 6, or 10% of farms, representing 14% of total cows, are greater than 200 miles one way from their primary processing plant.

Approximately 64% of the milk received by Billings from Montana based Producers during the calendar period 2015-2017 was transferred from Great Falls and Bozeman Producers, many of which are 200-300 miles away. Montana-produced milk represented approximately 69% of Billings total raw milk received during the period from Producers located both in-State and out-of-State.

The following chart illustrates where the Producers are situated relative to the Processing plants. The darker blue counties represent more farms.

Montana Dairies by County with Pool Plants



Costs related to bulk milk transported between the Montana plants and to out-of-State customers is fairly significant. Nearly 10% of calendar 2017 milk production was transferred to the Billings plant, primarily from Great Falls. The total hauling cost for these transfers was approximately $527,000, or $1.82 per cwt. The net impact on a Pool-wide basis was $0.19 per cwt.

Nearly 6% of calendar 2017 milk production was bulk shipped out-of-State, primarily from Bozeman and Great Falls. The total hauling costs for bulk milk shipped out-of-State was approximately $415,000, or $2.69 per cwt. The net impact on a Pool-wide basis was $0.149 per cwt.

In total, the hauling cost for the volume of bulk milk shipped inter-Plant and out-of-State during calendar 2017 was an average of $2.15 per cwt and the net impact on a Pool-wide basis was $0.34 per cwt. A portion of the volume shipped out-of-State by Great Falls is offset by shipments into the state to supply Billings. This means that the Pool absorbed cost to transport volumes out-of-State that was in a sense "replaced" by milk that was brought into the state.

In addition to transport costs, out-of-State bulk shipments are generally sold at a deep discount, and incur brokerage and other fees, all of which act to lower the net blended price within the Pool.

Processing capacity within Montana has declined as plants have been shut down over the last 20 years. The three remaining Pool plants in Montana are relatively old, somewhat small and currently run below capacity, which lowers their general cost efficiency.

The Bozeman plant is owned by Darigold, a regional cooperative that operates in multiple states including Montana. All of the Producers supplying milk to Bozeman are members of the Darigold cooperative with the exception of the Montana Correctional Enterprises (MCE) that supplies milk to Darigold as a member of the state-wide Pool. The Bozeman plant is a Class I bottling plant that produces approximately 15 million gallons per year running 2 shifts, 6 days a week starting Sunday and ending Friday. Outside Montana, Darigold operates two Class I bottling plants in Boise, ID and Spokane, WA that are within approximately 400 miles of Bozeman.

Meadow Gold is owned by Dean Foods, a large independent Processor that operates across the country and within the Montana region. Nearly all suppliers to the two Dean plants in Montana are independent farmers and members of the Montana Milk Producers Association which, unlike Darigold, is not a formal cooperative. One exception is a Darigold cooperative member farm that ships its milk to the Billings plant under special agreement because of its proximity to Billings and the Billings plant's need for supply. Several Producers located in Wyoming also ship milk to Billings as part of its ordinary supply.

The Meadow Gold plant in Great Falls is primarily a Class I plant that bottles approximately 7.8 million gallons per year running 2 shifts, 4 days a week. It also produces relatively small volumes of other finished products including ice cream mixes, eggnog and juices. The plant in Billings is a Class I plant that bottles approximately 4.5 million gallons a year running 2 shifts, 4 days a week.

Billings receives approximately 36% of its raw supply from Producers located nearest to it, including several from Wyoming, with the remaining 64% coming from Meadow Gold and Darigold based Producers, many of whom are located 200-300 miles away. The difference in freight from what it would cost the Great Falls and Bozeman's Producers to deliver to their home plant, and what it costs to transport the milk to Billings instead, is charged to the Pool and borne by all the Producers in the state.

Outside of Montana, Dean operates 3 Class I bottling plants in Boise, ID, Salt Lake City, UT, and Bismarck, ND, all of which are located within 400-500 miles from the various Montana plants, with another 2 plants in Greeley and Englewood, Colorado that are within 500-600 miles.

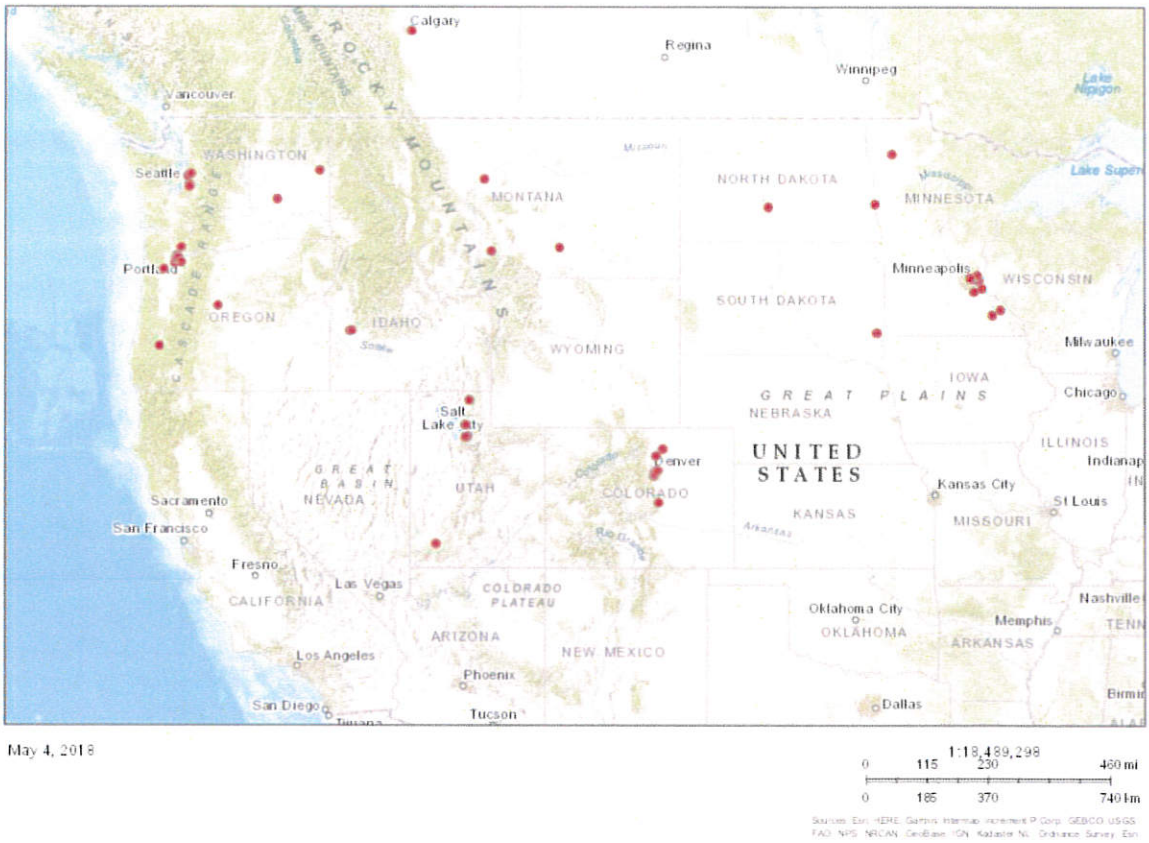
The three Montana plants together produce an average of about 27.5 million gallons of fluid milk a year. To put this in perspective, most Class I bottling plants in the US produce 20+ million gallons per year, with many plants typically producing 30 million gallons or more with the largest plants approaching 100 million gallons.

In addition to Meadow Gold and Darigold, 9 other companies operate 10 Class I plants in the region that are located anywhere from 350 – 700 miles from the closest Montana plant.

Several of Montana's closest neighboring States dwarf Montana dairy production in size and growth (see chart in Section 4.a. i. on page 24):

- Idaho's production is nearly 50 times that of Montana and its growth in production alone over the last 10 years was over 12 times Montana's total annual production. Idaho has 18 dairy processing facilities
- Washington's production is over 20 times that of Montana and its 10-year growth was 4 times Montana's total annual production. Washington has 13 dairy processing facilities
- Oregon's production is nearly 9 times that of Montana and its 10-year growth slightly exceeded Montana's total annual production. Oregon has 15 dairy processing facilities
- South Dakota milk production is nearly 9 times the size of Montana but grew more than Oregon. Its 10-year growth was 3.5 times Montana's total annual production. South Dakota has 10 dairy processing facilities and the Agropur plant recently announced an expansion that will process up to 9 million pounds of milk per day
- Like Montana, North Dakota' milk production declined over that last 10 years but still remains slightly larger (20%) than Montana
- Wyoming's milk production is smaller than Montana by approximately half, and there is no processing in-State, but production actually grew over the 10-year period by nearly 20%. Since shipments of Wyoming milk into Montana have been relatively steady over the years, it is assumed that the growth in production has been to serve other markets
- Colorado is nearly 12 times the size of Montana in milk production and has grown more than 60% over the last 10 years. Colorado has 11 dairy processing facilities

Class I Dairy Plants Surrounding Montana



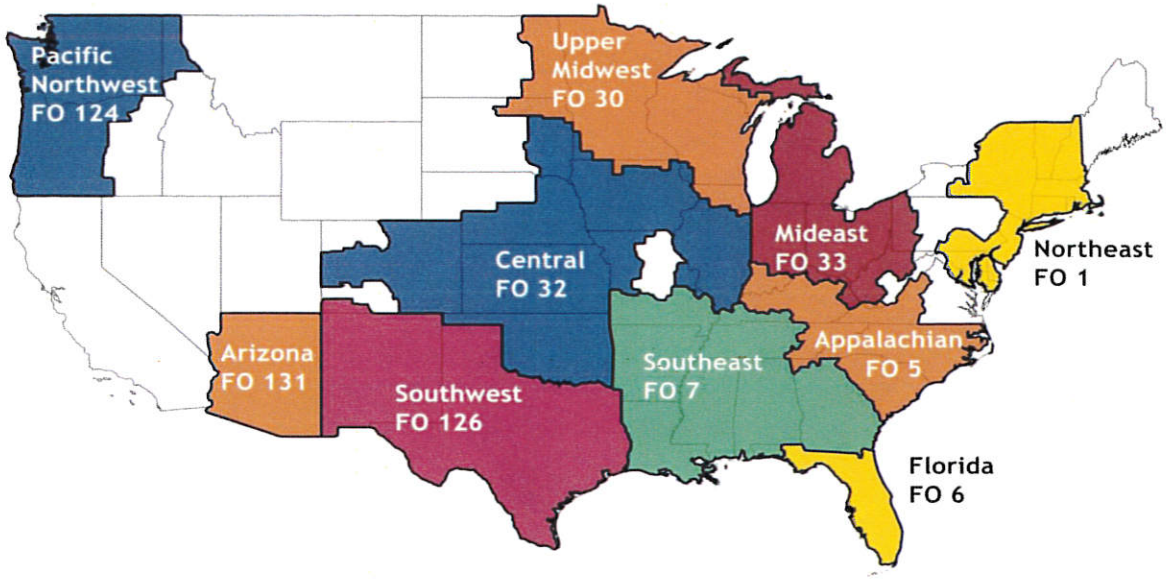
4. ANALYSIS AND FINDINGS

4.a. Study Task 1 – Price Formula Analysis & Recommendations

The objective of Study Task 1 was to develop recommended price formulas for Montana Class I, II, and III milk that balance the need for Montana Producers to receive equitable prices with the need for milk processing plants to be economically viable.

A large portion of the milk in the United States is regulated under the Federal Milk Marketing Order (FMMO). The FMMO divides the country into FMMO areas called Federal Orders. Each Federal Order has its own rules and Pool, but pricing is the same for all the Federal Orders (Class I prices vary by county based on "Zones"). The following map shows the areas that fall under FMMO regulation.

Federal Milk Marketing Order Areas



Map prepared by Market Administrator Staff in Bothell, Washington, February 2017.

All milk that is sold into a Federal Order must be costed at the FMMO minimum price. Most of Idaho, part of eastern Oregon, and all of Utah and Wyoming are unregulated and the Processors in those regions do not have to buy milk at FMMO minimum prices. Montana, North Dakota and California are not regulated under a Federal Order but have their own regulations regarding milk pricing. This also is true for most of the other unregulated areas on the map that are not Pooled in an FMMO area . Maine, Western New York, Pennsylvania, and Virginia have state-regulated milk prices, and are based on FMMO pricing, as does Hawaii. In fact, most milk in the United States is covered by minimum Producer price regulations.

The extent of the state regulations varies from state to state. In Idaho, there are very few regulations and the plants are free to negotiate whatever price they can with farmers for the milk they require. In Pennsylvania, the unregulated portions of the state have no Pool, but the plants must still pay at least the minimum Class price for their milk. This means that a Producer who ships to a Class I plant may receive close to Class I for their milk. However, if 25% of the milk from the plant is sold into a regulated area (and all of the major population centers are in regulated areas), then the whole plant becomes Pooled.

The current Montana Milk pricing formula for Class I is based on the FMMO Class I Price. Montana's Class II and Class III milk prices use formulas that are similar to the Federal Order formulas, but they use different adjustment factors and they are based on the last prices (market prices) for Nonfat Dry Milk and Butter reported prior to the 20th of the prior month in the National Dairy Market News Weekly Report published by USDA Agricultural Marketing Service.

Basing Class pricing on the FMMO, as is done now for Montana Class I, simplifies the monthly calculations and makes Montana more consistent with neighboring States. While most of the neighboring States are not part of the FMMO, their pricing is generally based on the FMMO prices.

4.a. i. Summary of Neighboring States

The following chart provides a summary of dairy industry information of the states within Montana's region.

Comparison of State Dairy Industry Statistics

		Idaho	Washington	Oregon	S Dakota	N Dakota	Montana	Wyoming	Colorado	Utah
Processing Plants		18	13	15	10	3	3	0	11	11
Milk Production	2006	10,905	5,464	2,242	1,505	470	354	118	2,547	1,747
(mm lbs)	2016	14,665	6,650	2,593	2,546	345	295	140	3,923	2,095
US State Rank		4	10	18	19	35	36	42	15	21
Growth in 2016 vs 2015		3.9%	0.7%	1.6%	7.9%	3.9%	-1.3%	3.2%	4.4%	7.9%
Number of Dairy Cows	2006	488	237	118	81	32	19	7	110	86
(1,000 head)	2016	595	276	125	115	16	14	6	151	92
US State Rank		**4**	**10**	**18**	**20**	**35**	**37**	**45**	**15**	**22**
Milk / Cow	2006	22,346	23,055	19,000	18,580	14,688	18,632	17,612	23,155	20,314
(lbs / year)	2016	24,647	24,094	20,744	22,139	21,563	21,071	23,300	25,980	22,272
US State Rank		**3**	**6**	**28**	**17**	**20**	**22**	**11**	**1**	**14**
Forage Prod. (1,000 tons) 2015		13,751	6,232	4,971	12,985	6,930	6,340	2,882	6,930	3,776
US State Rank		**7**	**19**	**22**	**8**	**15**	**17**	**29**	**15**	**26**
Licensed Herds	2006	690	610	320	600	320	110	30	170	320
	2016	520	480	230	235	85	65	10	120	180
US State Rank		**15**	**16**	**23**	**22**	**37**	**40**	**47**	**31**	**26**
Average Herd Size	2006	707	389	369	135	100	173	223	647	269
	2016	1144	575	543	489	188	215	600	1258	511
US State Rank		**8**	**11**	**12**	**15**	**24**	**22**	**10**	**4**	**13**
Gallon Production per person per month		84	9	6	29	4	3	2	7	7
US State Rank		**1**	**11**	**18**	**5**	**22**	**24**	**25**	**15**	**17**
Dairy Receipts (million $$)		$2,352	$1,133	$471	$435	$56	$44	$25	$664	$376
Population (2016 US Census)		1,680,026	7,280,934	4,085,989	861,542	755,548	1,038,656	584,910	5,530,105	3,044,321

Source: Progressive Dairyman, 2015 and 2016 U.S. Dairy Statistics, US Census

Idaho

Idaho has everything from small dairy farms to some of the nation's largest. 27.2% have 200 or fewer cows whereas 18.9% have more than 2,000 cows with the remainder spread fairly evenly in between. Idaho is home to 18 dairy processing plants that produce a wide variety of dairy products. The affiliations of its Producers consist of approximately 70% independent farms, 17% with Darigold and 15% with DFA. A number of large farms (2,000+ head) have closed and sold out in the recent past, having lost their market for milk.

Idaho operates under a free market pricing structure for supplying milk to the plants. Plants set and/or negotiate the price they pay farms for raw milk (Classes I, II, III and IV) based off the CME and Federal Order Class III. Often, the plant determines where the finished good price must be and works backwards to calculate what they are willing to pay for raw milk. Recently, the price for milk paid to the farmers has been trending down.

For example, a source knowledgeable of the Idaho dairy industry indicated that Chobani, a very large national yogurt manufacturer, offered to pay Class IV price for milk intended for a Class II product and attracted no new suppliers.

Under its "Component Law", the Idaho State Department of Agriculture enforces and audits what the farms receive for their components (fat, protein, somatic cell and bacteria). The Department periodically tests the plants to ensure each plant's lab results fall within a certain allowed variance and that farms are being paid correctly for their component content. In addition, plants offer quality programs.

Farms pay the cost of hauling their milk to the plant. Idaho has no Quota or Pool program, although Darigold has a program where its members have an established base. Other Processors have loose arrangements where their independent raw milk shippers must ask if they can increase their herds.

North Dakota

North Dakota has 3 processing plants that process one or more dairy products. The state has its own pricing formula for Class I milk that is based off the Federal Order 30 Class I zone price at each plant. The prices move in $0.21 increments as shown in the following reference table.

Order 30 Class I	ND Class I
$13.76	$14.39
$13.55	$14.18
$13.34	$13.97
$13.13	$13.76

The minimum price paid in North Dakota is $13.76 and prices increase in $0.21 increments based off of the Order 30 Class I pricing. If the Federal Order 30 Class I price moves above $13.13 then the ND Class I price would move to $13.97. It would stay at that price until the Federal Order 30 price moved above $13.34, at which point the ND Class I price would move to $14.18 and so forth. Likewise, if the Federal Order 30 Class I price moved from $13.60 down to $13.53 then Class I in ND would move from $14.39 to $14.18.

Since the pricing is a step function, the ND Class I "Differential" over the Mover varies. The Federal Order Zone Differential is $1.65, so the actual ND Class I Differential varies between $2.29 and $2.49. This is only slightly less than the Montana Differential of $2.55.

North Dakota also regulates the minimum wholesale price of milk. The reason the chart jumps in increments of $0.21 per cwt is because it is equivalent to a $0.01 change in the wholesale price per half gallon.

North Dakota has no Pool or Quota system. Each plant is effectively its own Pool and pays its blended price for all the milk it receives. In dealing with excess milk, the plants must do their best to balance their raw intake to sales and sell their excess milk. However, all the plants use Cooperatives to balance their supply, so they rarely have any excess. In the rare case where a North Dakota plant diverts milk out-of-state, it must pay the applicable ND price for the Class of milk as it will be used. The state audits that the selling plant is charged for the specific use. Farmers pay only for hauling charges to the first plant and are not charged for any inter-Plant hauling fees.

The Class III milk price in North Dakota is the FMMO Class III price less 4%, which is a discount of approximately $0.50 / cwt.

South Dakota

South Dakota has 10 dairy processing plants that process a variety of dairy products and has just announced a new cheese plant that is eventually expected to process up to 9 million pounds of milk per day. The state has 2 different Federal Orders, with the Central Federal Order being the predominant one and the Upper Midwest being the other. Most of the raw milk is produced & processed in the eastern part of the state. There is no state managed Pool or Quota system, although Land O'Lakes has its own informal program. Pricing from farm to plant is based off the FMMO. The current pricing to cheese plants is Class III plus $1.70 plus component premiums. The farms pay for hauling from the farm to the plant.

Utah

Utah has no controls or jurisdiction over milk pricing and does not operate under any state Pool or Quota program. Approximately 48% of the dairy farms in Utah are members of DFA. The remaining farms are independent and negotiate pricing with the processing plants. The dairy farms pay the hauling from their farms to the first plant. If the milk needs to be sent somewhere else the buyer usually pays the trucking. The base price dairy farmers in Utah are paid comes from the particular market where the milk is sold. The price is determined by the coops and Processors and is a blend of Federal Order Classes I, II and III. Premiums are paid for butterfat content above 3.5% and low somatic cell count (400,000 or below). Premiums generally are not paid for volume, proteins, or solids.

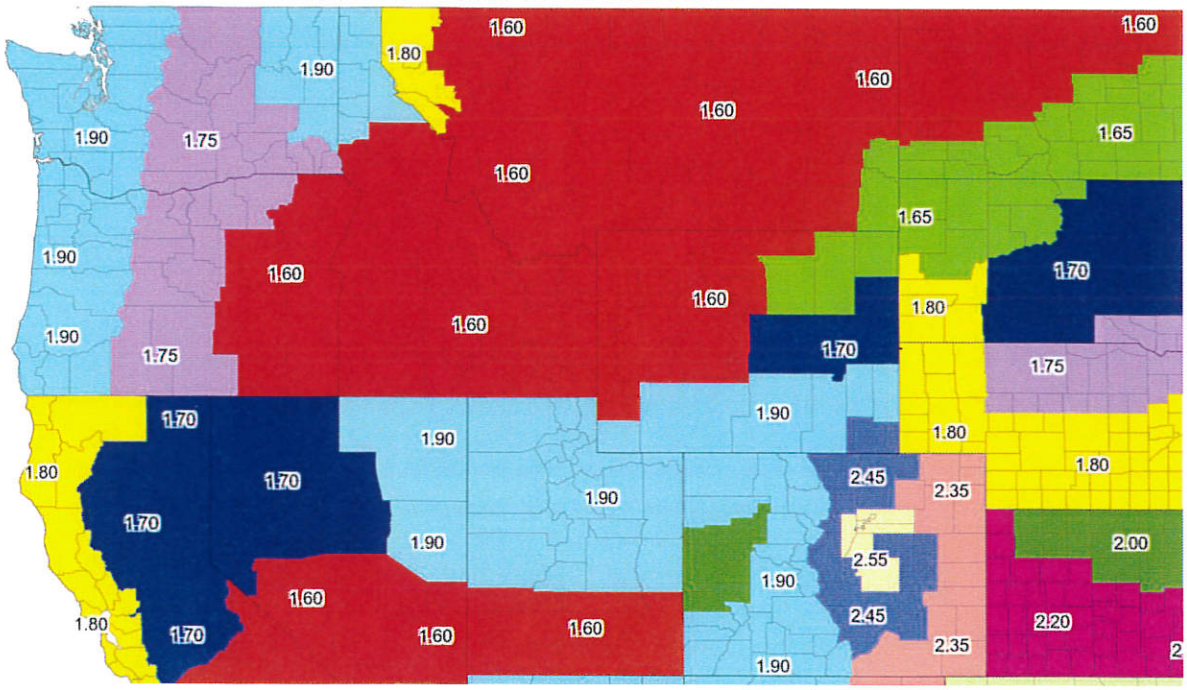
Wyoming

Wyoming is the smallest state in the region in terms of milk production and the state has no processing facilities. As a result, Wyoming has no regulations, control over, or management of the state's milk pricing.

4.a. ii. Montana Class I Pricing

Bottled milk for retail sale is considered Class I milk. Class I pricing is based on the FMMO "Mover" (derived from the greater of the Advanced FMMO Class III or IV prices) plus a Differential that is added to the Mover. For the FMMO (and for most regulated markets) the Class I pricing depends on the location of the receiving plant. A Zone Differential is added to the Mover to determine the total cost paid for Class I milk. The FMMO Zone Differential for most of Montana, including the locations of the three Class I plants, is $1.60. However, Montana does not use the FMMO zones.

The Pricing Surface for Class I Differentials for the Northwest



The Zone Differentials in the Pricing Surface above are only used by plants that are Pooled in a Federal Order. While the rules vary for each Order, generally a Class I plant is required to be Pooled in the Federal Order where it ships its milk. Once Pooled, the minimum price a plant must pay for Class I milk is the Mover plus the Zone Differential. For the Montana plants, instead of using the FMMO Zone Differential, the Montana Order uses a "Montana Differential" of $2.55 as compared to the FMMO of $1.60. Using the Montana Zone Differential instead of the FMMO Zone Differential added $1.4 million to what was paid to Montana's Producers in calendar 2017. The original basis and calculation for the Montana $2.55 Differential is unknown

and was put in place many years ago before the tenure of the current Board of Milk Control and staff.

At present the Montana Differential of $2.55 is about $0.65 to $0.95 higher than the Class I Differential paid by non-Montana based plants in the region and especially to the west (although it is only about $0.05 to $0.25 per cwt higher than North Dakota). This makes retail markets in Montana attractive to out-of-State Processors since their cost of raw milk is lower.

Increasing the Montana Differential above its current $2.55 would make delivery from out-of-State more attractive. The cost of bringing milk into the western part of Montana from the nearest fluid milk plant outside the state (around 200 miles away in WA) is estimated to be about $1.30/cwt or less, assuming no back-haul. This is not much more than delivering milk to western Montana from the Great Falls or Bozeman plants. Increasing the Montana Differential would widen the spread from the already lower raw milk costs in neighboring states, and that, combined with assumed lower production costs for out-of-State bottling plants, would create a situation that could allow out-of-State plants to serve the populated western areas of Montana more competitively than the Montana based plants.

Conversely, lowering the Montana Differential would make it less attractive for out-of-State Processors to deliver into Montana. However, lowering the Montana Differential would directly reduce revenue to Producers. Each $0.05 reduction in the Montana Differential would lower total revenues to the Pool and to Producers by approximately $73,500 per year, based on Montana's calendar 2017 Class I utilization of 146.9 million pounds for the Montana market.

For Processors, lowering the Montana Differential would likely have little to no impact, since they typically pass changes in their raw milk cost along to their retailers, although a Processor could decide to keep the additional profit if allowed within the agreement with their retailer. Likewise, retailers are free to decide whether to pass price changes on to consumers and will generally do so to a certain extent based on their local market conditions and competitive pressure. Lowering the Montana Differential could be considered if other changes were implemented that acted to offset the reduced revenues to Producers, or that resulted in an improved net price per cwt that Producers were paid for all the milk they produce.

At present we see no compelling reason to adjust the current Class I Montana Differential of $2.55 and our recommendation is to leave it at its current level. None of the stakeholders we talked with, including Processors and Producers, expressed any issue with it or suggested that it be adjusted in any way. There does not presently appear to be significant competitive pressure from out-of-State Processors or distributors on Montana's Class I fluid market, although this could change over time. The $2.55 Montana Differential is well established and, given the changes that may occur as a result of the recommendations in this report, it makes sense to maintain stability in this core component of Montana's milk market.

However, Montana could consider lowering the Class I Differential somewhat if it felt that it was necessary or appropriate. A lower Class I Differential would provide a slightly more competitive price within the region and help protect against encroachment from out-of-State Processors for Class I fluid sales.

Any new Differential should be based on an analysis of total Producer income and regional pricing. Consideration should be in line with recommendations regarding Pooling, Quota, Inter-Plant Hauling, and out-of-State product utilization pricing, to give Producers choice as to managing their individual level of production. To the extent that other Quota and Pooling related recommendations are adopted, and given their delivery costs, it may potentially place more pressure on remote Producers and this impact should be included in any evaluation.

Under any structure, there should be sufficient flexibility in place to make adjustments to the Montana Differential in an appropriate and timely manner to meet future conditions, and a mechanism should be put in place to ensure this can happen. Such mechanism could be set up to be reviewed and addressed on an annual basis taking, for example, the last three years into account and evaluating such factors as overall and Excess production, Montana's share of the in-State Class I market, Class I pricing in neighboring states, and input from Pool Processors and Producers as to the advisability of a change.

4.a. iii. Montana Class II

The current Montana Class II price uses a formula that is similar to the Federal Order formula, but uses different adjustment factors and is based on the last prices (market prices) for Nonfat Dry Milk and Butter reported prior to the 20th of the prior month in the National Dairy Market News Weekly Report published by USDA Agricultural Marketing Service.

The formula used by Montana results in lower pricing than the Federal Order formula, such that if the Federal Order pricing had been used during calendar years 2015-2017, the total Class II revenues to the Pool would have been approximately $144,000, $68,000 and $170,000, or 5.7%, 2.5% and 5.7% respectively, higher for Class II utilization value. The higher value into the Pool would have been paid to the Producers, while the impact on the cost side would most likely have been slightly higher prices to retailers or possibly somewhat lower profits for Processors. Note that the calculations do not take into account changes in inventory reclassification value, which would change the results by a few thousand dollars each year.

	Class II Utilization Value		
	2015	2016	2017
Current Montana Pricing	$2,515,334	$2,747,858	$2,958,686
Federal Order Pricing	$2,659,603	$2,815,402	$3,128,715
Difference	$144,269	$67,544	$170,029
Percent Difference	5.7%	2.5%	5.7%
Value to Pool per CWT	$0.0504	$0.0242	$0.0597

The FMMO Class II price for Skim is based on Advanced prices and is announced with the Class I prices just prior to the month they will take effect. The FMMO Class II Butterfat price is announced at the end of the month with the other Final prices. If Federal Order pricing were to be adopted for Class II, it may be desirable to calculate the Class II Butterfat price based on Advanced prices similar to the way Montana does it today.

The FMMO announces an Advanced Butterfat price that is used in the calculation of the Class I Butterfat price. If that price were used instead of the Final Butterfat price, and the same FMMO calculation was performed (Class II Butterfat = Butterfat Price + $0.007), then the pricing over the last 3 years would have been higher than the current Montana price, but not as high as the actual Federal Order price as shown in the following chart.

	Class II Utilization Value		
	2015	2016	2017
Current Montana Pricing	$2,515,334	$2,747,858	$2,958,686
FO Pricing - Adv BF	$2,564,525	$2,848,112	$3,092,430
Difference	$49,191	$100,255	$133,744
Percent Difference	2.0%	3.6%	4.5%
Value to Pool per CWT	$0.0172	$0.0359	$0.0470

Ordinarily, for the sake of simplicity and uniformity, we would recommend using the FMMO Class II price. However, we believe there is benefit to using Advanced pricing for Montana for several reasons. First, the value difference of the two methodologies is relatively minor. The second reason is that for planning and decision-making purposes, it is useful for Processors to know their cost in advance. Finally, Advanced Class II pricing would allow the Milk Control Bureau to continue releasing a single price announcement each month, as is currently done. This saves administrative effort and cost as opposed to the Bureau having to issue two price announcement each month.

For these reasons we recommend that Montana use the announced FMMO Class II skim price and calculate the Montana Class II butterfat price as $0.007 over the announced Advanced butterfat price.

4.a. iv. Montana Class III

In Montana, Class III represents all milk that is not Class I or Class II, whereas the FMMO has a distinction between Class III for cheese and Class IV for butter and powder. Montana Class III pricing is based on a formula that at one time resulted in prices very similar to Federal Order Class III. Over time this changed such that the Montana Class III pricing formula currently results in a Butterfat price that is $0.50 to $0.60 per pound lower than the Federal Order Class III price (note that Federal Order Class III and Class IV skim prices are different, but they use the same Butterfat price).

Montana Class III covers the sale of bulk raw milk and cream shipped to cheese, butter and powder manufacturing plants, mostly out-of-State. It is also used to price the first 2% of shrink, or loss, that is allowed as a normal consequence of processing milk at a plant. Any shrink above the 2% allowance is priced at Class I.

A major impact of the lower Butterfat price in Montana is that it creates opportunities for profitable sales and increased margins for the Processing plants. Class I bottled milk averages around 2% butterfat while raw milk is around 3.7%. The remaining Butterfat is bottled as a cream product (half and half, light cream, whipping cream, etc.), used in an ice cream product, or sold as bulk cream. Every 100 pounds of raw milk used in making Class I products generates about 4.5 pounds of cream.

This bulk cream is sold by Montana Processors to out-of-State butter plants at prices in line with the national butter price. This provides them with a significant profit because their cost is Montana's lower Class III Butterfat price. The benefit of the lower Butterfat price to the Processors is an equivalent loss of value paid to the Pool from what it would have received if Federal Order prices were used. For perspective, had Class III pricing been based on the lower of Federal Order Class III or Class IV pricing rather than Montana Class III pricing for the last few calendar years, the Pool, and subsequently the Producers, would have received an additional $2.7 million, $2.6 million and $2.9 million (or $0.94, $0.90, and $1.05 per cwt) in calendar years 2015-2017 respectively.

	Class III value difference between Montana and Federal Order pricing		
	2015	2016	2017
$ millions	$2.728	$2.583	$2.927
Value to pool per CWT (Total Utilization)	$0.94	$0.90	$1.05

We recommend that Montana adopt the lower of the FMMO Class III and Class IV pricing for its Class III price, and to be consistent with the rest of Montana Class pricing, it should be based on Advanced pricing. If FMMO Advanced pricing had been used to calculate the Montana Class III for the last three calendar years, the Pool, and subsequently the Producers, would have received an additional $2.6 million, $2.9 million and $3.0 million (or $0.88, $1.00, and $1.06 per cwt) in calendar years 2015-2017 respectively.

	Class III value difference between Montana and Advanced Federal Order pricing		
	2015	2016	2017
$ millions	$2.555	$2.857	$2.955
Value to pool per CWT (Total Utilization)	$0.88	$1.00	$1.06

As with Class II, for the sake of simplicity and uniformity we would ordinarily recommend using the FMMO Final prices that are announced at the end of the month in which they take effect.

However, for Montana, we believe there is benefit to using Advanced pricing for several reasons. The difference between calculating the Montana Class III price on Advanced and Final pricing over the last few years has not been significant. For planning and decision-making purposes, it is useful for Processors to know their cost in advance. It may be useful in trying to attract a Class III plant, since knowing the cost of product as it is made would allow for better control of Class III product sales. And finally, advanced Class III pricing would allow the Milk Control Bureau to continue releasing a single price announcement each month, as is currently done. This saves administrative effort and cost as opposed to the Bureau having to issue two price announcement each month.

An additional benefit of basing the Montana Class III on the lower of FMMO Class III and Class IV is that the cost of milk for a cheese plant, which is FMMO Class III in Federal Orders, would usually be FMMO Class IV in Montana. In other words, the cost of milk for the cheese plant would be equal to or usually lower than their cost in FMMO regulated markets.

Moving to Advanced Class III pricing based on FMMO pricing, and transferring the values noted above from the Processors to the Pool (i.e., Producers) would have a significant immediate impact and potentially serious short-term consequences in terms of the Processors profitability and viability. To ameliorate this near-term impact on Processors, we suggest that the Class III Butterfat price be adjusted downward by $0.20 - $0.30 per pound. This adjustment could be applied temporarily to allow the impact of the full change to be absorbed and managed over time, or it could be made permanent. A benefit of making the adjustment permanent is that it may help attract additional Class III Processors to Montana. We recommend a $0.25 per pound (approximately 10%) reduction to the butterfat price that reduces to around $0.10 (approximately 4%) over three years.

4.a. v. Montana Surplus Milk

Sales of milk that go out-of-State are defined as Surplus Milk. By administrative rule [ARM 32.24.150(42)], all milk produced by Montana Producers that is not processed and sold for consumption within Montana, or transferred to another Pool plant in Montana, is defined as Surplus Milk. Surplus Milk excludes shrink, inventory and fluid cream products.

Surplus Milk is disposed of in several ways: Packaged Class I fluid products are processed in-State and sold in markets in contiguous and non-contiguous States, for which Montana allows special discounts from the Class I price; bulk Sales of raw milk are made to Class I Processors out-of-State, none of which occurred in calendar 2017; and Bulk Sales of raw milk are made to Balancing plants which are typically cheese or powder plants located outside the state.

Current administrative rules provide for adjustments to the utilization value of the milk to reflect the actual sales price of Bulk Sales and hauling charges. Effectively, it is as if the Producers sold the milk directly to the out-of-State Balancing plant. The Processors in Montana each attempt to utilize Surplus milk in a way that creates the highest value. If possible, it is sold

as Packaged Surplus to other states which improves its utilization value over a Surplus Bulk sale. The rest is sold as Bulk milk.

Processors encourage their Producers to limit the production of Surplus milk, although this has not been very effective given the current Quota system, as discussed elsewhere. Given this situation, the Processors assist farmers in finding buyers for Surplus milk and provide this assistance at no cost to the farmers and at no profit to themselves. In general, the best strategy is to maximize sales of Montana Class I milk, which minimizes the amount of Surplus at the Processor.

Since the strategies of each Processor have a direct effect on the value of Surplus milk, it may make sense to adjust the structure for Quota and Pooling in Montana to more fairly allocate the value of Surplus milk. This is discussed more fully in Section 4.d., Study Task 4 on page 43.

4.a. vi. Variable Class I Price Formula to Manage for Seasonality

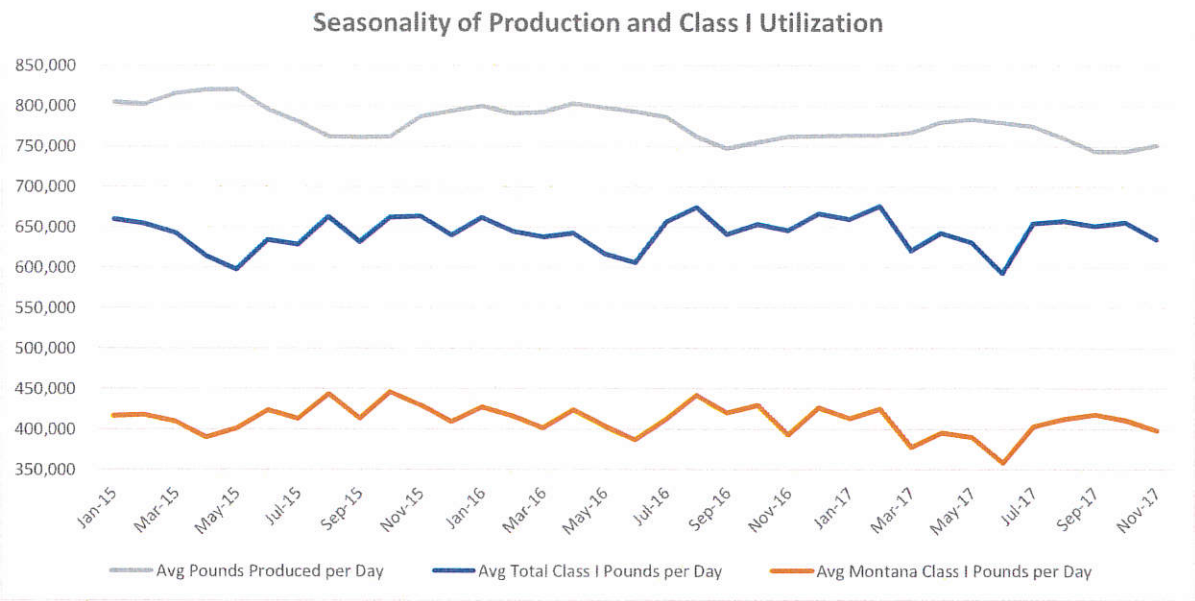
Seasonality of milk production occurs mostly because of traditional cow cycles. Cows naturally tend to calve in the fall/winter and peak milk production occurs in the spring (May/June in Montana). This natural cycle has traditionally been followed because cows are stressed during the heat of the summer months. When temperatures get over 65-70 degrees Fahrenheit, milk production suffers. Additionally, if calving occurs during these higher temperatures, the calf is stressed, and it can impact milk production over her entire life.

Cows can be inseminated at any time, so the timing of calving can be managed. In this manner, the production cycle can be shifted so that it occurs at any time throughout the year. However, calving during peak summer heat is usually avoided. Many larger farms (over 500 cows) manage their herds so that calves are born throughout the year. Even so, there is still some seasonality because of temperature variations.

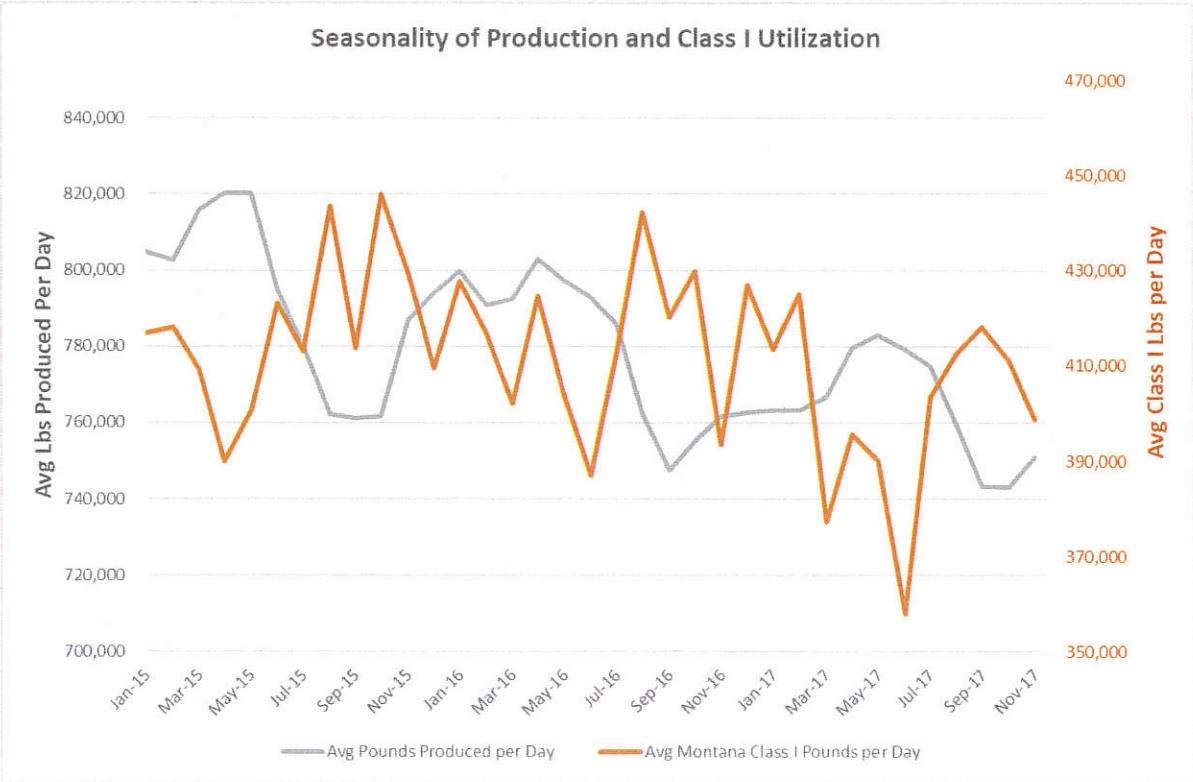
Seasonality in the milk supply in Montana is similar to other parts of the country. The difference in milk production between the months with the most volume (May/June) and the least (October) each year is about 7%. The usage of Class I milk also is cyclical, with peaks occurring a number of times during the year, but with a definite low during May and June when supply is highest. The difference between the month with the most volume and the least volume each year is about 11%.

The following chart shows monthly daily averages in Montana for the last 3 calendar years for:

- Average daily production
- Average daily total Class I Utilization (including out-of-state utilization)
- Average daily Class I utilization in Montana



To better see how the volumes of production and Class I usage compare, the usage was scaled so that the lines overlap. The scale on the left is average daily production, and on the right is Montana in-State Class I usage.



As can be seen in the chart above, the peaks and valleys between supply and usage are not aligned. When consumption is increasing, milk supply is decreasing, and vice versa. This is not an issue today because overall production is significantly greater than Class I demand such that even at its lowest point, production exceeds demand at its highest point on a daily basis. But if overall production were to decrease significantly to the point where supply on an annual basis was very close to annual Class I usage, then this seasonality effect could become a problem.

If total supply were to decrease, or demand increase, to the point where it became useful to better match supply with demand, it is possible to implement policies that encourage shifting supply. However, to the best of our knowledge, there have been few large-scale or critical situations where seasonal supply has been effectively adjusted to match demand. In fact, cooperatives across the US have generally found it more effective to build balancing plants to seasonally utilize milk when supply exceeds demand, rather than to try to encourage a smoothing of the supply.

As early as the 1930s, but more recently in the 1960s, there were several Federal Order areas that established seasonal rules. Most had "base-Excess" plans or the "Louisville" plan. Base-Excess plans establish a base and any volumes in Excess of the base are paid for at a lower rate. The Louisville plan retains money from the blend price during the spring months and uses it to supplement payments to Producers during the fall months when milk production is lower. This plan increases the price paid to farmers for milk sold in the fall and lowers the price of milk during flush spring months, without affecting prices charged to the Processors.

Several studies were performed during the 1980s and early 1990s to determine the effectiveness of these rules in diminishing the seasonality of the milk supply (Kaiser, Prindle, etc.). The studies confirmed that implementing seasonal controls did help to reduce seasonality somewhat, but they also concluded that the reductions in seasonality were not very large and that enhancements to the programs in the form of larger incentives and penalties might have improved the results.

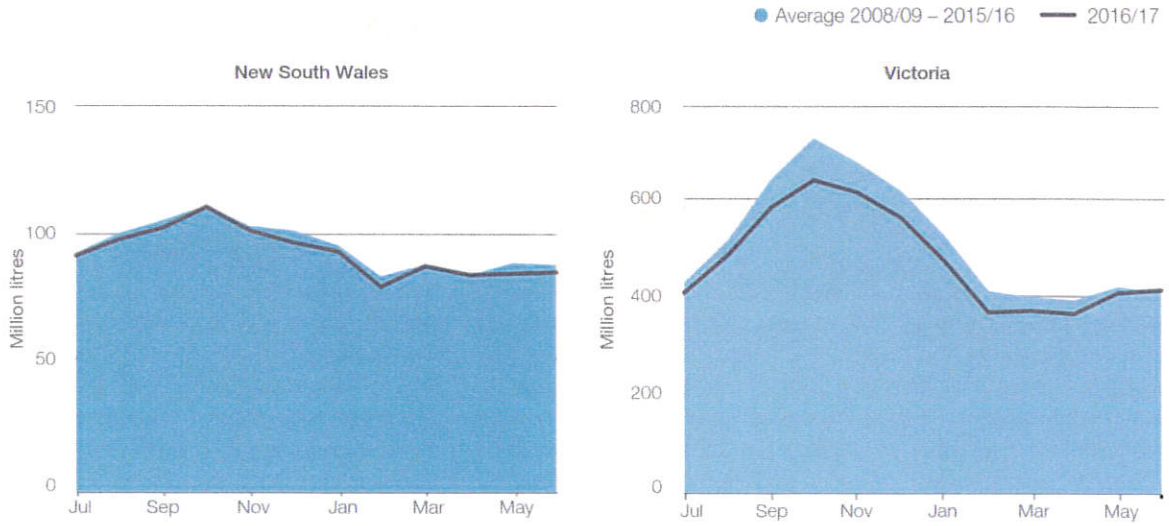
When the Federal Orders were restructured in 2000, the seasonality that had been built into some of the Orders was eliminated. None of the Federal Orders have seasonality rules today.

Some states have a larger seasonal mismatch in supply and demand than others. One example is Florida where large swings in production and a mismatch with demand are caused primarily by the high summer heat and its effect on cows and on the availability of forage. Millions of dollars are spent importing milk during the Summer and Fall, and then spent again shipping Excess milk out of Florida in the Winter and Spring. In the 1990s, Florida coops experimented with incentives to shift milk production to meet demand. The experiment lasted 2 years and was abandoned [Choices magazine, 4th Quarter 2003 "Reducing Seasonality in Dairy Production" by Richard N. Weldon, Andrew A. Washington, and Richard L. Kilmer].

Our research did not identify any more recent significant studies on seasonality incentives. The incentive that was introduced in Florida was a $3.00 premium on production in the Fall that exceeded 75% of Spring production. A number of farms implemented procedures to shift more of their production to the Fall and were moderately successful, but other farms simply increased their overall annual production to take advantage of the premium in the Fall so that the net effect was very little change to seasonal matching of supply and demand. Even though the program achieved limited success in shifting some supply, it was terminated after a few years because it apparently did not shift enough volume to justify maintaining it.

In Australia, milk production was down in 2016-17, but remains strongly seasonal in the key south-eastern dairying regions, reflecting the predominantly pasture-based nature of the industry. Milk production peaks in October, tapers off until late-summer, and then flattens out into the cooler winter months (See Victoria below). The production of long shelf-life manufactured products in these parts of the country has enabled maximum milk utilization within the seasonal cycle. However, the seasonality of milk output in Queensland, New South Wales and Western Australia is much less pronounced, due to a greater focus on drinking milk and fresh products. Farmers in these states manage calving and feed systems to ensure more even, year-round milk production, and they have been incentivized to do so for many years. In other words, in the parts of Australia where fluid milk comprises a large part of milk utilization, the Producers have successfully managed to reduce seasonal differences. The implementation is similar to the Florida experiment, where an incentive in the "trough" months based on a percentage of the volume in the "flush" months is used. The following charts show the effectiveness of the plan in New South Wales where there have been incentives to minimize seasonality, compared to Victoria.

Figure A1 Seasonality of milk production 2016/17 (million litres)



From Dairy Australia – "Australian Dairy Industry in Focus 2017"

In theory, a mechanism could be put in place in Montana to shift some milk production from the Spring to the Fall to more closely match seasonal demand so long as the incentive is well designed and does not encourage and result in simply increasing overall production. Although summer heat is not as large an issue in Montana as it is in the South, shifting production would reduce some volume and likely raise costs for the Producers. The incentive payments would need to cover these increased costs of production.

If having sufficient supply In Montana becomes an issue, some sort of incentive program could be implemented to more closely match supply with demand throughout the year. However, given that Montana currently has more than sufficient milk supply to meets its Class I demand for the year, implementing seasonal incentives to try to match production with Class I usage during the year does not seem necessary.

4.a. vii. Component Pricing

The Federal Order System provides a mechanism for Component Pricing for Class III and Class IV milk that adds value to what Producers can receive. With Component Pricing, instead of paying for Skim on just a per pound basis, the Skim is valued based on its Total Solids Not Fat content for Class IV, and on Protein and Other Solids content for Class III. In six of the 10 Federal Milk Market Orders, payments to Producers also are based on Protein and Other Solids. The other four Orders use Skim and Butterfat.

The component pricing mechanism encourages the use of higher Protein milk for Cheese and Powder (Class III and Class IV) where it has more value. Since there are no cheese or powder plants in Montana, there currently is no need for Component Pricing. On the other hand, establishing a component-based formula may be something to consider. Even though it would not currently affect milk sales and utilization, it could help to attract potential investment in facilities (e.g., cheese) where component pricing would be attractive. This is one aspect to consider, in conjunction with the discussion and recommendations provided in this report under Study Task 5.

4.b. Study Task 2 – Recommendations for Adjustments to Utilization of Class I Packaged Milk Sold as Surplus Milk

4.b. i. Surplus Packaged Milk

In conjunction with the evaluation of the basic Class I price formula, we evaluated the adjustment to the utilization value for Pool milk sold as Class I packaged products to markets outside Montana to determine whether it was necessary or appropriate to revise the currently allowed adjustments.

The Montana Class I cost for raw milk is $2.55 over the Federal Order Mover (higher of Advanced Class III and Class IV prices). For packaged milk sold to customers in states

contiguous to Montana, an adjustment of $2.55 is made to lower the Class I price paid to the Pool, which effectively prices the milk at the Mover. If the milk is being sold to customers in states that are non-contiguous to Montana, the adjustment to lower the Montana Class I price is $3.05, which results in a price that is $0.50 below the Mover.

We are not aware of the specific basis for how the contiguous state adjustment of $2.55 was established other than it offsets the Montana Differential and effectively prices such milk at the Mover. Our understanding is that the adjustment for packaged sales to non-contiguous states of $3.05 was established primarily to take advantage of an opportunity to utilize what was otherwise Bulk Surplus milk for sale as packaged Class I milk to a specific customer with retail outlets in non-contiguous states.

Based on our analysis, the estimated cost of delivering a full load of packaged milk to a customer that is 400-500 miles away is approximately $3.00 to $3.50 per cwt. The local cost of Class I milk in the non-contiguous State's market is approximately $1.90 over the Mover, plus any local premiums. We estimate local delivery in that market is approximately $1.00 per cwt, so the total cost for a Processor in that state to deliver packaged milk is approximately $3.00 per cwt over the Mover. The net result is that the total Montana adjustment of $3.05 for packaged sales in non-contiguous states, along with the estimated freight cost of $3.00 to deliver such product, makes Montana packaged milk competitive in the market of the non-contiguous State up to 400-500 miles away.

It should be noted that all the packaged volume currently being sold in non-contiguous states is based on a contract with a single customer with multiple outlets and is not spread across a portfolio of customers. In addition, given the geography in the Northwest, potential customers in non-contiguous states could actually be closer than customers in contiguous states.

4.b. ii. Background

Montana is almost unique in the sense that there are very few States we are aware of that discount the Class I cost of milk for any reason. Montana has the least number of cows and milk of any State in the region with dairy processing facilities (Wyoming has fewer cows, but has no processing facilities), but Montana does produce significantly more milk than it needs to meet it's available in-State sales.

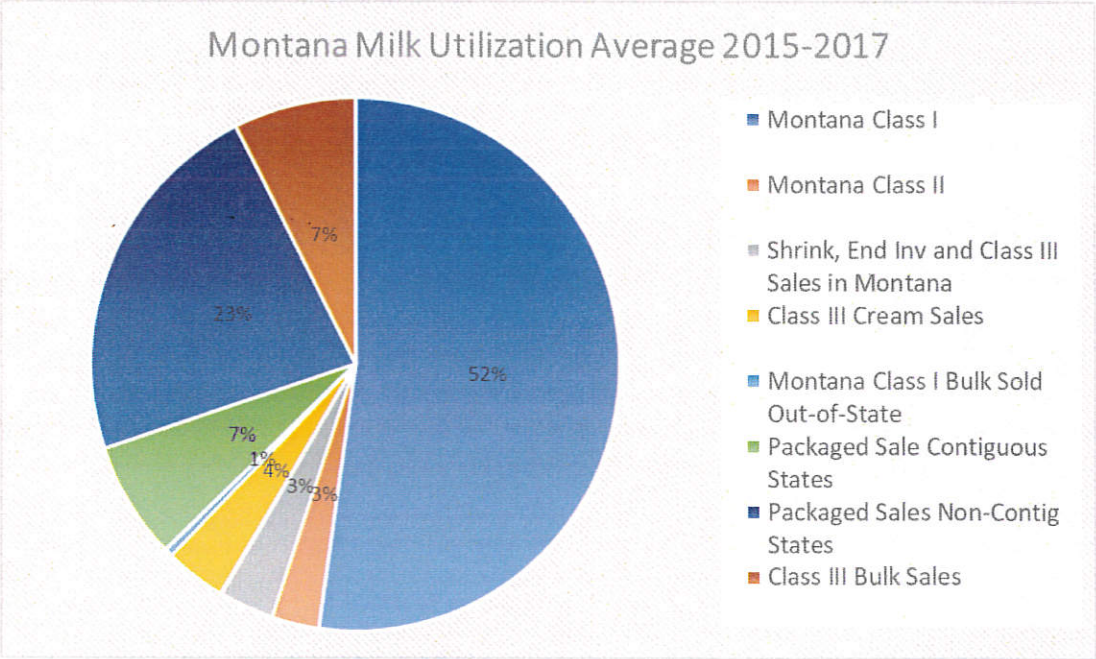
The discounts on packaged milk sold out of the state serve to help Montana's Processors utilize and realize value from what would otherwise be Bulk Surplus milk. Other states have Surplus milk and, like Montana, often that milk is sold to balancing plants outside of the state. Unlike Montana however, the proportion of milk sold outside of those states is relatively small since there is sufficient balancing plant (cheese and powder) manufacturing capacity within the state to process and balance most of the milk produced in the state. Montana currently sells only a bit more than half of the milk produced in the state to outlets in the state. There are no balancing plants in Montana.

For Montana Processors, the average annual utilization by Class for the last three calendar years, 2015 – 2017, was as follows:

- 52.2% of total utilization was Class I milk sales in-State
- 2.9% on average was Class II sales in-State
- 7.1% of utilization was Class III cream, shrink, and sales to in-State Processors
- This left 37.8% on average of milk production that was considered Surplus

The utilization of the average annual 37.8% Surplus production for the last three calendar years (2015 – 2017) was as follows:

- Class I milk bulk sales to Class I Processors out-of-State was 0.5% of total production, or 1.3% of Surplus volume
- Packaged sales to contiguous states was 7.1% of total production, or 18.8% of Surplus volume
- Packaged sales to non-contiguous states was 22.7% of total production, or 60.1% of Surplus volume
- Bulk sales out-of-State was 7.5% of total production, or 19.8% of Surplus volume



All milk produced must be sold to avoid having Producers suffer a significant loss. There are two basic solutions to the problem, especially when nearly 38% of total milk produced is Surplus milk; either reduce production (discussed in Section 4.d., Study Task 4 on page 43) or find a home for the milk at the best price available, and hopefully one that provides sufficient economic value.

4.b. iii. Maximize Value of Surplus

At the current level of production, the obvious goal, shared by the Board of Milk Control, is to maximize the price Producers receive for the 38% of milk that represents Surplus milk, while not creating a detriment to Processors. Plants that take and utilize Surplus milk are considered Balancing Plants because they help to balance the milk supply. Balancing Plants generally are cheese or butter/powder plants. If Surplus milk is sold as bulk milk to a cheese or powder Balancing Plant, the price received is generally Federal Order Class III or Class IV at best, and often less. In addition, the return to the Producers is reduced by the cost of transporting the milk to that plant, plus any brokerage or other fees associated with making the sale.

In calendar 2017 the cost of transporting Bulk Surplus milk averaged $2.69/cwt and reflected charges that ranged from $2.20 /cwt from Bozeman to Jerome, ID, to $4.15/cwt from Great Falls to Logan, UT, to reach the closest available balancing plants.

To maximize the value of Montana Surplus milk, the Board of Milk Control has provided a mechanism that allows it to be sold out-of-State as packaged milk by pricing the raw milk at a discount. The milk is priced effectively at the Mover for milk going to contiguous states, and at $0.50 below the Mover for milk going to non-contiguous states.

Since the Mover is the higher of the Advanced Class III or Class IV, the price received for Surplus milk sold as packaged Class I milk is generally going to be higher than if the milk was just sold as bulk Class III or Class IV less the cost of transport. The other impact to Producers of selling the milk as Packaged Surplus is that they only pay for delivering the milk to their associated plant, with the cost of transport to the customer covered by the discount and paid for by the Processor.

By creating a discount for sales of out-of-State Packaged Surplus Milk, all packaged milk sold out-of-State will be priced at that fixed discount. Rather than mandate a fixed price, it may be more economic to declare a maximum allowed discount and then require the Processor selling the milk to justify the discount they would like to receive based upon actual costs.

One option is to allow the Processing plant that sells the milk out-of-State to receive a deduction consisting of two components from the Class I price. The first component would be the difference between the Class I price in Montana and the Class I price of the market into which the milk is being sold. The second component would address the additional cost to transport full truckloads of the product to the out-of-State location, compared to the cost of local delivery at the destination.

It is likely that, for the current non-contiguous out-of-State sales, the discount would be similar to the current $3.05 discount to the Montana Class I price but, as noted earlier, there may be customers who would be closer than what necessitates the $3.05 discount, as well as some that

would be farther away. The deductions would need to be initially justified and then reviewed on a periodic basis or any time the customer delivery locations changed significantly, to ensure they represent actual cost requirements.

A second option would be for the Milk Control Bureau to calculate what cost would be competitive in various markets. For each market, the allowable discounts could be calculated based on the Class I prices and premiums in the market, adjusted for the cost of shipping to that market. The prices could be reviewed as appropriate, either periodically or whenever there is a sufficient change in the market, such as significant change in the cost of diesel fuel.

A third option, which may only work if the Statewide Pool is eliminated or restructured from its current form, is for the Processor to contract on an open arms-length basis with its Producers to supply the required amount of milk at a discounted price. This option could be established with or without approval or oversight from the Board of Milk Control.

4.c. Study Task 3 – Hauling Unprocessed Milk Between Plants

We evaluated the current practice of having all Montana Producers share, through the Pool, in paying for the cost of hauling unprocessed milk between Montana Pool plants. In evaluating the practice, we researched whether similar practices are used in other regulated markets and whether other regulated markets set limits to the cost of hauling milk between plants that are borne by Producers. We also considered reasons why the cost should or should not be borne by Producers and considered the development of flexible formulas that would incentivize and more efficiently manage the flow of milk within the state to limit the need for and cost of hauling milk between plants, or to limit the portion of that cost that is borne by Producers.

In Montana, milk that is normally shipped to one plant, but is needed at a plant farther away, can be diverted and shipped directly to the more distant plant with the incremental shipping cost charged to the Pool. In other words, Producers pay for the portion that represents what it would cost to haul to the closer plant, but the additional hauling required to divert and ship milk to the more distant plant is shared by all of the Producers through the Pool. This is referred to as "inter-Plant" hauling.

The "inter-Plant" milk is typically not physically delivered to a Producer's "home" plant and then reloaded and hauled to another Pool plant. It is nearly always shipped directly from a Producer to the intended Pool plant. A deduction that represents the cost if the milk had been delivered to the Producer's home plant is made against the actual shipping cost and charged directly to the Producer as their "normal" delivery cost. The remainder is charged to the Pool and shared by all the Producers in the state as an inter-Plant hauling cost.

Nearly all inter-Plant milk is currently delivered to the Billings plant with an average of approximately 75% coming from Great Falls and 25% from Bozeman over the last three

calendar year period of 2015-2017, although Bozeman's share dropped to just under 15% in calendar 2017.

The volume of milk shipped to Billings over the last three calendar years has averaged a little over 28.6 million pounds per year and represents nearly 64% of the Billings plant's in-State utilization. This occurs because there is insufficient milk production the area of the State near Billings to meet its total utilization needs.

After researching most of the Order and non-Order areas of the country, we found that Montana is the only Order where the cost of transportation between plants is included in the Pool. The Southeast Order provides a limited subsidy for milk shipped in from out of the area during the low season, and some Orders allow Assembly and Transportation credits to Supply plants that divert milk to Class I plants. A Supply plant is generally a Balancing Plant that will "divert" milk to a Class I plant when the Class I plant needs it. This might occur on an occasional basis.

Throughout the rest of the country, Producers are responsible for just paying the direct cost of hauling their milk to their processing plant. It is rare for raw milk to be shipped from one plant to another plant. Exceptions occur when components like cream or whey may be sold or shipped to another plant for further processing but in general, Processors absorb the cost of such transport.

Most Producers in the country are members of a cooperative marketing organization (coop) that charge their individual member Producers the direct cost of hauling their milk to the closest plant serviced by the coop, regardless of where their milk is actually delivered. Any difference between what is paid by the individual Producer and the actual cost of hauling the milk to wherever the coop decides to process it is then shared by all the member Producers in the region.

Although this appears to be somewhat similar to Montana's pooling and sharing of inter-Plant hauling costs, it is different in the material respect that it is confined solely to the member Producers of the coop and is not pooled or shared by Producers of unrelated entities or plants across the state or region.

Larger, independent Producers generally pay the full amount of hauling to whatever plant their milk is shipped. On rare occasions, if there are no Producers near a plant, the plant may have to pay a premium to help cover the hauling cost to obtain raw milk.

Montana's practice of charging inter-Plant transport of milk to the Pool means that certain Producers, and to a certain extent, the receiving Processor, do not bear the full cost of having milk delivered to that Processor. Nearly 100% of inter-Plant raw milk is being delivered to the Billings plant from Meadow Gold's Great Falls and Darigold's Bozeman Producers. Including the hauling cost associated with inter-Plant transport in the Pool results in Darigold Producers

subsidizing a portion of the hauling cost that would otherwise be borne by the Meadow Gold Great Falls' independent Producers or possibly, to some extent, by Meadow Gold itself.

The total inter-Plant hauling cost in calendar 2017 was nearly $530,000 and Darigold's allocated share of this amount through the Pool, based on calendar 2017 utilization volumes, was about $295,000, versus $23,000 for the hauling cost of the milk it actually shipped to Billings, or there would be no cost if Billings paid the cost of the transfer.

The cost of hauling is an important factor when considering where to locate a new dairy farm (although few new dairies have been established recently in Montana). In general, sharing the delivery cost through the Pool lessens the pressure for new dairy farms to locate close to the plant, or to induce an existing farm located far from the plant to move closer in order to reduce their direct hauling costs. Once established, it is a difficult decision to move a farm just to get closer to a Processor, and it is not something that has occurred in Montana for a long time.

On the other hand, an argument has been put forth that subsidizing the cost of getting milk to the Billings' plant improves the volume of Class I milk that can be processed. If the cost wasn't subsidized by the Pool, the milk would not flow to the plant and Billings may either acquire additional Class I milk from out-of-State or possibly even shut down, so by providing more Montana milk to the plant to be used as Class I milk, the subsidy is increasing the value of all the Pooled milk. It is unclear if this argument is in fact correct, as it is also possible that the Billings volume could be provided from certain in-State Producers who were willing to absorb the cost to obtain a better price, or that Bozeman and Great Falls might absorb the in-State Class I milk currently being processed by Billings if the plant were to close.

Our considered recommendation is to eliminate charging the Pool for Inter-Plant hauling for several reasons. This practice appears to be unique to Montana. On a standalone basis it is not equitable to have costs incurred through activities of certain Producers subsidized by other Producers where they do not direct and equal value in return. This is especially true if the party incurring the cost is essentially a competitor of a party sharing in the cost.

This recommendation is made on a standalone basis. However, there are other changes we have recommended to the structures for the Quota and Pooling systems that would affect other factors that act as offsets to one another, including the inter-Plant hauling cost. Taken in concert, all the changes as recommended would act to offset some of the economic impact of eliminating this particular practice.

Alternatively, if the Pool is eliminated or separate Pools are established for individual Producer Groups or groups of Processors, then it would be up to the members of these separate Pools to decide to share inter-Plant hauling costs. In essence, the separate Pools would work in similar fashion to the way coops function in spreading hauling costs among members in the region.

4.d. Study Task 4 – The Montana Quota System

We evaluated the effectiveness of the Montana Quota system to manage production levels and improve Producer blend prices. In evaluating the Montana Quota system, we considered the following: potential impacts of changes to the Quota milk price, the Excess milk price Differential, changes to Quota rules that would make the system responsive to levels of milk processing within Montana, how to more closely match outstanding Quota with Montana market needs in the future, and finally, the impacts of transitioning the Quota system.

Many of the issues regarding the Montana Quota system also have an impact on the Montana Pool and so we evaluated the current Pool structure as well that resulted in identifying certain additional alternatives and recommendations.

4.d. i. Other States with Quota

Our research identified two states that have formal Quota systems: Virginia and California. In addition, although Pennsylvania does not have a statewide Quota system it does have some informal measures to manage production levels. A summary of each of these structures follows.

Virginia

Virginia has approximately 608 dairies and 90,000 cows (2016) although they lost a large dairy in November 2017. The Quota system in Virginia, which is referred to as Base, was established to provide stability and a fair price to Producers for fluid milk sold in Virginia. Virginia's Base (Quota) cannot exceed 108% of Class I fluid milk sold just in Virginia and is adjusted annually. Class I sales outside of Virginia are referred to as Class I-A.

Base can be and is held by out-of-State Producers as well as Virginia Producers. Approximately 55-60% of in-State Virginia Producers own Base, 284 Pennsylvania Producers own Base and Producers in nine other states own Base. Producers can transfer or sell Base and transfer are handled administratively by Virginia assuming all other requirements are met. All owners of Base are obligated to sell at least their level or have their Base reduced to their level of production.

The benefit of Base is that the Producer is paid the higher Virginia Class I price for all Base production. Virginia's pricing mechanisms result in prices greater than Federal Order for Class I. Any volume produced over Base is sold based on the applicable Federal Order classifications wherever the milk is sold.

Prices within Virginia are different based on where a Processor is located. Prices are tied to nearby contiguous areas including Washington, DC and certain locations in North Carolina to

keep pricing in check with surrounding markets. Pricing is also tied to a list of indices, but most have been maxed out and can no longer effectively increase prices.

Each year retail fluid milk sales in Virginia are examined and compared to the existing Base level. In February, the milk Board looks at the last calendar year and adjusts the Base. If Base exceeds retail sales, it must be reduced so as not to exceed 108% of those sales. If retail sales exceed Base, the Board has the option to increase Producer Base so long as it does not exceed 108%. The new Base takes effect March 1st of that year and all owners of Base are adjusted on a pro-rata basis.

The farm price is based on the FMMO Advanced Skim and Butterfat pricing. This is used along with numerous (8) other cost components to arrive at a Virginia based Producer Price. Class I is Fluid milk processed and sold in Virginia, and accounts for 87% of the milk. Class I-A is Fluid milk that is processed in Virginia by plants that sell milk in Virginia, but is sold out-of-State. This Class was developed to track the volume leaving Virginia and is priced at the Class I Federal Order of where it is sold. There is no minimum wholesale price for this Class. Class II is all other products.

Pricing from the plants to retailers or wholesalers is determined by the Milk Commission which audits plants and, using a weighted average, determines a minimum plant throughput cost. The weighted average is set for one year. To determine the wholesale price a percentage is added to the weighted average. To set a Retail price, 6% is added to the wholesale price

California

California has approximately 1,330 dairies with 1,735,350 cows (2017) both of which represent slight reductions from the prior year.

The Quota system in California was established in the late 1960's, based on total production and Class I utilization at the time, to create stability and equity in pricing for Producers. Its goal was not meant to manage or control production levels.

When first established, the initial asset value, in other words the value a farmer could receive for selling its assigned Quota to another party, was $0.00. The asset value of Issued Quota is market driven and is currently valued at about $530 per pound per day of SNF (Solids Not Fat). California Quota volume was originally set at 110% of its Class I fluid milk sales and a Pool was established to determine payments to Producers holding Quota.

Quota is currently a finite volume of milk as Class I consumption growth never materialized that would allow Quota to be increased. The last time any new Quota was issued was in 1992. Over the years Class I utilization has decreased as a percent of total production in the state. In 2017 California produced 39.8 billion pounds that was utilized as follows:

- 12.8% as Class I
- 5.5% as Class II

- 3.0% as Class III
- 32.5% as Class IVa
- 46.2% as Class IVb

Not all Producers hold Quota or are members of the Pool nor is there any requirement to do so. 57% of dairy Producers in the state hold Quota. Class I and II plants in California participate in the Pool but Class III and IV plants are not required to do so.

For a Class III or IV plant to participate in the Pool it must transfer some portion of its milk to a Class I plant. This may be done to keep Producers who hold Quota and are supplying that plant happy as they then can receive Quota milk pricing for that portion of their milk.

Quota may not be held by an out-of-State Producer. Producers can transfer or sell Quota. If a farm shuts down operation, it has 60 days to sell or transfer its Quota or the Quota reverts back to the Pool. The state has always worked to help its Producers sell their Quota and it is unknown whether there is any Quota held by the Pool.

New entrants to holding Quota and to the Pool must meet certain production requirements to obtain Quota. In addition, they must maintain their production level at the same or greater volume for 5 years to keep their Quota. Farms pay the cost from farm to plant and in some instances, the co-op covers the cost then deducts the cost from the farm. Any shipments or transfers between plants is paid by the shipping plant.

The benefit of holding Quota at present is that the Producer receives a premium of $1.70/cwt for all the milk it produces up to their Quota limit. Beyond the Quota limit, all milk sold by a Producer is based on California's Class pricing in the Pool along with all other Producers. The Base and Over Base Price is the same for Butterfat, but there is a premium on the Quota skim non-fat Solids (SNF). The premium for Quota milk is $0.195 per pound SNF for all the milk produced within Quota and is the same regardless of how a Producer's milk is utilized (Class 1, 2, 3, 4a, or 4b). The standard for testing of non-fat solids in milk is 8.7% which, when multiplied by the $0.195 premium per pound of SNF, equates to the $1.70 per cwt of skim milk. However, the Quota premium is paid at actual test. For example, if a Producer's milk tested at 9.1% SNF, the hundredweight Quota payment would be $1.77/cwt. (0.195/lb * 0.091 * 100lbs).

California's milk market program establishes minimum prices Processors must pay for Grade A milk received from dairy farms. The most significant factors in determining the minimum price Processors must pay for milk are the wholesale commercial market price for the four dairy product commodities as follows:

- The simple average spot price for Grade AA butter at the Chicago Mercantile Exchange (CME),
- The California weighted average price (CWAP) for nonfat dry milk (NFDM) as reported by the California Department of Food and Agriculture (Department),

- The simple average spot price for block Cheddar cheese at the Chicago Mercantile Exchange (CME), and
- The simple average of the price for Western dry whey (WDW) as reported by Dairy Market News (DMN)

The Pool is made up of Classes I, II, III, IVa & IVb prices (Class III ice cream, Class IVa Butter/powder, Class IVb hard cheese) and plants may have contracts with both co-ops & independent farmers supplying them raw milk.

A petition was submitted in California to establish a federal order for pricing and the USDA recently responded and announced the plan for implementing this. The USDA order structure has no provisions for Quota. Separately California has created a Quota implementation plan that would be automatically triggered if the USDA pricing plan is adopted and transition to the USDA plan will require a vote by the California Producers.

Pennsylvania

Pennsylvania has 6,650 dairies with 525,000 cows as of 2016. Pennsylvania does not have a formal state Quota system. However, some of the cooperatives have a Quota type system within their own membership. For example, Land O'Lakes has a Quota system with a stringent disincentive of $10/cwt for product sold over Quota. The plan states that "Under the program, members producing more than their base volume will be charged any incremental costs (freight, market discounts) associated with marketing that milk in less profitable channels".

A dealer and its Producers may establish a system of level or uniform milk production in accordance with the requirements of the dealer, and pursuant to the terms and conditions prescribed by the Board, if the milk dealer first shall make a formal application to the Board and receive written authorization to do so.

The PMMB (Pennsylvania Milk Marketing Board) establishes minimum Producer, Wholesale, and Retail prices. The minimum Producer price includes a Board-mandated over-order premium on Class I milk produced, processed, and sold in Pennsylvania.

There are 6 marketing areas in Pennsylvania. Three of the areas are in Federal Orders 1 or 33 (Areas 1, 4 & 5), and the PMMB uses the Blend or Uniform Price established in Federal Market Area 1 or 33 to compute the farmer's price.

In PMMB Areas 2, 3 & 6 (FMMO non-regulated areas) there are plant Pools established for computing a blend price. If the plant is a Class I plant and ships at least 25% of its product into a Federal Order area, then it will be Pooled in that Federal Order.

Fluid milk dealers may request an allowance on bulk sales of Surplus or distressed milk to other licensed dealers solely engaged in the manufacture of dairy products if the selling dealer

obtains written authorization in advance from the Board and provides the Board with information required on detailed forms.

When a dealer provides the service of transporting the Producer's milk from the Producer's farm to a dealer's plant of first receipt, the dealer may deduct from the payment to the Producer for such service based upon the dealer's actual cost of transportation, a record of which shall be kept by the dealer.

Monthly, the PMMB sets Minimum Wholesale prices based on an annual study of plant costs. The annual plant cost study collects and computes the average cost for milk plants to process, pack and deliver product. There are discounts which customers are entitled to off the Minimum Wholesale Price based on volume and services supplied.

The PMMB also sets Minimum Resale prices each month. These prices are determined by a formula based off the Minimum Wholesale Price, a survey of the in-store handling costs, an established profit, and a discount rate based off volume and services.

4.d. ii. Quota in Montana

The original purpose of Montana's Quota system was to help manage and provide stability to the level of milk production and to help create a sustainable price that Producers receive for milk sold within Quota. When there is too much milk being produced, Surplus milk is typically sold at distressed prices.

Since Montana Producers are paid based on the blended price of all milk sold as utilized, discounted Surplus milk brings down the blended price that all Producers receive. To avoid this, a Quota system would typically be based on actual demand for the higher-priced Class I milk so that the milk that is produced and sold within Quota would be at a higher price. Milk produced in Excess of the Class I demand is typically sold at a lower price in the market, and any Producer generating Excess milk would receive a separate lower price for the Excess production. This is meant to discourage Excess milk production in general, but also allows Producers who choose to produce Excess milk to do so and receive a lower price for it.

Excess milk, or milk produced above Quota volume, may still be needed to produce items other than Class I bottled milk. However, if there is more milk than the Processors need for bottling or manufacturing products, that milk is considered Surplus, and it is usually sold to a Balancing plant at a discount.

Montana's Quota system establishes a $1.50/cwt price Differential for Skim and Butterfat between Pool-wide blend prices for milk produced within a Producer's Quota and Pool-wide blend prices for milk produced in Excess of a Producer's Quota. The price Differential was created to discourage Producers from producing in excess of their Quota.

Daily Quota (in units of pounds of milk per day) was allocated in 1988 to Montana Producers based on their historic deliveries to fluid milk plants, although Quota itself is not tied to individual plants, but just to Producers. Quota may only be held by Montana Producers. Also, a Producer's Quota does not change if the Producer sells milk to a different plant in Montana.

Issued Quota can only be held by active dairies and cannot be leased, although it can be sold on an open market basis to any Producer. Producers can sell a portion of their Issued Quota to other Producers at any time, or all of their Quota as part of shutting down active operations. Any Quota that is offered for sale as part of a farm shutting down, but that is not sold within 90 days of the farm becoming deactivated, is then forfeited and reallocated on a pro-rata basis to all outstanding farmers. Reassignment of Quota is rare, since exiting Producers can find buyers of their held Quota from among active Producers.

The Milk Control Bureau is required to issue additional Quota to Producers in response to the occurrence of two market triggers that must both have taken effect. The first market trigger is that the utilization of milk for Class I and Class II (for sales of products to the Montana market) must have increased from two years prior to the preceding year. The second market trigger is when, in the preceding year, over 83.5% of Quota milk receipts are utilized for Class I and Class II sales of products to the Montana market.

In recent years, roughly 60% of Quota milk has been utilized in Class I and Class II sales of products to the Montana market. The last year that state-wide Quota was increased and allocated to Producers was 2001, which resulted from the market triggers occurring in 2000.

The administrative rules that govern Quota do not provide for any automatic reductions of Quota that might be based on such events as production history, Quota utilization, market triggers, or closure of dairies or plants. Administrative rules that govern Quota also do not provide for increasing Quota in response to demand created by Class III plants or demand for raw milk by plants for products marketed outside Montana.

Approximately one-third of Montana dairies currently produce milk in Excess of their Quota and last year this Excess production accounted for roughly 4% of statewide production. The remaining two-thirds of Montana dairies produced milk within their individual Quota volume, with nearly two-thirds of these dairies producing under their Quota volume by 10% or more. Collectively, the "underproduction" of Quota was over twice the Excess production over Quota.

As noted above, Quota volume significantly exceeds Class I utilization for Montana Processors, and in fact exceeds total annual production, meaning that Montana Producers are collectively producing less milk than allowed by Quota. In this situation Quota is not serving any purpose for which it was established.

Certain Producers do produce more milk annually than their Quota allows and receive $1.50/cwt less for this Excess volume of milk. However, all Producers in the state are negatively

affected by Excess production. Since Montana already is in a significant Surplus position, and the $1.50 difference between Quota and Excess is fixed, the Excess produced by Producers simply contributes more to the Bulk Surplus, which as noted in other Sections of this report, effectively lowers the blended Pool price that all Producers receive.

In order to understand the impact of the current Quota system and changes to Quota, we analyzed utilization by Processing plant. The following table shows utilization (pounds) by plant and by Class for Montana for calendar 2017.

	Production and Utilization of Montana Milk 2017 Pounds					
	Bozeman	Great Falls	Billings	MCE	Total	% of Total
Class I						
Within Montana	58,598,288	58,757,224	28,447,617	1,084,362	146,887,491	52.7%
Bulk Sales to Class I Processors	-	-	-	-	-	0.0%
Packaged Sale Contig	1,973,705	5,894,966	10,860,145	-	18,728,816	6.7%
Packaged Sales Non-Contig	69,819,376	-	-	-	69,819,376	25.0%
Total Class I	**130,391,369**	**64,652,190**	**39,307,762**	**1,084,362**	**235,435,683**	**84.4%**
Class II	1,801,700	5,602,721	3,869	336,493	7,744,783	2.8%
Class III						
Shrink, End Inv and Sales in Montana	3,441,880	2,702,263	3,727,653	78,394	9,950,190	3.6%
Allocated to Cream Sales	5,746,329	2,093,285	2,472,578	-	10,312,192	3.7%
Bulk Sales	9,341,669	6,116,268	-	-	15,457,937	5.5%
Total Class III	**18,529,878**	**10,911,816**	**6,200,231**	**78,394**	**35,720,319**	**12.8%**
Total Utilization of Montana Milk	**150,722,947**	**81,166,727**	**45,511,862**	**1,499,249**	**278,900,785**	**100.0%**
Total Montana Production	**154,958,712**	**105,922,001**	**16,520,823**	**1,499,249**	**278,900,785**	

The table shows that Class I utilization sold within Montana in calendar 2017 was nearly equal for Bozeman and Great Falls, while Billings utilized about half the volume. Altogether, Montana Class I utilization sold in Montana represented 52.7% of the total annual milk production in calendar 2017.

Surplus Packaged Sales account for 31.7% of the total annual milk production, with Bozeman accounting for 81% of that total. There is a detailed discussion of Surplus Packaged Sales in the Section 4.b. Study Task 2.

The Darigold and Meadow Gold Producer groups hold close to the same amount of Quota and this produces somewhat of a misalignment with regard to Class I fluid sales within the State. Darigold's Producers hold approximately 51.8% of total state-wide Quota but Darigold as a Processor serves 40% of the retail Class fluid milk sold in the State. On the other hand, Meadow Gold's Producers hold 47.9% of total state-wide Quota, but Meadow Gold itself serves 60% of the retail Class I fluid milk sold in the State.

The milk that MCE produces and utilizes in its own processing plant represents about 0.3% of total state-wide Quota but is utilized mostly for its own internal purposes. However, MCE also

acts as a Producer selling raw milk to Darigold and has significantly more Quota associated with that volume. In fiscal 2017, MCE produced Excess milk nearly 24% above its Quota.

Total state-wide Quota in Montana represents about double the in-State Class I demand in Montana and exceeded total Montana milk production in calendar 2017 by approximately 7%.

The Quota system in Montana is not working effectively and has had little impact on production or pricing as evidenced in a number of ways. Total annual production has varied somewhat over the last 15 years but has always been below state-wide Quota even though certain individual farmers produced well over their individual Quota. This means that the remaining farmers are collectively producing well below their Quota and that Quota in and of itself is not a driving factor in managing production volume. Also contributing to reduced production over the last several years has been a steady decline in the number of farms and total number of cows in Montana (see "Montana – Number of Cows and Dairies – Trend" in Appendix C). The market value of issued Quota as an asset, obtained through selling Quota when a Producer reduces herd or shuts down, has declined over the years.

Individual Producers cannot manage their own production level as a means of receiving a higher average milk price because total state-wide Quota exceeds total production and all Producers receive the same blended price through the Pool, adjusted for their Butterfat content. Any individual Producer who reduces production has minimal impact on the blended Pool price, and if another Producer increases production, it can effectively offset any impact.

Given these results, it's clear that established Quota volumes and the current Excess Differential of $1.50/cwt are having little if any effect in managing overall production in Montana or acting to raise or stabilize milk pricing for those Producers who might otherwise wish to manage (e.g., lower) their production to receive a higher price for their milk.

In 2015 – 2017 respectively, the usage value of the milk in Montana was $48.2 million, $43.6 million and $47.6 million, prior to inter-Plant hauling charges. This is $16.25, $14.77 and $16.49 per cwt, respectively, at a standard of 3.5% Butterfat. Actual Butterfat content is typically higher than 3.5% and varies by Producer and in total for the Pool, as well as by utilization and period. We used the common standard of 3.5% to simplify our analysis and provide a consistent basis for comparing periods and utilizations. The following table shows the usage values of the milk in Montana for 2017 broken down by plant and disposition.

	Utilization Value of Montana Milk 2017 before additional charges				
	Bozeman	Great Falls	Billings	MCE	Total
Class I within Montana					
Montana Value	$8,927,983	$8,735,449	$4,354,815	$118,063	$22,136,308
Beg Bulk Inv Adj	$9,648	$0	$117,841	$0	$127,489
Total Montana Class I	**$8,937,630**	**$8,735,449**	**$4,472,656**	**$118,063**	**$22,263,798**
Value per CWT	**$15.25**	**$14.87**	**$15.72**	**$10.89**	**$15.16**
Value per CWT at 3.5% BF	**$19.03**	**$19.02**	**$19.44**	**$18.93**	**$19.11**
Packaged Sales to Contiguous States					
Montana Value	$277,651	$909,362	$1,629,084	$0	$2,816,097
Adjustment	($50,329)	($150,322)	($276,934)	$0	($477,585)
Total Montana Packaged to Contig	**$227,321**	**$759,041**	**$1,352,151**	**$0**	**$2,338,513**
Value per CWT	**$11.52**	**$12.88**	**$12.45**	**$0.00**	**$12.49**
Value per CWT at 3.5% BF	**$16.51**	**$16.51**	**$16.52**	**$0.00**	**$16.52**
Packaged Sales to Non- Contiguous State					
Montana Value	$10,417,903	$0	$0	$0	$10,417,903
Adjustment	($2,129,491)	$0	$0	$0	($2,129,491)
Total Montana Packaged to Non-Contig	**$8,288,412**	**$0**	**$0**	**$0**	**$8,288,412**
Value per CWT	**$11.87**				**$11.87**
Value per CWT at 3.5% BF	**$16.01**				**$16.01**
Class II					
Montana Value	$827,737	$2,029,891	$11,027	$90,031	$2,958,686
Beg Bulk Inv Adj	$3,141	$4,279	$44	$9,210	$16,674
Total Montana Class II	**$830,878**	**$2,034,170**	**$11,071**	**$99,241**	**$2,975,360**
Value per CWT	**$46.12**	**$36.31**	**$286.14**	**$29.49**	**$38.42**
Value per CWT at 3.5% BF	**$15.73**	**$15.57**		**$16.57**	**$15.64**
Class III					
Cream, Shrink and End Inv.	$5,465,144	$2,095,176	$2,146,314	$46,031	$9,752,665
Beg Bulk Inv Adj	($5,966)	($4,877)	($1,998)	$0	($12,840)
Total Class III	**$5,459,178**	**$2,090,300**	**$2,144,316**	**$46,031**	**$9,739,825**
Value per CWT	**$59.42**	**$43.59**	**$34.58**	**$58.72**	**$48.07**
Value per CWT at 3.5% BF	**$12.86**	**$12.71**	**$12.92**	**$12.91**	**$12.84**
Bulk Sales to Class III Processors					
Montana Value	$1,256,861	$808,474	$0	$0	$2,065,335
Adjustment	$236,219	$80,965	$0	$0	$317,184
Haul Charges	($205,517)	($210,326)	$0	$0	($415,843)
Total Class III	**$1,287,564**	**$679,112**	**$0**	**$0**	**$1,966,676**
Value per CWT	**$13.78**	**$11.10**	**$0.00**	**$0.00**	**$12.72**
Value per CWT at 3.5% BF	**$13.30**	**$10.82**	**$0.00**	**$0.00**	**$12.20**
Total Processor Utilization Value	**$25,030,983**	**$14,298,071**	**$7,980,194**	**$263,335**	**$47,572,583**
Value per CWT	**$16.61**	**$17.62**	**$17.53**	**$17.56**	**$17.06**
Value per CWT at 3.5% BF	**$16.01**	**$17.05**	**$17.03**	**$17.61**	**$16.49**
Inter-Plant Hauling Charges	($23,018)	($503,576)	$0	$0	($526,595)
Value of Transferred Milk	$754,241	$4,309,886	($5,064,127)	$0	$0
Net Utilization Value	$25,762,206	$18,104,381	$2,916,066	$263,335	$47,045,988
Value per CWT	**$16.63**	**$17.09**	**$17.65**	**$17.56**	**$16.87**
Value per CWT at 3.5% BF	**$16.02**	**$16.57**	**$17.03**	**$17.61**	**$16.30**

Before adjustments related to inter-Plant hauling charges, the average price received by Producers in calendar 2017 was $17.06/cwt, or $16.49/cwt at a standard 3.5% Butterfat.

Given that the current Excess discount is $1.50, and the total amount of Excess in fiscal 2017 represented about 4.0% of production, the Quota milk price was $16.55, and the Excess price was $15.05 at 3.5% Butterfat (before inter-Plant hauling charges).

We adjusted the actual data per cwt to 3.5% butterfat so that the results can be more easily compared and because just looking at actual data can be a little misleading. For example, the value of Class I milk utilized for sale in Montana in calendar 2017 was $15.16/cwt. This may seem low if compared to the published average Class I value in other states or areas of the country. However, the average butterfat content of the milk sold as Montana Class I is just under 2%, so the value of $15.16/cwt is for milk at just under 2% butterfat. If the value is adjusted to the "standard" butterfat of 3.5%, the result is $19.11/cwt, which can be compared to the published standard Class I price in other jurisdictions. Similarly, Class II volume sold in Montana is mostly cream, with an average butterfat content of around 13% and a value of $38.42/cwt. This value varies significantly based on the type of cream sold (8% butterfat for half and half to 40% butterfat for heavy cream), so to get a better idea of comparable Class II prices, we used the standard of 3.5% Butterfat, which results in a Class II value of $15.64.

4.d. iii. Options for Setting the Amount of Quota Going Forward

Since the current Quota system in Montana is not creating an incentive to reduce Surplus milk in the state, we believe that the system should be modified. We identified three options for addressing Quota going forward.

1. **Quota Option 1:** Our recommendation is to reduce state-wide Quota to where it has meaningful impact on individual Producer decision making.

   For Montana, the most logical level appears to be at or slightly above the volume of raw milk required to meet the Montana Class I demand. Class I is the core of dairy products processed and sold in Montana and essentially represents the floor of required production volume. However, if the goal is to assure that the state-wide Quota volume is sufficient to cover Class I sales, then at least two other elements need to be considered: Cream and Shrink.

   Raw milk averages about 3.7% butterfat. Packaged Class I milk currently contains an average of about 2% butterfat, leaving about 1.7% to be utilized for cream. Since bulk cream is sold at 40% Butterfat, every 100 pounds of raw milk generates approximately 4.5 pounds of cream.

   All Processing plants have shrink or product losses. By rule in Montana, no more than 2% of total milk processed can be classified as shrink and priced as Class III milk. Something similar to this exists in most regulated markets. So, for every 100 pounds of milk processed, 2 pounds of shrink are allowed to be costed at the Class III price, assuming actual shrink is at least 2%. Any shrink above 2% is priced as Class I

Thus, cream and shrink represent approximately 6.5%, or 6.5 pounds out of every cwt processed, and are priced as Class III milk. Therefore, to ensure that enough milk is produced, it seems logical to include this additional 6.5 pounds of Class III as part of Quota. Rounding up, Quota established to ensure sufficient supply is produced to meet Class I demand needs to be set at a minimum of approximately 107% of Montana Class I Usage.

Setting Quota close to actual Class I demand results in providing a significantly higher milk price for Quota volume than for Excess. Producers will receive essentially the Class I milk price for the volume they produce within their Quota, and this should put them in a healthy financial situation.

As discussed later, larger farms likely will be happy to produce Excess milk for a lower price if a portion of their milk is Quota milk and paid at a good price. This means that Quota volume could be set at close to the Class I demand and any Excess milk needed would still be available since it likely will be priced at Class III or better.

2. **Quota Option 2:** The second option is to leave the state-wide volume of Quota where it is but increase the discount significantly above the current $1.50 to provide a strong, even uneconomic, disincentive for producing Excess.

   In calendar 2017, a little over 10.5 million pounds of Excess milk was produced state-wide. This Excess volume was equivalent to just under half the average annual bulk sales for the period calendar 2015-2017, and approximately 68% of calendar 2017.

   If Excess production in calendar 2017 had been reduced by this 10.5 million pounds, the result likely would have been a reduction in Bulk Surplus Sales by an equivalent amount, resulting in an increase in the overall Pool value of $0.25/cwt, from $16.49/cwt to $16.74/cwt in the net blended price, at a standard 3.5% butterfat.

   However, Producers who do not currently produce at their allowed Quota could in turn simply increase their own production and make up the difference without exceeding total state-wide Quota. Thus, simply increasing the Excess Differential would not necessarily have any impact on total production volume.

   Bulk milk sales decreased from 27 million pounds in calendar 2015 to 15.5 million pounds in 2017 with no changes to the Quota or Pool systems. Darigold's decrease in bulk sales was offset somewhat by an increase in its packaged sales out-of-State, but Meadow Gold's reduction in bulk sales represented a real decline.

3. **Quota Option 3:** The third option is to eliminate the Quota system entirely.

   Elimination of the Quota system could be accomplished either on a standalone basis or in line with changes in how Classifications of milk are priced, changes to the Pool system, or changes made along with other mechanisms that may be set in place.

   Quota system elimination must take into account that many Producers use the value of their Issued Quota asset as collateral for bank loans. Eliminating the Quota system would obviously eliminate its associated asset value in the market and as loan collateral and some mechanism would need to be established to address this consequence.

   In addition, Issued Quota asset value is a consideration that farmers take into account when deciding whether to reduce or sell their herd and loss of that value would have a significant financial impact in such decisions.

   However, absent the two issues discussed above, Quota as a system, and the Excess discount, currently appear to have little or no effect on managing production, making the Quota system ineffectual in that regard. An outcome of this can also be seen in the declining market value of Issued Quota as an asset.

4.d. iv. Effect of Reducing Quota Volume to a Level Based on Class I Demand

If Quota during calendar 2017 had been set at the Montana Class I utilization, the Quota milk price would have been approximately $18.67 per cwt (at a standard of 3.5% Butterfat) and the blended milk price for all other volume over Quota (Excess) would have been $13.31 per cwt. This assumes Quota volume was set at 107% of Class I demand, and the payment for Quota was based on Class I and Class III pricing. Various options for pricing Quota volume are discussed in Section 4.d.v.

This Differential between Quota and Excess milk prices of $5.36 ($18.67 - $13.31) is substantially greater than the current Excess Differential of $1.50. This natural pricing differential would essentially eliminate the need for the fixed Excess Differential of $1.50 although a minimum fixed Differential could still be kept in place.

With a lower Quota volume tied to a higher price, Producers would receive the higher price for all production up to their Quota volume. If they decide to produce additional volume, it would then be at the lower Excess price. As volume declines, the result would be a higher net blended price at a lower volume. Under the current Quota and Pool structures this is essentially not an option for individual Producers, as has been discussed.

The long-term effect of this approach would likely be to lower overall production over time. This would have an expected subsequent effect of raising the overall average price Producers receive for any Excess (Quota milk price would be tied to Class I sales). This assumes that the

lowest value of milk, out-of-State bulk sales, would be reduced first. In any case, Producers would now have options and greater choice in deciding what level of production they wish to pursue.

It is also expected that the asset value for a pound of Issued Quota held, if sold on the open market, would increase so that the net cumulative asset value of all Producers' Quota would not change significantly, and may even increase. In other words, we expect that the asset value of Quota on the open market would increase, such that the lower amount of Issued Quota times a higher market value would equal or exceed the value of currently Issued Quota at its current market value.

Consideration of what level to set state-wide Quota volume raises the issue of what level of production would be optimal for the industry as well as whether, to what extent, and how quickly a decline in production levels should be incentivized. Setting Quota volume to approximate Class I demand should act to lower production. At lower production levels, the net average price paid to Producers will be higher. For most Producers, the higher price paid, even at the lower volume, should put them in a better financial position. However, some very small Producers may initially have difficulty reducing volume and remaining viable. These Producers would potentially need to acquire additional Quota, or close operations, if their lower Quota production volumes, even at a higher price, proved insufficient to maintain their dairy operation.

If total volume declined too much, it is possible that there may not be sufficient milk to cover the current level of Surplus Packaged Milk sales. However, considering the fact that the discount for Surplus Packaged Milk puts the price at about the Class III price, it is likely that Producers would provide Excess milk at that price.

The volume of milk sold as Class III Bulk milk out-of-State during the calendar period 2015-2017 declined by over 11.5 million pounds, offset somewhat by an increase in Class I Packaged Sales out-of-State of over 6.5 million pounds. The net drop in Bulk Sales seems to indicate that it is of insufficient value, but that Class I Packaged Sales out-of-State have sufficient economic value on an incremental cost basis (see Incremental Cost discussion Section 4.d.ix). The net result of this perception may be that farms do not see economic value in purchasing cows, especially from farms exiting the business, to produce milk that will be sold as Class III Bulk Surplus and this has resulted in a state-wide drop in the total number of cows and lower total production.

It is unclear how the Processors would respond to a reduced amount of Issued Quota. Darigold, as a cooperative, has specific obligations to its Producers whereas Meadow Gold, operating as an independent facility with independent Producers, has no formal obligation to its Producers. Milk currently being sold as Class III Bulk Surplus generates no value to Processors, they sell it primarily to support their Producers at what is believed to be no profit or loss to themselves. If there is significant production in excess of Quota volumes, would the Processors continue to do

their best to dispose of the milk, or would they simply stop receiving milk from certain Producers?

For example, the new Walmart plant at least partially caused a decrease in the demand for Class I milk in parts of the Midwest. As a result, a number of large independent Producers have been notified that their contracts will not be renewed, and they are not sure where they will be able to sell their milk.

One question that would need to be addressed if the level and rules for Issued Quota is changed is whether Quota should be set simply as a limit or established as a requirement. In other words, should Producers be required to produce at their Quota or lose it? This may not be an issue if Issued Quota is set close to Class I demand since most Producers would likely produce all of their Quota volume and also additional milk for a reasonable Excess price.

Satisfaction of Quota volume is calculated on a monthly basis. Given this, a rule requiring a Producer to relinquish part of their Issued Quota, in the event they did not produce enough milk to meet their Quota, might ordinarily consider whether a Producer met their Quota on a monthly basis and the number of months this occurred. However, since Issued Quota has an asset value that would be lost if a Producer was required to relinquish a portion of its Quota, it makes sense to address the issue over a longer time period. Our suggestion therefore is that Producers would relinquish Quota only to the extent that their total annual production did not meet their Issued Quota volume also calculated on an annual basis.

There should be a mechanism to periodically evaluate and re-establish the total volume of state-wide Issued Quota, either to increase it or to decrease it. The amount of Issued Quota allocated to each Producer should be recalculated and reassigned annually as part of any state-wide Quota adjustment.

If the Quota volume is established at a level equal to about 107% of Montana Class I sales, the associated issue that must be addressed is how the reduction should be implemented to be effective and equitable to all parties. Existing Issued Quota has an asset value in and of itself that can be sold on the open market and is used as collateral for bank loans. Any change to Quota needs to ensure that the current open-market asset value is not affected detrimentally in the short term but is allowed to find its market-based level over time.

Reducing all Producer's Issued Quota on a pro-rata basis appears to be the simplest and most equitable approach. Although many Producers have historically produced over or under their Quota volume to varying extents, the amount of Issued Quota itself has not been much of a driving factor, as discussed elsewhere, so the actual reasons why any particular Producer chose to produce at a certain level are unknown. A pro-rata reduction maintains each Producer's relative share of state-wide Issued Quota and their relative position with regard to the asset value of their Issued Quota. Incorporating actual production levels or other factors into how

Issued Quota is adjusted for each Producer would by their nature introduce some level of unknown and potential unfairness into the process.

Once the adjustment has been made, Producers would then have a stable basis for managing their production in regard to their Quota and over time can make clear decisions as to their level of production and whether to sell or purchase Quota.

This approach would not immediately resolve a misalignment in Quota that would be created between Producers and Processors related to Class I sales within the State. As discussed earlier, Meadow Gold Producers would not collectively hold enough Quota to satisfy Meadow Gold's share of Class I milk in Montana, while Darigold Producers collectively hold more Quota than needed to meet Bozeman's Class I Montana market share. The difference between the two was approximately 28 million pounds in calendar 2017. This is a little over 8% of the current state-wide Quota volume, and almost 20% of the actual Class I utilization.

Adjusting Quota downward is not expected to have an immediate effect on production, which likely will evolve over time. We believe that this process of evolution, an open market, and improved asset value for Issued Quota, likely will provide the basis for the near-term misalignment to work itself out.

In the event the Quota mismatch does not resolve itself satisfactorily, the Board of Milk Control could take further action, as appropriate, to facilitate bringing Issued Quota and Processor Class I volumes in line. We believe the overall adjustment to lower Issued Quota to 107% of Class I sales could be implemented in a single move assuming that sufficient notice is given and there is adequate opportunity for public review and comment. This proposed adjustment to Issued Quota could be implemented regardless of any other changes that are made to Montana regulations as a result of this study.

Establishing Issued Quota at 107% of Montana Class I sales should result in Quota milk being priced close to the Class I price. Assuming this is true, a subsequent question arises as to whether the Montana Class I Differential could be adjusted. Since Producers, especially those who keep within Quota, would receive a substantially higher price for their milk than they do currently, it may be an opportunity to lower the Montana Class I Differential somewhat to support Montana's competitiveness.

Only Cream Sales and Shrink associated with the Class I sales were considered in calculating the Quota level at 107% of Class I sales. Including Class II in-State sales in setting Quota could be considered as well, although that would potentially reduce the asset value of Quota by reducing the milk price paid per cwt. Class II volume was 5.27% of Montana Class I volume in calendar 2017.

4.d. v. Options for Pricing Quota Milk

There are a number of ways that Quota and Excess volume can be priced. Our recommendation is to use Quota Pricing Option 1 as described below, which assigns Quota milk the highest values of utilization without distorting the utilization of the various classes of milk. However, we believe this should be implemented under the Cascading Tiered Pricing method discussed in Section 4.d.vii which follows.

1. **Quota Pricing Option 1:** The first option would be to have Quota milk priced on a Pooled basis using the Class I price for Class I volume, and then any additional volume needed to meet Quota starting with the volume with the next highest value.

   If Quota volume is less than or equal to Class I utilization volume, then the calculation is simple, and the Quota milk price is Class I. If Quota volume exceeds Class I utilization volume, then the volume of the next highest value (generally Class II) needed to make up the difference, would be Pooled with the Class I volume and that Pooled average would be the milk price for the Quota volume. If the Quota volume was greater than the volume of Class I and Class II combined, then volume from the next highest level would be added, and so forth.

   This approach is similar to the Cascading Tier method example described in Section 4.d.vii. The major difference is that the Cascading Tier method allocates the various utilizations of Excess, while this option has a single blended value for all Excess volume.

2. **Quota Pricing Option 2:** A second option is that Quota milk is always priced at Class I.

   By setting the price for Quota milk at the Class I price, the price for the produced volume of Quota milk is maximized for the Producers with Issued Quota. In addition, the spread between Quota and Excess milk prices is maximized.

   If actual Class I utilization is less than the Quota volume, then the additional Class I milk price is pulled from the Pool of Excess utilization value, and the Excess milk price would be lowered somewhat.

   As long as Quota volume is close to Class I volume, then Excess utilization value will not be affected very much. But if Class I utilization became significantly less than Quota volume, then the utilization value of Excess could be reduced significantly.

3. **Quota Pricing Option 3:** The third option would be to price Quota milk at the Class I price plus the utilization value of the associated Class III cream and shrink.

As discussed elsewhere, for every hundred pounds of Class I milk bottled, about 4.5 pounds of cream are generated, and typically there is 2% shrink, and both are assigned to Class III. Since this 6.5 pounds per cwt of Class III milk are a natural part of Class I bottling, it seems logical to blend the value together with the Class I sales to calculate the milk price of Quota.

The result is that the blended price for Quota milk volume would be approximately 100 pounds of Class I and 6.5 pounds of Class III. These percentages could be kept, even if Class I usage was significantly different from Quota, but the calculations for Excess are a little more complicated.

4.d.vi. Pricing Excess Volume

Once the Quota Volume is priced, there still remains the question of how to price the Excess Volume. The current method is to simply create a difference of $1.50 per cwt between the price for the Quota and the Excess Volume. Assuming that the Quota Volume is reduced to close to Class I volume, there needs to be a significant disincentive to producing substantially more than the Quota Volume. To truly discourage production of Excess volume, we believe the difference between the price for Quota and Excess Volume should be approximately $5.00 per cwt. As discussed elsewhere, if the value of the Class I demand and the value of all other usage is calculated for calendar 2017, the difference is approximately $5.00 per cwt. However, not all Excess needs to be discouraged. In fact, only the excess that is truly Surplus to the needs of the Montana Processors should be discouraged. Class II, Montana Class III, and cream are "Excess" volumes that are needed and should be priced accordingly. Therefore, we recommend that instead of a single price for Excess Volume, a pricing mechanism similar to the Cascading Tired Pricing discussed in the next section should be implemented.

4.d.vii. Cascading Tiered Pricing

The mechanism used to price Quota and to allocate Excess utilization value can be structured in different ways. The milk price for Excess, defined as any milk produced above Quota volume, should be determined by the utilization of the Excess volume. In general, we believe the most equitable method is to assign the value of the Excess among the Producers who produce the Excess volume, but not to Producers who stay within their Quota, and it should flow to individual Producers based on the volume of Excess they produce relative to their Quota production.

An approach that addresses both Quota and certain Pooling considerations would be to create a "cascading" tiered structure for pricing whereby Producers generating Excess volumes would absorb a share of each descending tiered class of pricing (Class I, II, III and Surplus) based on the volume of Excess production they generate relative to their Quota production. At each tier, the allocation of value would be based on the pro-rata share of Quota owned by just those Producers whose un-utilized Excess production falls into that tier.

This approach would define the price that each Producer receives for their milk based on each Class that a Producer's Excess production cascades into, rather than a single "Pooled" price for all Excess. The current single Pooled price for Excess does not consider the volume of Excess a Producer generates relative to that Producer's Quota production. Producers who generate a higher percentage of Excess production relative to their Quota production would realize a greater share of the lower value tiers of utilization.

The value realized by the volume in each tier would be the actual utilization value of each Class of milk. However, the value of the first tier (Class I or Quota volume) could be structured using any of the methods described in Section 4.d.v. In the following example, we use Quota Option 1 as described in Section 4.d.v.

The approach for tiered pricing would work as follows:

- The first tier, Class I, would be allocated on a pro-rata basis to all Producers based on the amount of Quota volume they hold
- If the amount of Quota volume produced is greater than Class I utilization, then the remaining Quota would be allocated in the Class II tier first
- Excess milk would then be allocated by tier until it has all been valued. Each lower value "tier" of utilization would be allocated only to those Producers who generate sufficient Excess to fall into that tier
- The allocation in each tier would be the calculated pro-rata share of each Producer based on their Quota volume compared to the total Quota volume of just those Producers falling to that tier
- The lowest value of utilization (Bulk Surplus) would be absorbed by those Producers with the largest Excess in relation to their Quota volume

This approach maximizes the return to those Producers who have a greater share of state-wide Quota and minimize their percentage of Excess production, while Producers who generate the highest percentage of Excess production relative to their Quota production will receive the lowest blended price.

This approach can work regardless of how the Pool is structured. However, the Excess milk price paid to the Producers would depend on which Pool they deliver to if the Pool is no longer state-wide.

The following examples describe scenarios of how Cascading Tiered pricing could work.

Scenario 1 assumes there are 8 Producers who hold Quota. Producers 5, 6 and 7 have total production equal to their Quota, Producers 1, 2, 3, 4 and 8 have Excess production.

Scenario 1:	Allocation Based on Quota									Quota Volume of Producers in Each Tier
		Producer								
		1	2	3	4	5	6	7	8	
Quota	Total Owned	200	100	150	250	50	50	75	125	1,000
Percent Share of Quota for Each Tier	Class I	20.0%	10.0%	15.0%	25.0%	5.0%	5.0%	7.5%	12.5%	
	Class II	24%	12%	18%	30%				15%	825
	Class III	29%	14%	21%	36%					700
	Bulk	44.4%	22.2%	33.3%						450
Total Production		300	150	300	350	50	50	75	150	
	As % of Quota	150%	150%	200%	140%	100%	100%	100%	120%	
Class Utilization		Allocation of Utilization								
Class I	1,000	200	100	150	250	50	50	75	125	
Class II	165	40	20	30	50				25	
Class III	170	53	27	40	50					
Bulk	90	7	3	80	0					
Total	1,425	300	150	300	350	50	50	75	150	
Price per cwt		Allocation of Utilization Value								
Class I	$ 18.00	$3,600	$1,800	$2,700	$4,500	$ 900	$ 900	$ 1,350	$2,250	
Class II	$ 16.00	$ 640	$ 320	$ 480	$ 800	$ -	$ -	$ -	$ 400	
Class III	$ 14.00	$ 747	$ 373	$ 560	$ 700	$ -	$ -	$ -	$ -	
Bulk	$ 12.00	$ 80	$ 40	$ 960	$ -	$ -	$ -	$ -	$ -	
Total Utilization Value		$5,067	$2,533	$4,700	$6,000	$ 900	$ 900	$ 1,350	$2,650	
Utilization Value per cwt		$16.89	$16.89	$15.67	$17.14	$18.00	$18.00	$18.00	$17.67	

In this example Quota volume is equal to Class I sales, each Producer is assigned their Quota proportion of Class I sales, and all the Class I volume is assigned. Producers 5, 6, and 7 have no Excess production beyond their Quota so they are paid at the Class I price ($18.00 per cwt) for their milk and do not participate in any lower tiers, whereas the other Producers (1,2,3,4 and 8) do.

The next highest tier in utilization value is Class II, which is allotted to those Producers (1,2,3,4 and 8) who fall into that tier. Each Producer's share of the 165 pounds utilized in the Class II tier is calculated on a pro-rata basis with the numerator equal to the individual Producer's Quota and the divisor equal to the cumulative Quota of just those Producers falling into that tier, in this case 825 pounds (Quota of Producers 1-4 and 8).

Producer 8's pro-rata share of the Class II tier is 15.1% (125 lbs divided by 825 lbs), that when applied to the 165-pound utilization in the Class II tier, utilizes all of the dairy's Excess of 25 pounds. This results in a blended price of $17.67 per cwt for Producer 8 calculated as follows:

- 125 Quota lbs times $18.00 Class I price, plus 25 Excess lbs times $16.00 Class II price
- The resulting sum of $2,650 utilization value divided by total production of 150 lbs equals $17.67

The other Producers' Excess allotment is calculated in the same way. This allows them to utilize a portion of their Excess, but not all, so their remaining Excess falls into the Class III tier and so forth, where each successive lower valued tier is calculated in the same way. Producer 4 has no remaining Excess after the Class III tier so just Producers 1, 2, and 3 participate in the lowest tier, Bulk Sales.

The three Producers who produced only Quota are paid the Class I value. All the other Producers are paid slightly different (lower) values depending on how much of each of the lower value tiers their Excess production fell into.

Producer 3 realizes the lowest blended price because that dairy had the highest level of Excess in relation to Quota and that caused it to fall into the lowest tier and be allotted the greatest share of that tier.

In Scenario,2 we assumed that Producer 5 shuts down and the Quota is sold to Producer 2, but not the cows:

Scenario 2:	Producer 5 shuts down and Sells Quota to Producer 2, but not cows									Quota Volume of Producers in Each Tier
		Producer								
		1	2	3	4	5	6	7	8	
Quota	Total Owned	200	150	150	250		50	75	125	1000
Percent Share of Quota for Each Tier	Class I	20.0%	15.0%	15.0%	25.0%		5.0%	7.5%	12.5%	
	Class II	27.6%		20.7%	34.5%				17.2%	725
	Class III	33.3%		25.0%	41.7%					600
	Bulk			100.0%						150
Total Production		300	150	300	350		50	75	150	
	As % of Quota	150%	100%	200%	140%		100%	100%	120%	
Class Utilization		Allocation of Utilization								
Class I	1,000	200	150	150	250		50	75	125	
Class II	165	47		35	58				25	
Class III	170	53		75	42					
Bulk	40			40						
Total	1,375	300	150	300	350		50	75	150	
Price per cwt		Allocation of Utilization Value								
Class I	$ 18.00	$3,600	$2,700	$2,700	$4,500		$ 900	$ 1,350	$2,250	
Class II	$ 16.00	$ 747	$ -	$ 560	$ 933		$ -	$ -	$ 400	
Class III	$ 14.00	$ 747	$ -	$1,050	$ 583		$ -	$ -	$ -	
Bulk	$ 12.00	$ -	$ -	$ 480	$ -		$ -	$ -	$ -	
Total Utilization Value		$5,093	$2,700	$4,790	$6,017		$ 900	$ 1,350	$2,650	
Utilization Value per cwt		$16.98	$18.00	$15.97	$17.19		$18.00	$18.00	$17.67	
Total Value in Scenario 1		$5,067	$2,533	$4,700	$6,000	$ 900	$ 900	$ 1,350	$2,650	
Change in Total Value		$ 27	$ 167	$ 90	$ 17	$ (900)	$ -	$ -	$ -	

Now, since Producer 2 has sufficient Quota to cover all the production, that dairy receives the Class I price for all of the production. The value of all the other Producers with Excess changes slightly, and most improve because there is less overall production and the Excess volume that falls into the lowest value tier decreases accordingly. This demonstrates how the value per cwt improves from decreased production.

In Scenario 3 we assumed that Producer 5 shuts down but sells both Quota and cows to Producer 2:

Scenario 3:	Producer 5 Shuts Down and sells Quota and Cows to Producer 2									Quota Volume of Producers in Each Tier
		Producer								
		1	2	3	4	5	6	7	8	
Quota	Total Owned	200	150	150	250		50	75	125	1000
Percent Share of Quota for Each Tier	Class I	20.0%	15.0%	15.0%	25.0%		5.0%	7.5%	12.5%	
	Class II	22.9%	11.4%	17.1%	28.6%				14.3%	875
	Class III	26.7%	20.0%	20.0%	33.3%					750
	Bulk	57.1%		42.9%						350
Total Production		300	200	300	350		50	75	150	
	% of Quota	150%	133%	200%	140%		100%	100%	120%	
Class Utilization		Allocation of Utilization								
Class I	1,000	200	150	150	250		50	75	125	
Class II	165	37	28	28	47				25	
Class III	170	54	22	41	53					
Bulk	90	9		81						
Total	1,425	300	200	300	350		50	75	150	
Price per cwt		Allocation of Utilization Value								
Class I	$ 18.00	$3,600	$2,700	$2,700	$4,500		$ 900	$ 1,350	$2,250	
Class II	$ 16.00	$ 597	$ 448	$ 448	$ 747		$ -	$ -	$ 400	
Class III	$ 14.00	$ 757	$ 308	$ 568	$ 747		$ -	$ -	$ -	
Bulk	$ 12.00	$ 103	$ -	$ 977	$ -		$ -	$ -	$ -	
Total Utilization Value		$5,058	$3,456	$4,693	$5,993		$ 900	$ 1,350	$2,650	
Utilization Value per cwt		$16.86	$17.28	$15.64	$17.12		$18.00	$18.00	$17.67	
Total Value in Scenario 1		$5,067	$2,533	$4,700	$6,000	$ 900	$ 900	$ 1,350	$2,650	
Change in Total Value		$ (9)	$ 923	$ (7)	$ (7)	$ (900)	$ -	$ -	$ -	

Under this scenario Producer 2 continues to still have Excess, but not enough to fall into the lowest tier. Since the total volume did not change, the amounts of the various tiers do not change either. However, since Producer 2 has more Quota, and a lower percentage of the total production volume is Excess, the production stays within the higher value tiers, and the total value received by Producer 2 increases while the other Producers see their total values decrease slightly.

The above examples are relatively simple and for illustrative purposes only. The actual implementation would require two different sets of calculations, one for skim and one for butterfat. However, each would work in the same way as described above.

We believe this approach best supports reducing state-wide Quota volume, as recommended, to Class I sales levels and subsequently encourages the purchase of Issued Quota by individual

farmers, as needed, that in turn supports an increase and stabilization of the asset value of Issued Quota.

4.d. viii. The Pool Structure

All the raw milk produced in Montana is sold to Processors in Montana or in nearby states. In Montana the value of the milk is determined by its final use. Simply stated, all the revenue associated with all milk sales is put into a Pool, and the resulting total revenue is divided by the total cwt of milk sold to determine the Pooled value per cwt. Adjustments are made to the Pool for various costs including inter-Plant Hauling, out-of-State bulk milk sales and hauling, administrative costs and other fees.

Some of the cost components charged to the Pool are incurred by activities of just some Producers or Processors in certain cases, and all participants in other cases, but the effect is shared by all Producers. The result, in certain cases, is that certain sub-groups of Producers may be subsidizing the activities of other sub-groups. Some of these subsidies work to offset one another but across the board the impact tends to lean more on the side of either the Darigold or Meadow Gold "systems" on an annualized basis and Pooling, by its nature, tends to obscure certain inefficiencies or opportunities for improvement.

We analyzed Pool results over the last three calendar years to determine the impact of these components by Processing plant and its related Producers to understand the scope and impact of these factors. This included analysis of the difference between the net blended price that was paid to all Producers as a result of the state-wide Pool, and what prices would have been paid to Producers had the Pool been subdivided by processing plant and Processor organization (essentially Darigold and Meadow Gold).

Some of the specific components included in this analysis included:

- Impact of the adjustments (discounts) and volume for Surplus Class I Packaged sales both to contiguous and non-contiguous states
- The volume and value of Class II sales
- The volume and value of Class III cream sales and shrink
- The volume and value of Surplus Bulk milk sales including associated hauling costs
- The cost for inter-Plant hauling between plants

As discussed in the General Observations and Findings Section of this report, the combination of Pooling and Quota systems has contributed to Montana farmers sustaining a level of production within the state that exceeds what is needed for in-State utilization. This over-production puts significant downward pressure on prices. It should be noted that total production did decrease during the calendar period 2015-2017 and this decrease was mirrored by a decrease in Bulk Sales. On the other hand, approximately half of the Producers continued to generate Excess milk, some at a fairly significant volume.

We believe the structure of the Pool should change to accommodate recommended changes in the Quota system and for means of Pricing as well as for reasons associated solely with factors of the Pool itself. We identified and evaluated several different options, as described below, and believe that the first option represents the best approach either on a stand-alone basis or in line with our recommendations related to the other Tasks addressed in this study. The options and our recommendation are as follows.

1) **Pool Option 1:** The first, and our recommended option, is to restructure the Pool to accommodate the differences between the Processors. This could be done in one of several ways.

   (a) **Pool Option 1-A:** The first approach, which is the approach we recommend, would be to have Quota and Excess milk Pooled by Processor or Processor Group.

   The Quota and Excess milk price paid by each Processor would be the result of the utilization at each Processor. Assuming Quota is based on Montana Class I sales (see recommendation in Section 4.d. iii), Producers would have the flexibility and a clear choice as to how much Excess to produce.

   The amount of value received by the Plant for its utilization of Excess milk would determine the price that the Producers shipping to that plant receive for Excess milk.

   Certain issues would need to be addressed but we believe these issues could be resolved in conjunction with the other changes that are made:

   - How to initially apportion Quota volume among the Producers. If Quota volume is reduced proportionately for all current holders of Quota, Darigold Producers would collectively hold more Quota volume than the Class I sales of the Darigold plant, while Meadow Gold Producers would not hold enough Quota to meet Meadow Gold's Class I sales.
   - Whether a Producer associated with one Processor could have a portion or all the Quota volume it held be "assigned" to a different Processor. If so, how would the milk be delivered? If not, would this restrict the market for buying and selling Quota as an asset and make it less liquid?
   - Whether the market for Issued Quota might result in different values for Producers associated with the different Processors. Normally it would be expected that Issued Quota would naturally flow through transactions in the open market to where it was needed.

   If the Cascading Tiered Method is used to allocate utilization value, then many of these issues are resolved.

(b) **Pool Option 1-B:** A second approach would be to have Quota milk Pooled state-wide while Excess is Pooled by Processor.

This results in all Producers getting paid the same price for Quota milk, but different prices for Excess milk depending on which Processor they ship to and their level of Excess. Setting Quota at a level based on Montana Class I sales would give Producers flexibility and a clear choice as to how much Excess to produce. The value received by the plant for sales of Excess milk would determine the price paid to the Producers for Excess milk.

As described above, there would be the issue of how to reconcile state-wide Quota and actual production with the Class I needs of each Processor and how Excess would be assigned and treated.

A second issue would be how it would work if the recommendation for a Cascade Tiered pricing mechanism is put in place.

(c) **Pool Option 1-C:** The third approach would be to eliminate the Quota system but Pool by Processor.

Under this option each Processor would pay only for the milk it needs. All Montana milk would be at Montana Class prices. All Surplus Milk (milk that leaves the State) would be priced similar to the existing rules.

Without a Quota system, any incentive for Producers to change production would be primarily price driven and through arrangements agreed to directly between the Processors and their associated Producers.

However, since the Producers associated with Darigold are Darigold Cooperative members, and most of the Producers associated with Meadow Gold are members of the Montana Milk Producers Association, there would likely be sufficient pressure to control production.

Internally, each group could institute its own Quota system that would still be under the purview of the Montana Board of Milk Control if it so desired.

2) **<u>Pool Option 2:</u>** The second option is to eliminate the Pool altogether but keep the Quota system.

This may not be possible since the Milk Control Bureau's interpretation of 81-23-302(15), MCA is that the statewide Quota system is an optional add-on of the statewide Pool. So, if the statewide Pool system is eliminated, the statewide Quota system would be eliminated by default. Producers delivering to a common

distributor could petition for a Quota plan under that distributor under 81-23-302(14), MCA. The following discussion contemplates that it may be possible.

Pricing for raw milk would still be controlled for all Classes. Each Processor would contract with Producers for the milk it needs. Since Darigold is a cooperative this likely would be straightforward and involve just its current Producer members.

As an independent Processor with independent Producers, Meadow Gold would appear to have more flexibility as to how it sourced milk, which in turn could have a different impact on its current Producers than Darigold. Also affected might be the volume of milk transported to Billings and by whom.

Potential outcomes of eliminating the Pool are that each plant would be freer to acquire and pay for the milk it actually needs and could more easily avoid having to deal with Surplus. Any special sales relationships would affect only those Producers who are involved with the plant or in the specific contractual relationship.

Each Producer could decide how much milk to produce and possibly to which plant they should ship based on payments offered by the Processors. Darigold, as a formal cooperative, could create and require compliance with specific rules to manage its members, whereas Meadow Gold may approach the issue differently. Special discounted sales at one Processor would only affect those Producers participating with that Processor, or possibly only those Producers who want to participate in that sale at assumed lower returns.

Producers losing their relationship with a Processor would have to find a home for their milk on their own. The Montana Board of Milk Control could potentially help facilitate these "distressed" sales, but the value received would go directly to the Producer and likely would be lower than the current blended price.

Competition among Producers trying to find a home for their milk could drive down returns for all Producers, but the bottom price paid for milk processed and sold in Montana would be limited to Montana Class minimums. In theory, this competition could benefit the Processors, but since they are already paying the Class prices, it is unlikely they could reduce their cost.

If a Quota system is kept and the Pool eliminated, a number of difficult issues arise, and we do not advocate this because each Processor would have to manage the Quota associated with it through its affiliated Producers. A significant question would be what happens to unaffiliated Producers who hold Quota?

It may be necessary to give Pool plants the flexibility to make suitable arrangements among each other to keep Quota affiliated with them and production in balance. Or

the relative difference in the asset value of Quota may drive the sale of Quota to where it is needed.

In general, both Darigold and Dean (Meadow Gold) are large organizations with operations in many states. It is likely that they both have experience managing milk supply and pricing in other states where there is no Pool, which should allow them to appropriately manage their operations in the absence of a Pool.

3) **Pool Option 3:** The third option is to keep the Pool essentially the same as it is now with perhaps some slight revisions.

All Producers would remain in the Pool. Depending on changes to Quota, Producers could be paid a greater Differential between Quota and Excess milk.

Certain changes could be implemented to effect changes in certain components, such as the inter-Plant hauling charges and out-of-State bulk transport costs.

4.d. ix. Incremental Cost of Milk Production

The purpose of establishing a Quota system and a Pool in Montana is to strengthen the Dairy industry in the state. If properly implemented, the Quota system should strengthen Producers by allowing them to individually control their own production and maximize profits.

The Pool protects Producers from competition between the plants by Pooling all the milk, so it doesn't matter to the Producers how much milk each plant processes and sells. But at the same time, under the current rules, it helps subsidize and maintain certain inefficiencies that might otherwise be driven out of the system.

When not properly implemented, a Quota system and Pooling can have the detrimental effect of lowering milk prices and potentially affect the quality of the milk. The goal should be to keep the elements of the Quota system and the Pool that prevent undue price competition in place while also addressing issues that inhibit continuous efficiency improvement, thereby helping to guarantee an adequate supply of quality milk to the Montana Processors and ultimately to the residents of the State.

If Quota volume is established based on Class I Montana demand, then the Quota milk price should be close to the Class I price. The viability of the existing Processors depends, to some extent, on their sales of other Classes of products, as well as bulk milk and Packaged Surplus sold outside of Montana. The amount of Excess milk (milk produced in Excess of Quota volume) available to supply the plants will depend on the price paid for the Excess and the incremental cost of production by the Producers. If it is worthwhile for the Producers to supply additional milk at the lower price, they will do so. Otherwise, there may not be sufficient supply available at that price.

The State of Montana does not track the cost of Dairy Production on the farm, and most of the key inputs are not summarized by the State. However, many of the pieces are available from other sources. California tracks the cost of production by region within the state and by farm size. There also is a summary for Holstein and Jersey cows.

The USDA has cost of production data by farm size, but it is somewhat dated and is being discontinued, although recent data is useful as a comparison. USDA also tracks dairy farm costs and margin for many states. Montana is not one of them, but neighboring Idaho, Oregon and Washington are tracked. Even though they are much larger milk-producing states than Montana, and have on average much larger dairies, the data may provide some reference. It should be noted that the California data is different from the USDA data for California. Given that the last complete collection of USDA data was 2010, it is likely that the California data is more accurate.

Below is the USDA data on Dairy Farm Costs of Production by Herd size, published by the Economic Research Service (ERS). The last complete data collection was 2010, so that is what is shown. The cost amounts have changed over the last several years, but it is likely that the relationship between the herd sizes has not changed significantly.

Milk Production Costs and Returns per Hundredweight (cwt) Sold, by Size Group

Item	Fewer than 50 cows	50-99 cows	100-199 cows	200-499 cows	500-999 cows	1,000 cows or more	All Sizes
				dollars per cwt sold			
Gross value of production:							
Milk sold	17.59	17.39	16.94	16.88	16.34	15.34	16.26
Cattle	1.56	1.31	1.14	0.99	1.02	0.97	1.07
Other income 2/	0.93	0.88	0.78	0.77	0.71	0.67	0.74
Total, gross value of production	20.08	19.58	18.86	18.64	18.07	16.98	18.07
Operating costs:							
Feed--							
Purchased feed	5.04	4.65	4.97	6.02	6.32	6.91	6.09
Homegrown harvested feed	7.32	6.82	6.06	4.91	3.39	2.05	3.97
Grazed feed	0.50	0.23	0.15	0.12	0.02	0.02	0.10
Total, feed costs	12.86	11.70	11.18	11.05	9.73	8.98	10.16
Other--							
Veterinary and medicine	0.78	0.87	0.77	0.90	0.88	0.63	0.76
Bedding and litter	0.38	0.37	0.32	0.30	0.28	0.11	0.23
Marketing	0.24	0.20	0.21	0.22	0.27	0.21	0.22
Custom services	0.60	0.59	0.61	0.67	0.66	0.38	0.53
Fuel, lube, and electricity	1.08	0.97	0.80	0.79	0.59	0.46	0.66
Repairs	0.98	0.92	0.65	0.64	0.38	0.39	0.54
Other operating costs 4/	0.03	0.01	0.00	0.00	0.00	0.00	0.00
Interest on operating capital	0.02	0.02	0.01	0.01	0.01	0.01	0.01
Total, operating cost	16.97	15.65	14.55	14.58	12.80	11.17	13.11
Allocated overhead:							
Hired labor	0.56	0.85	1.25	1.85	1.87	1.50	1.46
Opportunity cost of unpaid labor	13.48	6.92	3.47	1.42	0.50	0.16	2.19
Capital recovery of machinery and equipment 4/	7.61	6.18	4.37	3.49	2.42	1.90	3.28
Opportunity cost of land (rental rate)	0.12	0.05	0.04	0.02	0.01	0.00	0.02
Taxes and insurance	0.33	0.31	0.24	0.22	0.16	0.09	0.18
General farm overhead	1.00	0.90	0.72	0.68	0.43	0.41	0.58
Total, allocated overhead	23.10	15.21	10.09	7.68	5.39	4.06	7.71
Total costs listed	40.07	30.86	24.64	22.26	18.19	15.23	20.82
Value of production less total costs listed	-19.99	-11.28	-5.78	-3.62	-0.12	1.75	-2.75
Value of production less operating costs	3.11	3.93	4.31	4.06	5.27	5.81	4.96
Supporting information:							
Milk cows (head per farm)	33	68	135	312	699	2,251	175
Output per cow (pounds)	15,378	17,136	18,925	19,840	22,546	23,019	20,620
Milking frequency more than twice per day (percent of farms)	2.07	2.59	8.53	30.50	59.80	55.30	9.42
Milk cows receiving bST (percent of cows)	1.98	3.34	5.35	11.95	21.85	6.80	8.78
Organic milk sold (percent of sales)	10.60	5.65	3.65	2.63	0.58	1.90	2.84

1/ Developed from survey base year, 2010.

2/ Income from renting or leasing dairy stock to other operations; renting space to other dairy operations; co-op patronage dividends associated with the dairy; assessment rebates, refunds, and other dairy-related resources; and the fertilizer value of manure production.

3/ Costs for third party organic certification

4/ Machinery and equipment, housing, manure handling, feed storage structures, and the dairy breeding herd.

Source: USDA-ERS, US national average data from 2010

There are several interesting observations that can be made. The larger dairies receive less in revenue per cwt. This is likely because larger farms tend to ship to larger Processors, usually cheese and powder plants. Larger Farms also may be in areas that are not regulated or less regulated where the milk prices are lower, or they may be in a state, like California, where the price for Class III milk and below is lower than USDA prices, and some large farms contract directly with the Processor at a fixed or standard rate.

While the cost of Purchased Feed increases with Dairy Size, the Total Feed Cost decreases with size. The cost of Homegrown harvested feed is much less for large herds, likely because large herds graze less and use less homegrown feed. Purchased Feed cost is 27% more for herds with 500-999 cows compared to herds of 100-199 cows, while total feed cost is 13% less, which is $1.45 per cwt less.

There is a trade-off between Labor and Utilities although labor generally increases with herd size until 1,000 cows is reached. More automation generally requires more electricity and less labor per cow. The cost of Repairs tends to decrease significantly with herd size.

Other Costs, in total, and excluding Feed, are not that different for different herd sizes unless the herd is under 100 cows or over 1,000 cows. Ignoring the largest and smallest farms Feed averaged about $3.50 per cwt in 2010. The Other Costs for dairies with 500 cows is only $0.30 per cwt less than for 100 cows.

Since most Allocated Overhead costs are fixed, they are spread over greater volume as herd size increases, resulting in a drop per cwt. One notable exception is Hired Labor which actually increases with herd size until 1,000 head is reached.

California collects a lot of state-wide cost data, some of which is summarized here.

California Statewide Cost Comparison Summary				
Cost / cwt	2014	2015	2016	2017
Feed	11.06	10.51	9.29	8.85
Hired Labor	1.57	1.69	1.77	1.88
Herd Replacement	1.38	2.14	2.12	1.87
Operating Costs	2.88	2.92	2.92	3.05
Milk Marketing (incl Hauling)	0.56	0.56	0.55	0.55
Total Cost	17.44	17.82	16.65	16.20
Return on Invest & Mgmt	1.67	1.52	1.42	1.40
Total	19.11	19.34	18.07	17.60
Pounds/cow/day	73.17	72.47	72.91	71.61
Income over Feed Cost	11.27	5.45	6.28	8.15
Income over Total Cost	4.88	(1.85)	(1.08)	0.80
Total Cows	1,404	1,407	1,483	1,514

https://www.cdfa.ca.gov/dairy/uploader/postings/copcostcomp/Default.aspx

This can be compared to some of the other data collected. Most cows in California are either Jerseys or Holsteins, and data is collected for each. As an example, the following chart is for Jersey cow feeds in fourth quarter 2017.

California Jersey Dairies - Feed Summary
4th Quarter 2017-Weighted Averages, Based on CDFA Cost Study Dairy Surveys

FEED	MILK COWS				DRY COWS			
	$ Per Ton[1]	As Fed #'s Per Cow Per Day[1]	Dry Matter #'s Per Cow Per Day[2]	% of Total Feed Cost[1]	$ Per Ton[1]	As Fed #'s Per Cow Per Day[1]	Dry Matter #'s Per Cow Per Day[2]	% of Total Feed Cost[1]
DRY ROUGHAGE								
Alfalfa Hay	$268.39	4.59	4.11	11.1%	$139.73	1.61	1.45	5.2%
Other Hay	$94.48	1.24	1.03	1.0%	$131.11	6.24	5.27	1.2%
Almond Hulls & Shells	$73.53	3.41	3.05	2.1%	$71.46	1.63	1.46	0.2%
Total Dry Roughage	**$173.18**	**9.23**	**8.19**	**14.5%**	**$122.30**	**9.48**	**8.18**	**26.9%**
SILAGE								
Corn Silage	$60.84	26.17	8.68	14.4%	$60.84	10.36	3.43	14.6%
Other Silage	$48.87	7.42	2.52	3.3%	$45.71	22.80	7.72	24.2%
Green Chop	$0.00	0.00	0.00	0.0%	$0.00	0.00	0.00	0.0%
Total Silage	**$58.19**	**33.60**	**11.20**	**17.7%**	**$50.44**	**33.16**	**11.16**	**38.8%**
OTHER FORAGES & WET FEEDS								
Earlage	$0.00	0.00	0.00	0.0%	$0.00	0.00	0.00	0.0%
Wet Distiller Grain	$60.57	2.50	0.76	1.4%	$60.57	0.83	0.25	1.2%
Wet Corn Gluten	$64.11	1.92	0.76	1.1%	$64.11	1.16	0.46	1.7%
Whey	$24.68	0.53	0.09	0.1%	$24.68	0.28	0.05	0.2%
Other Wet Feeds	$30.21	0.63	0.13	0.2%	$11.28	0.61	0.14	0.2%
Total Other Forages & Wet Feeds	**$54.95**	**5.58**	**1.75**	**2.8%**	**$48.03**	**2.88**	**0.90**	**3.2%**
CONCENTRATES & BYPRODUCTS								
Inside Barn Mix	$0.00	0.00	0.00	0.0%	$0.00	0.00	0.00	0.0%
Rolled Corn	$172.53	10.61	9.38	16.6%	$172.53	1.12	0.99	4.5%
Rolled Barley	$0.00	0.00	0.00	0.0%	$0.00	0.00	0.00	0.0%
Whole Cottonseed/Pima	$293.09	3.71	3.41	9.8%	$294.27	0.17	0.16	1.2%
Soybean Meal	$322.32	0.71	0.63	2.1%	$322.32	0.07	0.06	0.5%
Canola	$265.14	2.96	2.71	7.1%	$265.14	0.61	0.56	3.7%
Beet Pulp	$165.75	0.16	0.15	0.2%	$165.75	0.02	0.02	0.1%
Wheat Millrun	$142.69	0.48	0.43	0.6%	$0.00	0.00	0.00	0.0%
Dried Distillers Grain	$181.73	1.78	1.64	2.9%	$181.73	0.28	0.26	1.2%
Other Grains & byproducts	$294.65	4.32	3.94	11.5%	$315.46	1.47	1.33	10.8%
Mill/Custom Mix	$281.00	2.49	2.17	6.3%	$0.00	0.00	0.00	0.0%
Total Concentrates & Byproducts	**$232.28**	**27.23**	**24.47**	**57.2%**	**$252.68**	**3.75**	**3.38**	**22.0%**
MINERALS & ADDITIVES								
All Minerals	**$327.12**	**2.66**	**2.24**	**7.9%**	**$448.80**	**0.88**	**0.77**	**9.1%**
PASTURE								
Pasture	**$0.00**	**0.00**	**0.00**	**0.0%**	**$0.00**	**0.00**	**0.00**	**0.0%**
TOTALS	**$141.19**	**78.29**	**47.85**	**100.0%**	**$85.98**	**50.15**	**24.38**	**100.0%**

Cost Per Cow-Per Day	$5.53	Cost Per Cow-Per Day	$2.16
Cost Per Cwt. of Milk	$9.45	Cost Per Cwt. of Milk	$0.63
Avg. Milk Cows	2,155	Avg. Dry Cows	367
Milk Production Per Cow-Per Day	58.51		

1 All figures based on weighted averages
2 Dry Matter is estimated
This table represents California Jersey herds that participate in the Cost of Production Survery. This table does not include organic herds

Summarizing this data:

Jersey Feed Cost	2015	2016	2017
Alfafa Hay per ton	307.95	249.33	255.12
Alfalfa Cost per cwt	1.51	1.15	1.07
Corn Silage per ton	84.55	71.66	56.98
Corn Silage per cwt	1.36	1.26	1.25
Cost Per Cwt. of Milk	11.13	9.59	9.17
Avg. Milk Cows	1,996	2,033	2,043
Milk/Cow/Day	60.14	61.43	59.75
Based on CDFA Cost Study Dairy Surveys			

Holstein Feed Cost	2015	2016	2017
Alfafa Hay per ton	272.37	223.43	221.01
Alfalfa Cost per cwt	1.56	1.29	1.16
Corn Silage per ton	78.58	67.05	57.97
Corn Silage per cwt	1.39	1.15	1.06
Cost Per Cwt. of Milk	9.36	8.31	7.88
Avg. Milk Cows	1,216	1,313	1,358
Milk/Cow/Day	77.09	77.42	76.65

The reported cost of feed in California in 2016 averaged $9.59 for Jersey cows and $8.31 for Holsteins. This compares to a statewide average of $9.29 (above). A relevant issue to evaluate is the margin between milk revenue realized and the input cost of various feeds used to affect the butterfat content for each breed and whether higher feeds cost result in higher butterfat content and revenue to justify them.

Alfalfa and Corn are the two largest feed components and are both tracked by USDA NASS. The cost of these inputs can be compared between California and Montana and the surrounding states. The following is USDA NASS data.

Price of Alfalfa ($ per ton)	2014	2015	2016	2017
CALIFORNIA	244	181	155	175
IDAHO	200	170	129	136
MONTANA	127	125	134	142
OREGON	228	200	164	172
SOUTH DAKOTA	117	105	89	111
WASHINGTON	213	171	135	155
Based on USDA Statistics database				

Price of Corn ($ per Ton)	2014	2015	2016	2017
CALIFORNIA	189	173	185	165
IDAHO	164	185	175	167
MONTANA	148	158	163	138
OREGON	175	157	167	152
SOUTH DAKOTA	131	130	122	118
WASHINGTON	193	169	185	167

Unfortunately, the USDA reported prices don't tie to the dairy farm prices. The likely reason is that most farms lock in prices during the harvest, and therefore the prices should be lower than the annual average. Also, both hay and corn come in a variety of qualities. The alfalfa hay used on the dairy farms appears to be of above average quality. The corn fed to the cows is silage and is definitely below the average value of field corn, which would include corn for food processing, cereals, and many other products, both food and non-food. However, the relative USDA crop prices probably are valid.

Interestingly, the Montana crop prices are lower than California, and lower than the surrounding states other than South Dakota. This would tend to argue that Montana feed costs

may be lower than California. However, the average herd size for the California data is around 2,000 cows, which is considerably larger than the Montana herd sizes. Looking at the USDA data by herd size (above), the cost of feed is 20% lower for herds over 1,000 cows than herds around 200 cows. The net result is that it appears that the feed costs per cwt for Montana dairies might be 5-10% higher than California. Using this metric, and comparing the feed costs to the value of milk received, results in the following:

Montana Income Over Feed Cost			
Cost / cwt (3.5% bf)	2015	2016	2017
Average Pool price (Quota)	15.91	14.50	16.30
Estimated Feed Cost	11.56	10.22	9.73
IOFC	4.35	4.28	6.57

A key statistic used to measure profitability is IOFC, or Income Over Feed Cost. The IOFC measures the additional value available to cover other costs after Feed, which is the single largest cost. If the assumptions are correct, in 2015 and 2016 there was about $4.30 per cwt available. In 2017, it was over $6.50 because the spread between Pool price and feed cost improved.

From the earlier charts, the Other Costs (excluding labor) are between $3.50 and $4.00, so before fixed costs (including hired labor), the average farm was positive. In 2017, this improved further.

If the difference between Quota and Excess is $1.50, then Producers over the last few years were paid less than their incremental cost for Excess Production, but positive for Quota production. If Quota were set close to Class I, then the IOFC for Quota would have been:

Montana Income Over Feed Cost (Quota=Class I)			
Cost / cwt (3.5% bf)	2015	2016	2017
Quota at Class I	18.60	17.22	19.11
Estimated Feed Cost	11.56	10.22	9.73
IOFC	7.04	7.00	9.38

In this case it appears that IOFC might also cover most of the fixed costs. The IOFC for Montana Excess, assuming Quota had been set at Class I volume, would have been:

Montana Income Over Feed Cost-Excess (Quota=Class I)			
Cost / cwt (3.5% bf)	2015	2016	2017
Net Price of Excess	13.89	12.52	14.31
Estimated Feed Cost	11.56	10.22	9.73
IOFC	2.33	2.30	4.58

This would not have covered the Other Costs in 2015 and 2016 and there likely would have been a reduction in volume during that period. This analysis was performed using pricing at 3.5% butterfat whereas actual payments to Producers depend on the actual butterfat content in their milk.

4.e. Study Task 5 - Expansion

We evaluated the plausibility and feasibility of expanding dairy processing and manufacturing in Montana, and the impact such expansion would likely have on the potential growth in milk production in Montana.

As described in the Observations and Findings section of this report, the dairy industry in Montana reflects trends that are occurring both nationally and regionally:

- Overall fluid milk consumption is trending down although, recently, higher fat content in fluid milk has been trending up
- There is an oversupply of milk that, in concert with declining consumption, creates a certain level of pricing volatility, although many factors contribute to pricing and the margins at the farm level
- Many dairies are ceasing operations while the average herd size of those that remain has increased to generally take up the slack
- The economics of dairy farming favors farms with sufficient size to realize economies of scale. Farms with herds larger than 2,000 cows can realize cost efficiencies of 25% per cwt compared to dairies with 500 or fewer cows that represent the bulk of Montana's farms
- These trends of lower demand for fluid milk and consolidation of farms, as well as Processors, are expected to continue

Juxtaposed against these national and regional dairy trends is the fact that a number of Montana's neighboring states dwarf Montana in the size and growth of their respective dairy industries. Idaho, Washington, Oregon, Utah and Colorado are vastly larger than Montana in all respects, from milk production, processing facilities and capacity, and growth. South Dakota, which is 9 times the size of Montana, recently announced an expansion to a cheese plant that will ultimately process 9 million pounds of milk per day.

In concert, these factors present a significant challenge for Montana when trying to consider whether there may be opportunities to expand. Detailed industry retail data, provided by private firms such as IRI, are needed to perform a detailed analysis of where there may be potential opportunities for entry of specific products into Montana's local and regional market. However, these data sources are provided only on a subscription basis and are expensive to obtain and thus were outside the scope of what our analysis could include.

The following discussion therefore focuses on a selected portfolio of the types and scale of products and facilities that could be evaluated in regard to how or where investment could be made in new or expanded facilities that would provide some level of growth for the industry.

Investment in a dairy plant is primarily based on being able to operate profitably and sustainably with available milk at the right price being a large part, but not the only driving component of the equation. To attract a manufacturing plant, the milk cost must be similar or lower than in other locations, but the other costs must be competitive as well. There must be adequate utilities and labor at reasonable costs, sufficient water for plant needs, adequate wastewater facilities at reasonable cost and a regulatory environment that is not cost prohibitive.

Assuming the environment can be structured to make operating a dairy plant feasible, there remains the question of which products make sense for investment. Data provided by the Board of Milk Control presents the volume of various Dairy Products consumed in Montana as well as the volume of those products that are produced in Montana versus brought in from other States. We evaluated these volumes to determine whether it would be potentially feasible to produce more of these products in the State.

4.e. i. Fluid Milk

Fully 85% of the Class I milk consumed in Montana is produced in Montana. The bulk of the remaining 15% brought in from out-of-State is likely in extended shelf life specialty milk in single serve and half-gallon containers (organic, lactose reduced, and nationally branded specialty and chocolate milks) and in any case, represents just 3.25 million gallons in volume.

Assuming the bulk of the 3.25 million gallons is extended shelf life product, there is probably insufficient volume to justify building a UHT (Ultra High Temperature) or ESL (extended shelf life) plant to produce these products. The rule of thumb in the industry is that a UHT plant requires a minimum of approximately 5 million gallons throughput per year to be sustainably profitable. In addition, since much of this volume is likely already served by national brands, it is likely that only a small portion could be converted to in-State production.

4.e. ii. Yogurt

In fiscal 2017, a little more than 18 million pounds of yogurt was sold in Montana with 98% coming from outside the state. Assuming an in-State facility could achieve a 20% market share, those sales would equate to 3.5 million pounds a year.

We assumed that a large share of the yogurt brought into Montana is likely national branded product (Danone, Yoplait, Chobani, etc.) or private label. For perspective, 398,000 pounds of yogurt are currently produced in the State. Adding sour cream under the same market share

assumption (20%) would increase the required volume of raw milk by about 36% or about another 1.25 million pounds.

To minimize investment, we assumed that volume would be produced as an add-on to an existing plant as opposed to building a greenfield plant. Further, assuming a 5-day per week processing schedule, would require processing 13,461 pounds of milk per day, to make 35,897 6-ounce packages of regular yogurt per day.

A typical high-speed yogurt filling line running at around 280 packages per minute would take little more than 2 hours per day to meet the required sales volume. A slower speed line might run 4-5 hours and come closer to a full shift when normal down-time and change-overs (e.g., for product and label changes) are included, but running at slower speeds incurs and absorbs other costs at a different rate than a higher speed line. The choice of filler line would take many factors into account.

With this low volume of plant production, it would be difficult to justify the level of investment required unless the target market share goal, or higher, was effectively guaranteed and could be achieved within a planned period of time.

Even with minimal investment, such a plant would be hard pressed to compete on efficiency and cost with large plants in the region, even those that are up to 500 miles away. On the other hand, a small, locally based yogurt operation that could sell a niche, specialty product at a higher price would appear to offer the best approach to attract investment in a start-up operation.

These calculations assumed regular yogurt was being made. For perspective, a pound of milk generates close to a pound of regular yogurt. It would take a single herd of approximately 140 cows to produce the volume in our example given the average daily production of cows in Montana. Greek yogurt, which typically requires 3 pounds of milk for each pound of yogurt, would obviously utilize more milk, but requires a much higher investment to manufacture.

As noted earlier, adding sour cream under the same market share assumptions would increase the required volume of milk by about 36% and move plant utilization closer to a standard full shift. Since sour cream and yogurt can utilize the same filling equipment, this would help the investment equation. Like yogurt, investment would likely require customers in hand that met or represented close to the target market share. We also assume a good deal of the sour cream currently being sold in the state is national brand and private label. It would be difficult to establish co-pack agreements for those products.

4.e. iii Cheese

The largest volume opportunity for Montana is cheese, assuming that it is simple cheddar or something similar. Again, assuming a 20% market share of Montana's cheese sales would

equate to 5.36 million pounds of cheese requiring 53 million pounds of milk, or just over 1 million pounds of milk per week.

In today's market, commodity cheese plants need to process about 1 million pounds per day to be sustainably profitable. The Agropur plant in South Dakota recently announced an expansion that is targeted to ultimately process 9 million pounds of milk per day. For perspective, all of Montana's current milk production does not equal 1 million pounds of milk per day.

Such an investment would have to be based on obtaining significant out-of-State volume in competition with large national plants, and multiple plants in the region, with established shares of the market. Given the above, we do not see much opportunity for establishing a large cheese operation.

However, it may be feasible to start small and produce cheese that would be sold as a premium private label cheddar or other specialty cheese, at a premium price. Once established, it may be possible to expand the plant to offer additional products that target certain commodity cheese on the open market. We reviewed 2 studies on costing a small artisan cheese plant.

- Nebraska Specialty Cheese Plant 2002, Reports from the Food Processing Center, University of Nebraska – Lincoln
- Start-up and operating costs for artisan cheese companies, American Dairy Science Association, 2014, Andrea Bouma, Catherine A. Durham, and Lisbeth Meunier-Goddik (Oregon State University)

The Oregon Study concluded that a very small cheese plant, producing 30,000 to 60,000 pounds per year (13,000 kg to 27,000 kg) could be built for $350K to $600K. This is 2,300 pounds of milk per day, assuming a 5-day week, and reflects the production from about 35 cows, given Montana's average production per cow. The estimated production cost in the first year is just over $10.00 per pound. Note that commodity block cheese on the CME is currently selling for about $1.50 per pound.

The Nebraska study estimated the cost of a larger cheese plant, processing 30,000 pounds of milk per day (7.8 million pounds of milk per year assuming a 5-day week, which will produce about 780,000 pounds of cheese per year). The plant cost is estimated at between $500,000 and $1 million and does not include any facility for aging the cheese. Adjusting for inflation, the cost today would be between $650,000 and $1.3 million. Estimated production cost was $2.32 per pound, or just over $3.00 adjusted for inflation. This reflects about 312 cows, given Montana's average production per cow.

4.e. iv. Other Products

There are a number of other niche products that could be considered for Montana with modest investment:

- *Butter* – a small churn to make butter from cream is relatively easy to install

- *Ghee,* or clarified butter – has long been used in Indian cooking and is now gaining favor everywhere. Ghee boasts a rich, nutty flavor, and is lactose-free, which makes it easier to digest. Ghee is almost pure butterfat and is generally made from butter, so an available supply of butter would be needed
- *Carbonated milk* – this has been tried numerous times and Arla, a Danish firm, is currently pursuing this market

4.e. v. Cost Summary

The total milk supply in Montana for calendar 2017 was about 280 million pounds of which about 147 million pounds was utilized for Class I sales in Montana. This leaves about 364,000 pounds per day of potentially available milk with some seasonal swings. This puts Montana in the position of too much milk for small plants and not enough for large plants. In other words, small plants, such as described above, may be viable, but will not go very far in utilizing the current volume of Surplus milk in Montana whereas large plants would require much more.

Our conclusion is that the current volumes in-State are insufficient, and the required expansion of milk production is too great to attract much interest in any kind of major dairy processing investment, but there may be a number of small, specialty plants that could be viable.

Opportunities for selling certain specialty products to out-of-State markets may exist but given some of the large Processors in the region (especially for yogurt and cheese), penetration would be difficult and likely take considerable time and associated investment. A brand associated with an existing local product (like the egg line from Montana Eggs LLC) may provide a path for market entry and expansion.

Given the nature of markets in Idaho, Utah, Washington, Oregon and other nearby states, it will probably require a food broker to expand sales out-of-State once the plant is functioning and distributing product in Montana.

Another option that could be tried is to lower the Class III cost of milk by recalculating the Class III price using a larger make allowance. The result is a lower cost for the manufacturers but also a lower price to the Producers. California's dairy farmers did this 20 years ago when the State order was created to attract investment, but they had a low cost of production based on large farms and low-cost purchased feed. This likely would be difficult for Montana to duplicate. Because other states now have similar lower costs of production, the model is not working as well for California today, and that is why they are considering moving to the Federal Order.

4.e. vi. Montana Business Environment

Forbes 2017 Best States for Business ranks Montana at #32 overall. The ranking components, and Montana's rank for each, are:

Component	Montana
Labor Supply	19
Growth Prospects	25
Business Costs	26
Economic Climate	31
Regulatory Environment	33
Quality of Life	36

This puts Montana in the middle of the pack and especially at a disadvantage compared to most of its neighboring States other than Wyoming, which has no dairy processing. According to the Forbes article, the overall rank of neighboring states is:

State	Rank
Utah	3
Nebraska	4
Colorado	8
North Dakota:	9
Washington:	11
South Dakota:	17
Oregon:	18
Idaho	20
Nevada	24
Montana	32
Wyoming	38

Any potential dairy related investor will naturally compare Montana with what other states in the region have to offer, both in terms of business climate and the dairy industry itself. In dairy production, Montana ranks 6 out of 7 in the region (Wyoming is last and has no dairy manufacturing) and is not growing. Other states are already much bigger, and growing, with some growing annually by more than Montana's total annual production. This means that Montana would likely have to go well above and beyond its neighbors to offer something that is differentiated and represents a better opportunity to attract a significant level of investment.

Alternatively, Montana could work to create an environment that attracts much smaller niche or micro markets as starting points to attract small "entrepreneurial" type investors.

4.e. vii. Encourage Development

The simplest, least-cost and near-term potential for growth in Montana's dairy industry is to create and promote an environment that fosters and attracts small-scale entrepreneurial investments in dairy production. Entrepreneurial small-scale start-ups could be supported in a number of ways including:

- Providing assistance with ideation, design, and Business Plans
- Providing assistance through entrepreneurial zones and related business development economics and incentives
- Fostering small-scale start-ups with advertising and promotional events
- Providing resources for Producers and Processors to learn, invest, and expand

Many states have set-up government and public-private partnerships to assist the industry. For example, Pennsylvania has a number of such organizations:

- Center for Dairy Excellence
- PA Preferred
- PA Bureau of Market Development
- PA Farm Bureau

Appendix A – Strategic Perspective

Given the purpose of the study, our findings, observations and analysis, the following strategic construct was used to provide the basis for making choices in our development of recommendations.

In summary, we believe recommendations for change should provide systems for pricing, Pooling, Quota and rule-making that rewards efficiency and incentivizes the system to wring costs out of the overall dairy industry value chain. Montana must improve its competitiveness, especially within its own market, to remain viable.

Over time Montana needs to continually rationalize its overall system. Ultimately this likely means a continuation of the trend towards fewer but larger Producers, and fewer but more efficient plants operating near or at capacity. Continued consolidation will likely happen in any case, but without a defined structure it may not occur in a way that provides the greatest benefit to the efficiency of the overall value chain.

Other perspectives and objectives that influenced our evaluation of alternatives and recommendations were to create and support a system and processes that:

- Provide as much simplicity, ease and transparency as possible. How things work should be as simple and understandable to enable rational decision making, especially for Producers. Montana is a small system and should not be overly complex to manage and regulate
- Incorporate flexibility and ability to make near term adjustments into the system. Montana is a small player and needs to be nimble to survive
- Create a structure that allows the system to adjust on its own to changes in its markets and environment and react quickly to both grab opportunities and address threats
- Give industry players opportunity, latitude and flexibility to make choices but protects the core Class I fluid business in Montana. Ensure Producers and Processors are fairly treated for core Class I business
- Enable industry to self-manage opportunities above that level. This may tend towards less regulation of non-Class I business and especially sales outside of Montana where players can choose to participate or not, or can openly and freely negotiate arms-length terms

If well structured, the system should, by its nature, provide an environment that not only improves the existing business but provides an attractive environment for investment in growth.

Appendix B – Project Activities

The following summarizes the research and analyses that were performed:

- Visit to Montana
  - Met and spoke with Processor personnel at the three fluid milk bottling plants in in Billings and Great Falls (Dean Foods Meadow Gold) and Bozeman (Darigold)
    - Conducted subsequent conference calls with both Processors
  - Met and spoke with Darigold Coop Producers in Bozeman and Meadow Gold Producers in Great Falls from the Montana Milk Producers Association
    - Conducted subsequent calls with individual Producers
  - Met with representative of a firm possibly interested in building a dairy plant
  - Met with Rowley Transport company
  - Met individually with all of the Board of Milk Control members
  - Met with Krista Evans, lobbyist for the Montana Milk Producers Association
  - Attended Board of Milk Control meeting on Dec 14th

- Developed and sent out detailed questionnaires
  - To each of the three Processing plants
  - To all of the dairy Producers. Received 12 back
  - Held follow-up informational calls with key individuals at both Meadow Gold and Darigold

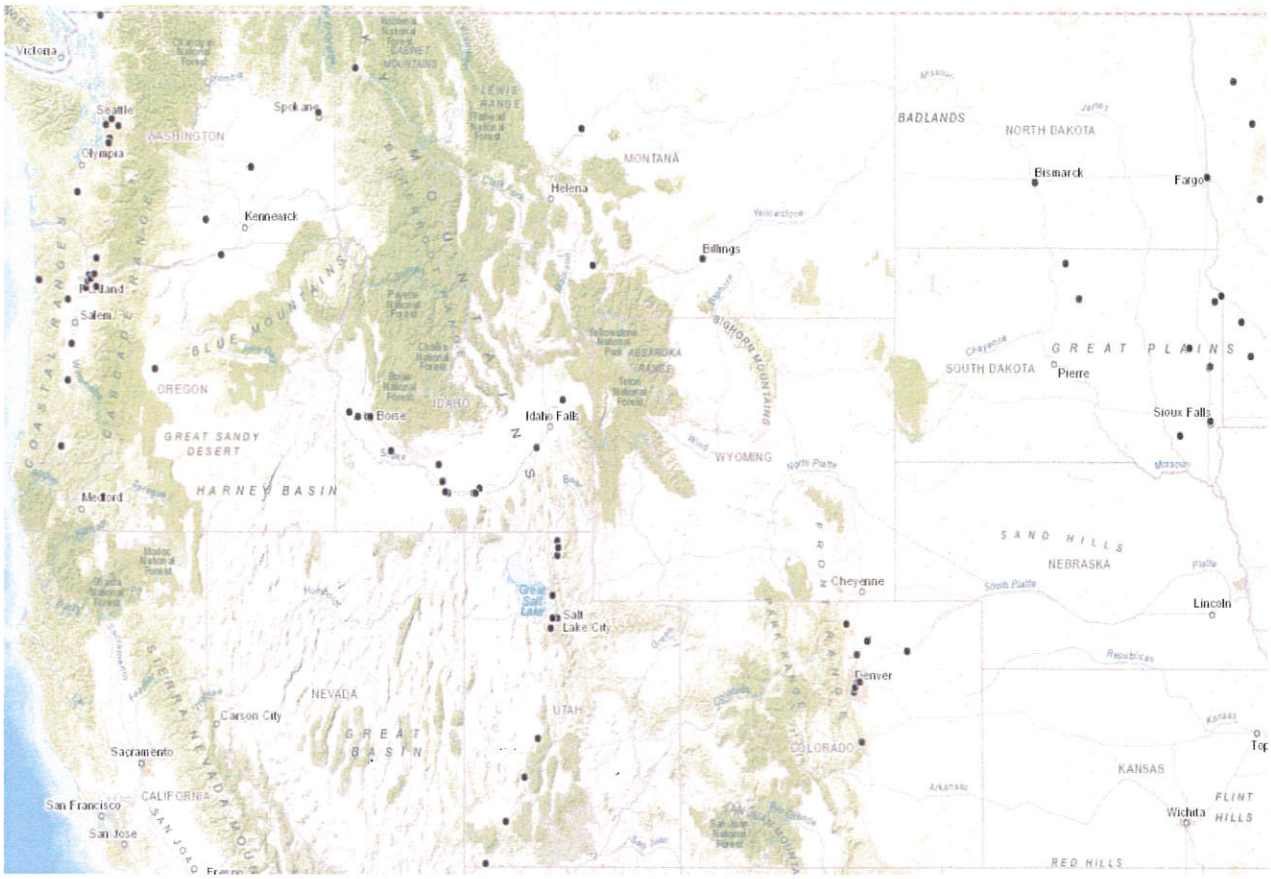
- Requested and received detailed information from Montana Milk Control Bureau
  - Detailed data on milk production, utilization, and consumption in Montana
  - Data about Producers
  - Milk volume sources in-State and from out-of-State
  - Data about milk use in-State and out-of-State
  - Pooling calculation detail by month over the last few years
  - Data and map of dairy plants in surrounding states
  - History of Producer retirements and additions
  - Analysis of freight payments by Producer and Pool

- Performed additional research and analysis
  - Order structure of neighboring and selected other States
  - Pool structure of neighboring and selected other States
  - Milk pricing in neighboring States
  - Milk prices received by Producers in Montana and neighboring States
  - Historical pricing and cost data from USDA and other sources
  - Cost of milk production in Montana compared to neighboring States
  - Review of several states regarding their Quota programs
  - Spoke with various dairy participants with expertise in various dairy related issues and approaches outside of Montana

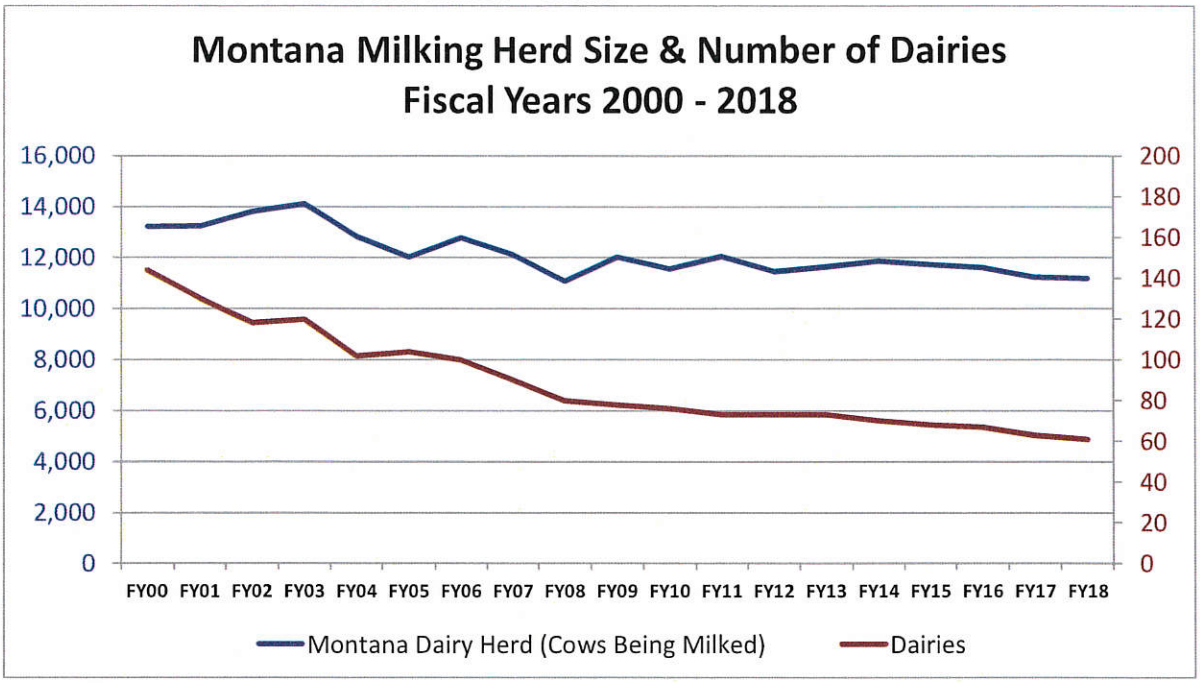
- Performed analyses of specific issues including:
    - How the current and proposed policies affect different Producer Groups
    - How the current and proposed policies affect different Processors
    - What are the qualitative and quantitative implications of the various policies to individual Producers and Processors
    - How proposed policies position Montana compared to neighboring States
    - Analyze the flow of dollars through the Pool based on various policies
        - In-State sales
        - Out-of-State bulk shipments
        - Out-of-State packaged shipments
        - Inter-Plant shipments
    - Implications of changing the Montana Differential

Appendix C – Charts and Tables

All Dairy Facilities in Montana Region

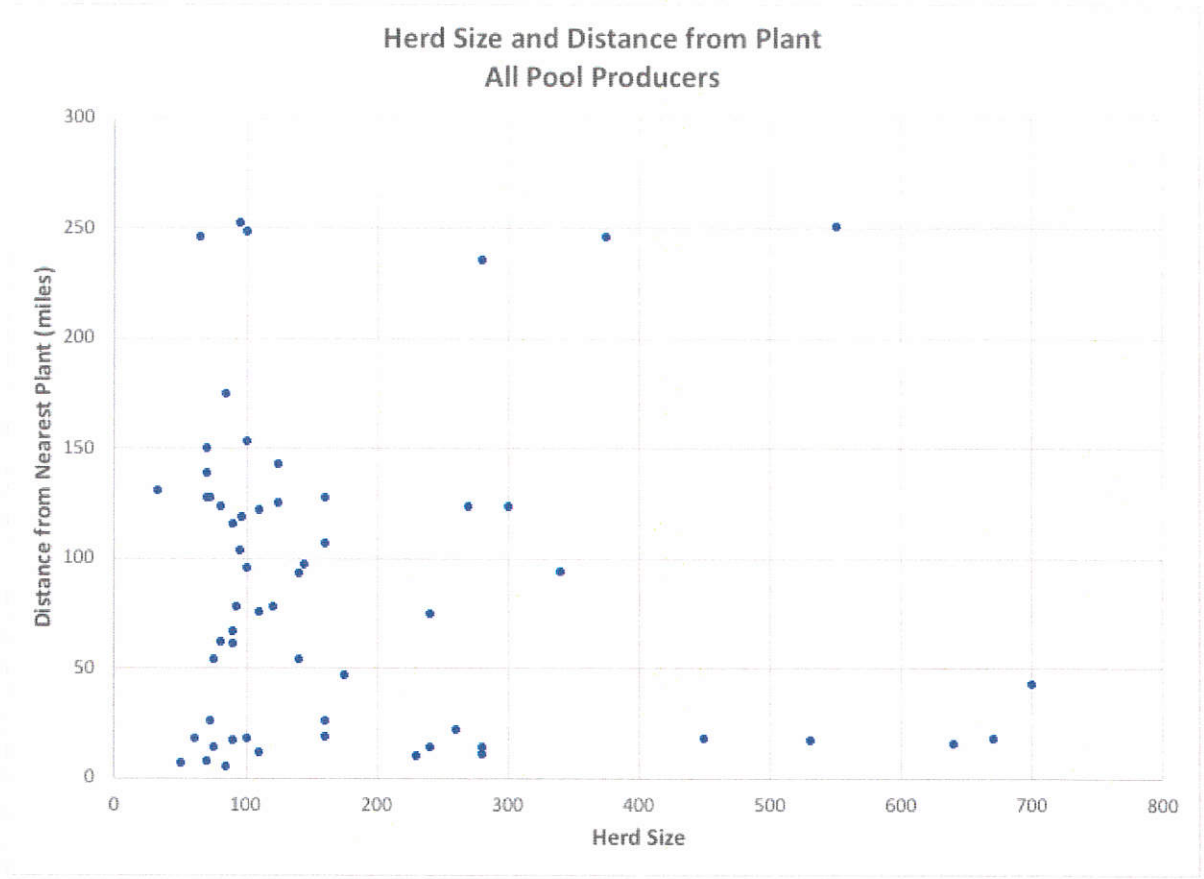


Montana – Number of Cows and Dairies – Trend



Source of Data: Montana Board of Milk Control

Herd Size and Distance from Nearest Plant



Source of Data: Montana Milk Control Bureau

The chart above shows the distribution of Pool Producers in terms of the size of their herd and the distance of their farm from their primary processing plant. As can be seen in the chart many Producers with fewer than 200 cows are 100 miles or more from their processing plant, with several as many as 250 miles away. On the other hand, farms with more than 200 cows tend to be much closer to their plant, most are less than 50 miles away with a few exceptions.

Appendix D – References

- Montana Board of Milk Control
- Montana Department of Livestock Milk Control Bureau
  - http://liv.mt.gov/Attached-Agency-Boards/Milk-Control
- The Montana Milk Control Act, ARM 32.23 (repealed) and 32.24.
  - http://www.mtrules.org/BookView/Default.asp?chpt=32%2E23
  - http://www.mtrules.org/BookView/Default.asp?Chpt=32%2E24
- USDA website data from AMS, ERS, NASS
- USDA articles including:
  - "Changing Structure, Financial Risks, and Government Policy for the U.S. Dairy Industry", released in March 2016
- California Department of Food and Agriculture and website
  - California Milk Control regulations
  - https://www.cdfa.ca.gov/dairy/
- California Dairy Statistics Annual – 2017, CA Dept of Food and Agriculture
- "Economic Importance of the California Dairy Quota Program", Lon Hatamiya, October,2015
- Various articles on California's Quota program
  - https://www.agweb.com/article/californias_quota_quandary/
- Virginia State Milk Commission Staff and website
  - http://www.vdacs.virginia.gov/food-state-milk-commission.shtml
- Virginia Factsheet - www.southeastdairy.org
- North Dakota Administrative Code
- Nebraska Specialty Cheese Plant 2002, Reports from the Food Processing Center, University of Nebraska – Lincoln
- Start-up and operating costs for artisan cheese companies, American Dairy Science Association, 2014, Andrea Bouma, Catherine A. Durham, and Lisbeth Meunier-Goddik (Oregon State University)
- Forbes 2017 Best States for Business
- "Seasonality is a Problem for NY Dairy Industry" by Harry M. Kaiser, Department of Agricultural Economics, New York State College of Agriculture and Life Sciences, Cornell University (1988)
- "Evaluation of the Base-Excess Plan for Leveling Seasonal Milk Production: Case Example of Maryland" by Allen M. Prindle, Journal of The Northeastern Agriculture Econ Council. VOL. IX. NO. 1, April 1980
- "Reducing Seasonality in Dairy Production" by Richard N. Weldon, Andrew A. Washington, and Richard L. Kilmer. Published in Choices, the Magazine of Food Farm, and Resource Issues, 4th Quarter 2003
- Dairy Australia – "Australian Dairy Industry in Focus 2017"

- Progressive Publishing – "2016 U.S. Dairy Statistics"
- Idaho Department of Agriculture – Idaho Milk and Dairy Statutes
- Pennsylvania Milk Marketing Board – Board milk control
- Utah Department of Agriculture and Food – Dairy Compliance
- South Dakota Department of Agriculture – Dairy and Eggs Department
- Wyoming State Agriculture Department – Consumer Health Services
- Virginia State Milk Commission – Milk control office

Appendix E – Comments Received

In response to the draft report that was issued for public review, we received comments from a number of sources including the Board of Milk Control, Milk Control Bureau, Montana Milk Producers Association, Montana Processors and individual Producers.

Many of the comments related to the data or text that was presented and either suggested corrections, requested additional detail, description or clarification of the draft content, or proposed edits related to formatting and typographical errors. We believe we have addressed all of these comments in the final report.

Certain comments provided feedback or concerns regarding specific recommendations that were made, and they are summarized below to provide perspective. In such cases we reviewed the recommendations in detail and the final report reflects our consideration of the concerns expressed below.

- All comments in regard to the $2.55 Class I Differential were in favor of keeping it at its current amount. This feedback came from Processors as well as Producers

- Strong opposition was expressed for revising the Class III cream price from its current formula to the lower of Federal Order Class III or Class IV. It was expressed this would have a significant impact on Processor profitability by increasing costs that could not be recouped in the market and would create an unfair competitive situation

- Views were expressed both for and against eliminating charging inter-Plant hauling costs to the state-wide Pool. A concern was expressed that there was insufficient analysis or reference to the associated pricing benefit the Pool receives from the milk being sold as Class 1 milk in Montana or as Packaged Surplus to Contiguous states versus potentially receiving a discounted Surplus price if it would otherwise have been shipped out-of-State as raw Bulk milk. This comment referenced other similar situations where the cost side of charges to the Pool should also take into consideration the benefit Pool members receive from how the milk is utilized such that situations are not created whereby certain Pool members no longer share in the cost but receive the benefits

- Views were expressed both for and against restructuring the Pool. The disbandment of the Pool or the creation of two individual Pools should be fully vetted amongst the Producers since it is ultimately their action that is required

- Various comments addressed Quota and Excess. Excess should not be Pooled and the Excess discount should be increased but not to $5.00. Quota is not working, but it should not be reduced. If Quota is reduced it should be at 120% of Class I utilization but should not be done in one shot. If Quota is re-allocated, Producers should be compensated for the value of Quota change

- A comment was made that the $0.50/cwt adjustment for Class I packaged milk sold to noncontiguous markets was agreed to at the time in combination with other parts of the current Pool regulations and that because this was part of a deal it should not be viewed as a stand-alone policy

- Another comment on this issue was that the $0.50/cwt surplus adjustment was not created as an offset to the Pool's absorption of inter-Plant freight. Pooling rules have always provided for the Pool absorbing the inter-Plant freight and the $0.50/cwt adjustment for Class I Packaged sales to Non-Contiguous states came much later

- A concern was expressed that the report inadequately addressed the logistical and marketing activities that are provided at no cost by the Processors in finding markets for Surplus Bulk milk generated by Producers. It was suggested that an evaluation be done to determine whether a credit should be provided to Processors for performing these services

Stone, Michael

From: josh wagoner <wagonerjt@gmail.com>
Sent: Wednesday, June 26, 2019 10:29 PM
To: Planning Comments
Subject: Big Sky Cheese

I am writing to ask the Zoning Board of Adjustments to deny the special use permit to Big Sky Cheese. The placement of this proposed business in their proposed rural location on prime soil designated as being of statewide agricultural significance makes absolutely no sense. The proper place for proposed development of this sort is in a agricultural/industrial park, which we have, not in a site chosen without forethought. I'm not anti-growth, but growth should be undertaken with thought for the future of the area and with the desires of residents in mind. I choose to live here because of the open spaces all around us, traditional and historic agricultural uses (not Michael Stone's "cultural heritage of industrial agriculture", a term that he has to be hallucinating or completely disingenuous to use in describing our surroundings and history) of ranching and grain farming entrenched deeply in and around the community, and hope for a bright future in the way local growth proceeds, as do many, if not most, people I know here, and Big Sky Cheese's location does not align with that. If they want to build in an existing agricultural/industrial park, I would not be opposed. Additionally, I'd like to state that, contrary to the statements of the head of a certain quasi -government agency that accepts a large amount of our tax dollars from Cascade County, implying that those of us who are against this project are bigoted against Canadians is beyond contempt. I, and we, who live, work, own a home, pay taxes, and vote here aren't fond of a certain Canadian named Ed Friesen because he is determined to push his larger business on us that we clearly don't want, in a location we see is obviously foolish, and he's done so without any attempt to engage the community and engender any good will for himself or his plans and without reaching out to see how such a undeniably permanent and drastically community-altering plan might be able to be modified to fit into our culture. So please, Bret Doney, don't patronize me, and please understand why we don't have an ounce of trust in anything you or Ed are doing and feel that we need to be on guard against underhanded dealings involving the two of you.

Thanks,

Josh Wagoner
710 5th Ave N
Great Falls, MT 59401

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Date Received: 6/26/2019
Date Reviewed: 6/27/2019
Complete: ☒ Yes ☐ No

Public Comment Form

Cascade County Public Works Department Planning Division
121 4th St N, Suite 2H-2I Great Falls, MT 59401
Phone: 406-454-6905 | Fax: 406-454-6919
Email: planningcomments@cascadecountymt.gov

Instructions

This form is for providing public comment to the Cascade County Planning Division for review by any one or more of the following review and/or approval boards: Zoning Board of Adjustment (ZBOA), Planning Board, or Board of County Commissioners. Only complete submissions will be included for board review. Please provide the relevant information for each section below. A complete submission provides all of the following: commenter name and address, comment subject, and commentary on the subject issue(s). If additional space is needed for commentary, please attach additional sheets to this form. Completed forms may be submitted in person at the Planning Division office or by email at planningcomments@cascadecountymt.gov.

Commenter Information

Name: J.Casselli

Complete Address: 11 Red Coulee Belt, MT 59412

Comment Subject (please check one):

- ☒ Special Use Permit Application
- ☐ Subdivision
- ☐ Zoning Text and/or Map Amendment
- ☒ Growth Policy
- ☐ Variance
- ☐ Floodplain Regulation Amendment
- ☐ Subdivision Regulation Amendment
- ☐ County Road Abandonment/ Discontinuation of County Street
- ☒ Other (describe): Zoning- Big Sky Cheese

Comment

In review of staff report and other information please accept the following comments and attachment:
The idea of this type of value added Agricultural production facility would add economic value to the county and provide additional employment. I do however question the location of this facility when the county and city have focused on attracting development business to the north park (malt plant, ADF) area and the new Agritec park development area (off River Drive). The county should be looking at incentives to spur this type of development where it already approved and planned for and the infrastructure is in place.
Just because property is purchased is not a given that everyone rolls over for something that may not be a compatible use of good ag Ag ground especially when other areas are already reviewed, approved and have been through a public process.
Specific issues and items of concern that shoare as follow also
1.. Traffic flow and types/amount will these estimates increase over time. We do not need more stoplights, consider turnlanes, and other co if considering more use winter road conditions and snow removal along with cost of this on this section of highway 87/200/89 is a concern.
2. Require all outdoor night lighting needs to be dark-sky complaint including parking lots, building, roads and sign lighting. This will help protect the rural character at night (growth policy) and reduce light/night sky impacts to surrounding land owners.
3.Water use and processing is a concern for large amounts of well water use , also onsite water treatment and stormwater control given proximity to antelope coulee and other small drainageways. Has proponent applied and will DNRC approve a water rights for expected amount of water use? Again this type of development would be better sited in area already having a water source in place.
4. Educational learning opportunities should be required by BSC for school groups, 4H, FFA etc to tour and learn from this business model given the Ag value added nature of the business.
5.Tourism- staff report notes this however there could be an opportunity for additional benefit of this with tours, gift shops etc.
page 1of 2 (see attached)

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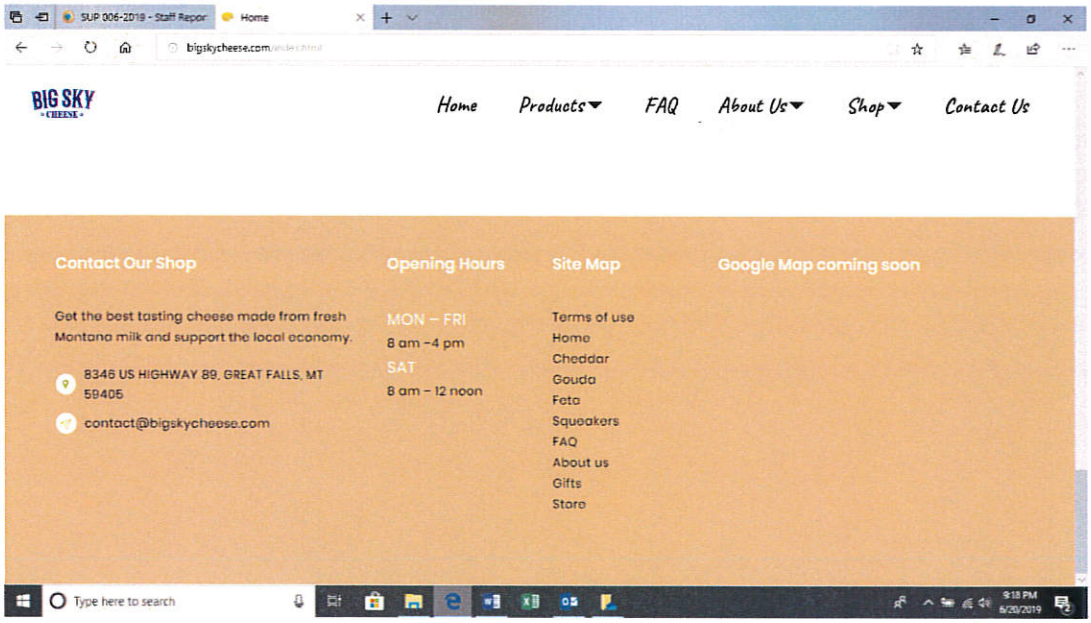
- From an economic standpoint and for reference below is information from the now famous Tillamook Cheese and although a different demographic in OR but there are similarities and the Great Falls Area could over time expect to see this type of employment. With current low unemployment rates of local labor, a facility like this could likely see jobs filled by relocation from within or outside MT to the area.

We rely on and embrace diverse perspectives, thoughts, backgrounds, and cultures to inform our work. We are committed to creating a climate of inclusion and conditions where all employees feel valued and a sense of belonging. At the end of 2017, 38% of our total workforce was female and 44% of our managers were female, and 26% of our workforce are racially and ethnically diverse. Tillamook County Creamery Association (TCCA) is a Drug-Free Workplace. EEO/AA (Source: www.Tillamook.com)

- Below is from the current Big Sky Cheese webpage: Please note the address and current information for a facility that currently has no county or other state approvals. The website appears fully functioning with a product line etc. This appears to be somewhat disingenuous and should be questioned by the CC Planning Board, Staff and Commissioners.



- In addition, the development authority should not be approving loans for projects not yet approved by the county. This can compromise or put pressure on the county to approve something because everything is in place and not from an objective standpoint or will of the county citizens.

06/26/2019
Nate Kluz
597 Armington Road
Belt, MT 59412

Comment Subject:
Cascade County Board of Adjustments consideration of Special Use Permit for Big Sky Cheese, LLC (Madison Food Park, LLC)

I am writing to urge this board to deny the Special Use Permit (SUP) request from Big Sky Cheese, LLC (Madison Food Park, LLC).

It is impossible to consider the SUP without consideration of the other business components that constitute the Madison Food Park (MFP). The scope of the MFP project is very well known given the SUP application that is still be amended by the company and on file with the Cascade County Planning Division (PD). In addition to cheese making, this project proposes to engage is alcohol distilling, rendering, and slaughtering pork, poultry and beef. This is a massive project that hopes to employ over 3,000 people, have over 1,000,000 square feet of building space and utilize approximately 4.7 cubic feet per second from wells in the Madison Aquifer.

Approving Big Sky Cheese (BSC) and allowing a phased approach to developing MFP does a disservice to this community by creating a climate of uncertainty for landowners, businesses, government and the developers. The MFP project needs to be reviewed in its entirety and with a greater level of due diligence and expertise than has been displayed in the staff report for this SUP. The application and staff report are insufficient in numerous ways (please refer to memos provided by Kate McMahon, AICP).

Other deficiencies include the application and staff analysis of the effects on property values. The staff report states that no impacts to the value of adjoining properties are expected. I don't understand how staff can make this assertion. Are they trained in property valuation or mass valuation? What do they know of external and economic obsolescence? What sources can they cite to support this assertion? I believe that approval of this permit and the perception that BSC is bellwether for MFP will have an immediate effect on the marketability of residential properties in Stockett, Tracy, Centerville, Belt and the small residential enclaves east of Great Falls to Belt. This is a topic that deserves far greater consideration.

Another curious assertion in the staff report pertains to the question of whether the BSC project "Promote(s) the development of cultural resources and tourism to broaden Cascade County's economic base". The staff report notes that "The proposed use is not applicable to this objective beyond perpetuating the cultural heritage of industrial agriculture in the region." I do not understand what the cultural heritage of industrial agriculture in this area is or means. There

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Complete: ☒ Yes ☐ No

is certainly a great agricultural cultural heritage in this area and it currently serves tourism and livability in this area through the preservation of large landscapes and open spaces. The cultural heritage also includes pasture grazing, stockmanship and the western cowboy way of life. These are not industrial agriculture values. Approval of this SUP and subsequent MFP SUPs, as well as those for the CAFOs necessary to supply MFP, will demean the current agricultural development pattern that is among the best reasons to visit Cascade County. The net effect of this will be a loss in marketability of Cascade County as a tourist (and business) destination.

I am not against dairy or cheese processing at all. I do believe this SUP needs to be considered within the context of the larger MFP SUP. If this is to be considered as a stand alone business, it begs the question: why this location? This community, through private and public monies, already has a shovel-ready Great Falls Development Authority Agri-tech business park with infrastructure including rail already in place. Another good location would be in the Sun River, Fairfield Bench or Vaughn areas near most of the areas dairy producers (that I know of). Another good location would be a community like Choteau, a place with declining population that is actively searching for new businesses. The reason this project is not in these superior locations is because BSC is a component of the MFP and BSC ought to be considered with all the other business components.

Lastly, I think the idea that this project hopes to increase dairy production in this community is preposterous. This goes against all the trends in the dairy farming today. The dairy farming industry is shrinking in places with environments more conducive to dairy feed production (alfalfa, corn silage, field corn) and existing markets and infrastructure. Entry into this sector is also difficult given the capital requirements necessary to procure buildings, land, robotic milkers, feed, genetics and labor. I see no actual plan to grow this sector beyond the hope that if you build a cheese plant the milk will come. That is not a plan.

I urge this board to please deny this SUP.

Stone, Michael

From: Susan Kralj <susan.kralj@icloud.com>
Sent: Thursday, June 27, 2019 7:59 AM
To: Planning Comments
Subject: Cheese plant

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Date Received: 6/27/2019
Date Reviewed: 6/27/2019
Complete: ☒ Yes ☐ No

I agree with all this.

Great letter. And oh so true. By Carl Jurenka.

Administrator: Please delete if not allowed. This is a letter I wrote today for the upcoming June 27th Cascade County Planning meeting. If you cannot attend, please consider writing a letter in protest.

June 18, 2019

Cascade County Planning Office

121 4th St. N., Suite 2 H/I

Great Falls, MT 59401.

Re: June 27th meeting concerning Big Sky Cheese

On the 27th of June, there will be a public hearing on Madison Food Park's principal owners intent to develop Big Sky Cheese. This is being called a value added dairy/cheese processing facility. In part, the facility would operate 260 days per year and employ 5 to 10 employees. I vehemently oppose this project for the following reasons:

A bridge loan of $2.27 million of taxpayers dollars has been given to a foreign owned corporation to hire 5 to 10 workers for 240 days a year.

Why is our taxpayer dollars being spent on a foreign for-profit corporation in order to build a so called infrastructure? Why isn't the cheese plant paying this themselves? Why is the cost being billed to the city and county taxpayers for a for-profit corporation? Being that this plant will operate 240 days a year, how will the workers make financial ends meet on days the plant is idle? Will the workers have to apply for unemployment benefits, food stamps, rent assistance? Is this a wise use of $2.27 Million of our taxpayer dollars to fund a business that will only hire 5 to 10 workers?

It takes 668 gallons of water to make one pound of cheese.

How will the waste water be treated when used for cheese production? How will the cheese plant dispose of this and other waste? What guarantee that this waste will not contaminate or poison nearby creeks, Missouri river, private water wells and the Madison Aquifer?

I am of the opinion that Big Sky Cheese is a con job and ruse by Madison Food Park to get their foot in the door to build the slaughter plant.

I strenuously object to the planned nightmare of a slaughter plant known as Madison Food Park by Friesen Foods, LLC. This nightmare of a plant would be built just 8 miles east of Great Falls. And only 2 miles east of MAFB. This slaughter plant will forever ruin Great Falls and the surrounding area with toxic air, water and noise pollution. Not to mention the damage to our quality of life.

Yes, our area needs "planned" growth. But not by allowing an industry known for it's toxic air, water and noise pollution. You, the Great Falls Planning Board need to get your heads out of your back sides, wise up and recognizes

that Madison Food Park does not have the best interest of Great Falls in mind or represent the people of Great Falls. Tell Ed Friesen "NO THANKS." And have him take this unbelievable nightmare to his own backyard in Canada.

I ask that you do not vote for this ruse of a cheese plant.

Sent from my iPad

GROW Great Falls MONTANA ECONOMIC DEVELOPMENT

UNTAME YOUR ENTREPRENEURIAL SPIRIT

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Date Received: 6/24/2019
Date Reviewed: 6/24/2019
Complete: ☒ Yes ☐ No

June 21, 2019

Cascade County Planning Office
121 4th Street N, Suite 2 H/I
Great Falls, MT 59401

Re: Big Sky Cheese, LLC Written Testimony

TO: Cascade County Zoning Board of Adjustment

I wish that I could testify in person at the Zoning Board of Adjustment's hearing on June 27th, however, I will be out of state.

Thank you for your thoughtful consideration of the application to permit the proposed Big Sky Cheese plant in Cascade County.

The Great Falls Development Authority urges you to support the Big Sky Cheese application. We believe this is a worthwhile project that will benefit Cascade County residents by creating primary sector jobs, growing our commercial tax base, and expanding local markets for our agricultural producers.

We have carefully reviewed the materials submitted to the County by the applicant. We believe that the addition of Big Sky Cheese to our community will be entirely positive. We believe that the proposed project is appropriate for the agricultural zoning district and the particular location for the business.

We feel so strongly about the potential of this startup business that we have committed a significant amount of our loan capital to provide a bridge loan package to help make the business possible.

As with every proposed project, we look at the details of each proposal, considering its economic and community impact. Our mission is to grow and diversify the Great Falls regional economy, create higher wage career opportunities, and improve market competitiveness. We believe Big Sky Cheese is a positive step forward in achieving this mission for the benefit of all of Cascade County.

We do not believe the proposed Big Sky Cheese project will have any negative community affects in regard to transportation, water, sewer, odor, workforce or other issues.

The proposed project will be criticized for being too small to have much impact in improving our economy. We do not believe any project is too small. One good job is a step forward. One more commercial building adding to our tax base is a step forward. One new local Montana-branded food product is a step forward. One new unique retail store for residents and visitors to enjoy is a step forward.

The proposed project will be criticized for being the precursor of something too big. However, all that is before you today is this one proposed project. Land use decisions must be fairly made based on the application under consideration.

Creating Primary Sector Jobs

Despite progress in growing total wages and increasing the average wage relative to the national average in Cascade County in recent years, our county still has fewer jobs than the peak employment quarter of 2008Q4. The most recent data from Chmura Economics' JobsEQ system indicates total Cascade County employment in 2019Q1 was 37,768, less than peak employment of 38,519 in 2008Q4. The Montana Department of Labor reports that 1,125 residents in Cascade County were looking for work this April.

Economies grow and prosper by creating businesses that draw new dollars into the local market. Jobs created by these businesses are primary sector jobs. We need more primary sector jobs in Cascade County. Manufacturing jobs tend to offer higher wages, provide steady employment and offer benefits unavailable in many retail and service jobs.

At startup, Big Sky Cheese will create an estimated 5-10 jobs, too few some critics may say, except if you, a family member, neighbor or friend is one of the out of work residents looking for a job or one of the thousands of residents looking for a better job, then the significance is enormous.

Growing Our Commercial Tax Base

Cascade County taxpayers are burdened with paying for ever-increasing costs of providing basic government services funded by a property tax base over-dependent on homeowners. Commercial development helps to build our tax base, shifting the burden from homeowners.

The proposed Big Sky Cheese plant and retail store is a small step forward in our continued success in building a stronger commercial property tax base.

Expanding Local Markets for Agricultural Producers

The largest industry in Cascade County is serving as the retail, service and health care center of the Golden Triangle, a prized agricultural region. The economic health of this region is largely driven by the ability of farmers and ranchers to profitably operate. In its June 2019 newsletter, the Montana Farmers Union noted that Montana farm income is down nearly 30% since 2012. Quoting directly, "Net farm income this year is expected to be almost 50% less this year than in 2013, making it our sixth consecutive year of depressed farm income."

We believe it is imperative for Cascade County, indeed the entire region, to develop new local markets for value-added agriculture. Montana ships an estimated 85% of its agricultural production out of state without any value added, making us over-dependent on global commodity markets.

Value-added agriculture offers one of the best opportunities to create new primary sector jobs in Cascade County. We have been working to attract investment in this industry sector since GFDA was formed. These efforts were boosted with the County's administration of an in-depth study of agri-processing industry opportunities completed in 2009, funded by the Office of Economic Adjustment of the Department of Defense. Since the completion of that study, we have invested considerable efforts and research into an array of niches in food, agricultural and bio-processing. With the support of the Montana Department of Agriculture, almost two years ago we were able to create a regional Food & Ag Development Center to boost our efforts.

Canadian Entrepreneur

Some critics have attacked the Big Sky Cheese startup because the entrepreneur who is proposing the new business is a Canadian from Lethbridge. We should welcome, celebrate and thank entrepreneurs, businesses and developers from away who are attracted to invest and create jobs in our community. The nationality of the entrepreneur has absolutely nothing to do with the requested land use approval. Attacks on our Canadian friends, particularly in Alberta who spend so much of their money in our community, are beyond contempt.

Big Sky Cheese will be a step forward in creating a Montana-branded value-added local agricultural product.

I am honored to submit this testimony on behalf of the Great Falls Development Authority. We urge your favorable action to allow the proposed Big Sky Cheese start-up to move forward.

Thank you again for your consideration of the application before you, and for volunteering your time in service to Cascade County.

Brett Doney
President & CEO

Public Comment Form

Cascade County Public Works Department Planning Division
121 4th St N, Suite 2H-2I Great Falls, MT 59401
Phone: 406-454-6905 | Fax: 406-454-6919
Email: planningcomments@cascadecountymt.gov

Instructions

This form is for providing public comment to the Cascade County Planning Division for review by any one or more of the following review and/or approval boards: Zoning Board of Adjustment (ZBOA), Planning Board, or Board of County Commissioners. Only complete submissions will be included for board review. Please provide the relevant information for each section below. A complete submission provides all of the following: commenter name and address, comment subject, and commentary on the subject issue(s). If additional space is needed for commentary, please attach additional sheets to this form. Completed forms may be submitted in person at the Planning Division office or by email at planningcomments@cascadecountymt.gov.

Commenter Information

Name: Carolyn K. Craven

Complete Address: 101 14th Avenue South, Great Falls MT 59405

Comment Subject (please check one):

- ☐ Special Use Permit Application
- ☐ Subdivision
- ■ Zoning Text and/or Map Amendment
- ■ Growth Policy
- ☐ Variance
- ☐ Floodplain Regulation Amendment
- ☐ Subdivision Regulation Amendment
- ☐ County Road Abandonment/ Discontinuation of County Street
- ■ Other (describe): Big Sky Cheese

Comment

06.19.19 Cascade County & City of Great Falls
06.19.19 New & Revised Definitions
06.20.19 Special Use Permit
06.20.19 Commercial Dairy Zoning
06.22.19 Carbon Footprint of Cheese Production ZBOA
06.25.19 Highlights MT Milk Study ZBOA
06.26.19 Waste Management Issues for Dairy Processors ZBOA
06.26.19 Big Sky Cheese Recommendations ZBOA

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Date Received:	6/26/2019	Date Reviewed:	6/27/2019	Complete:	☒ Yes ☐ No

Carolyn K. Craven
101 14th Avenue South
Great Falls, MT 59405

June 26, 2019

PUBLIC COMMENTS FOR ZBOA

MFP BIG SKY CHEESE SUP
RECOMMENDATIONS

RECOMMEND ZBOA REQUIRE THE FOLLOWING PRIOR TO SUP APPROVAL

1) **MFP to provide expected production of cheese in pounds annually**
2) **Provide capacity of onsite storage tanks and confirm compliance with the National Fire Protection Association for application in this rural area.**
3) **Obtain water rights from DNRC**
4) **Obtain water wells permit from DNRC**
5) **Obtain DEQ water and wastewater permits**
6) **Obtain DEQ permit for stormwater discharges**
7) **Obtain City County Health Department permit for water and wastewater**
8) **Obtain resolution of Antelope Creek being in the floodplain. The GP Goal 3C clearly states "Protect the floodplain from non-agricultural development. It does NOT say "try to protect". Perhaps an adjacent location would not have the floodplain issue.**
9) **Obtain a permanent access easement on the parcel in Section 27 or have the two parcels be combined as a single parcel in order to allow public access to Highway 89 from the indicated parcel for Big Sky Cheese.**

Respectfully submitted,

Carolyn K. Craven
101 14th Avenue South
Great Falls, MT 59405

I RESPECTFULLY REQUEST DEFERRED APPROVAL OF SUP UNTIL REVIEWS ARE COMPLETED BY THE PERMITTING AGENCIES.

The only way the public can comment is via the ZBOA public hearing. We would like to comment after the reviews by the permitting agencies.

Stone, Michael

From: Payton, Ian
Sent: Friday, June 21, 2019 4:57 PM
To: kate@appcom.net; Stone, Michael; Hopkins, Sandor R.; Haight, Carey; Yonker, Charity N.
Subject: RE: Urgent - Big Sky Cheese Plant SUP - Public Notice Issues

The application is for the cheese processing plant. The proposed plant is located on the specified parcel 5348300. The legal description as provided in the associated L/C for this use is incorporated in the notice. The legal description is also located on the four L/C maps.

From: kate@appcom.net <kate@appcom.net>
Sent: Friday, June 21, 2019 1:00 PM
To: Stone, Michael <mstone@cascadecountymt.gov>; Hopkins, Sandor R. <shopkins@cascadecountymt.gov>; Payton, Ian <ipayton@cascadecountymt.gov>; Haight, Carey <chaight@cascadecountymt.gov>; Yonker, Charity N. <cyonker@cascadecountymt.gov>
Subject: Urgent - Big Sky Cheese Plant SUP - Public Notice Issues

Hi,

I am writing on behalf of the Montanans for Responsible Land use. In reviewing materials for the Big Sky Cheese SUP, I encountered certain inconsistencies with the public notice and the application that was submitted to the county. (See attached memo) Due to the discrepancies described in this memo, we respectfully request that the public hearing on June 27th be rescheduled to allow for the publication of a new public notice that provides accurate information for members of the public who desire to comment on this proposal.

Please let me know as soon as possible so I can notify the group and we can prepare comments accordingly. Thanks for your assistance with the matter.

Kate McMahon
Applied Communications
406-863-9255

FOR OFFICE USE ONLY

Date Received: 6/21/2019
Date Reviewed: 6/27/2019
Complete: ☐ Yes ☒ No

To: Cascade County Attorney & Planning Staff

From: Kathleen McMahon, AICP
Montanans for Responsible Land Use (MFRLU)

Date: 6-21-19

Re: SUP #006-2019 (Big Sky Cheese)

I am writing this memo on behalf of the Montanans for Responsible Land use. In reviewing materials for the Big Sky Cheese SUP, I encountered certain inconsistencies with the public notice and the application that was submitted to the county. Due to the discrepancies described in this memo, we respectfully request that the public hearing on June 27th be rescheduled and to allow for the publication of a new public notice that provides accurate information for members of the public who desire to comment on this proposal.

(a) The public notice, staff report and application do not contain any legal description for the subject properties. These materials only reference the Montana Cadastral parcel numbers and geocodes for one parcel. (See Attachment 1) As properties are combined or subdivided, these reference numbers can, and frequently do, change. A legal description for the property does not change and that is why the Cascade County Zoning ordinance in Section 10.2(1) requires a legal description.

(2) The property boundaries in Exhibit A, Exhibit C, and Exhibit D of the application include 14 separate parcels. The parcel numbers for these properties are shown in Exhibit B. Exhibit C includes a blow-up of a portion of the properties that will include actual operations and infrastructure associated with the proposed cheese plant. The plant operations, access roads, holding ponds and irrigation areas are spread across four parcels. (See Attachment 2)

Since the public notice and staff report only refer to one parcel, a member of the public that is relying on the public notice or staff report, would not be aware of the scope of the proposal. It is not clear if the SUP is being issued for the one parcel included in the legal notice or the four parcels that include the plant operations and accompanying infrastructure, or the entire 14 parcels that are shown on Exhibits A, C and D.

In order for the public to make meaningful comments, the applicant and county must clarify which parcels are being included in the special use permit. In attempting to conduct analysis for the purpose of submitting comments, we need to know whether such comments should be limited to the one parcel in the public notice, the four parcels shown in Exhibit E or the entire 14 parcels show as the property boundary in Exhibit A, C & D.

Thank you for your attention to this matter.

.

Attachment 1: NOTICE OF PUBLIC HEARING

NOTICE IS HEREBY given that the Cascade County Zoning Board of Adjustment will hold a public hearing in the Family Living Center at Expo Park, 400 3rd Street Northwest, Great Falls, on Thursday, June 27, 2019, at 5:00 p.m. to consider Big Sky Cheese, LLC's application for a Value-added Agricultural Commodity Processing Facility: Cheese Processing Plant. The proposed use is located in the Agricultural zoning district. The proposal is located at 8346 US Highway 89, Great Falls. The parcel number is 0005348300 and Geocode is 02-3017-34-4-02-01-0000. The parcel is located in Section 34 Township 20 N Range 5 E, P.M.M., Cascade County, MT.

The application and supplementary materials are on file in the Planning Division's office, and any interested person may appear and speak for or against this proposal at the public hearing or submit in writing any comments to the Cascade County Planning office, 121 4th St N, Suite 2 H/I, Great Falls, MT 59401.

CASCADE COUNTY PLANNING DIVISION

Ian Payton, Dep. Dir.

Publication Date: Sunday, June 16, 2019 & Sunday, June 23, 2019

Attachment 2: Subject Property Parcel Boundaries

Parcel #	Comments
Parcels show on Exhibit E	
534830	Location of Cheese Plant/Potential Holding Ponds/Potential Spray Irrigation & Well Site
533930	Access road onto Highway 89
534840	Potential Holding Pond & Well Site
529570	Potential Holding Pond/Potential Spay Irrigation
Other Parcels Located within Property Boundaries as indicated on Exhibits A, C & D	
538450	
529590	
529690	
529700	
419500	
529810	
534590	
534070	
534835	
533950	

bsc&e
BIG SKY CIVIL & ENVIRONMENTAL, INC
ENGINEERS - PLANNERS - DESIGNERS - LAND SURVEYORS - ENVIRONMENTAL SPECIALISTS
1324 13th Ave. SW
P.O. BOX 3625
GREAT FALLS, MT 59403
(406)727-2185 OFFICE
(406)727-3656 FAX
www.bigskyce.com

PROFESSIONAL SEAL

BY: EJM
DATE: 8/17/19

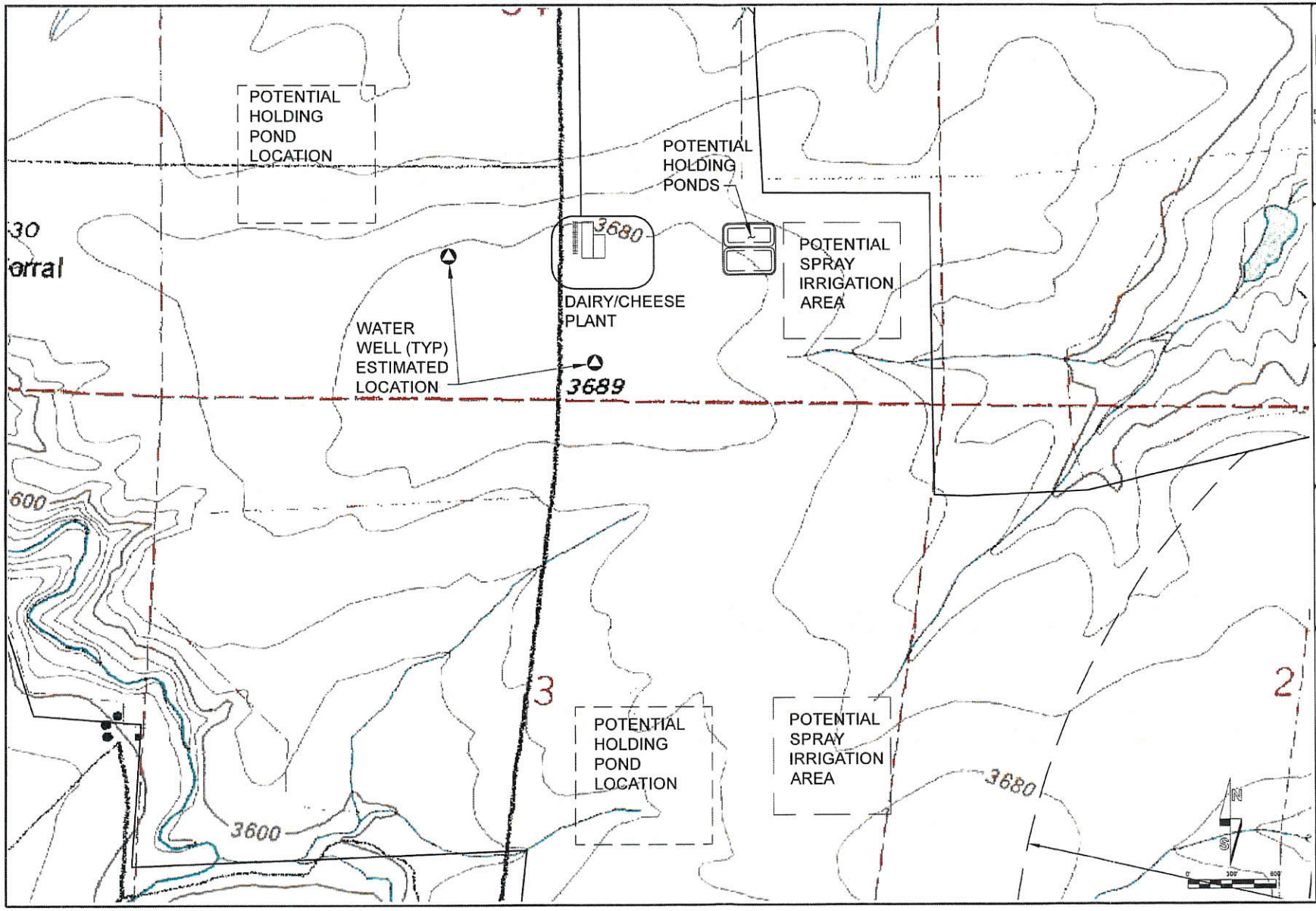
OWNER:
MADISON FOOD PARK, LLC

PROJECT NAME:
MADISON FOOD PARK

SHEET TITLE:
SITE AERIAL MAP DAIRY/CHEESE PLANT

DRAWING INFORMATION:
OFFICE PROJECT NUMBER: 17BN
OWNER FILE NUMBER: XXXX
CADD FILE NAME: 17BN-BASE
ASSOCIATED PROJECTS: XXXX

FIGURE:
EXHIBIT A



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GREAT FALLS, MT 59403
(406)727-2185 OFFICE
(406)727-3656 FAX
www.bigskyce.com

PROFESSIONAL SEAL

BY: KJM
DATE: 4/17/19

OWNER:
MADISON FOOD PARK, LLC

PROJECT NAME:
MADISON FOOD PARK

SHEET TITLE:
SITE CONTOUR MAP DAIRY/CHEESE PLANT

DRAWING INFORMATION:
OFFICE PROJECT NUMBER: 17BN
OWNER FILE NUMBER: XXXX
CADD FILE NAME: 17BN-BASE
ASSOCIATED PROJECTS: XXXX

FIGURE:
EXHIBIT E

Compiled 06/27/2019

Public Comment Form

Cascade County Public Works Department Planning Division
121 4th St N, Suite 2H-2I Great Falls, MT 59401
Phone: 406-454-6905 | Fax: 406-454-6919
Email: planningcomments@cascadecountymt.gov

Instructions

This form is for providing public comment to the Cascade County Planning Division for review by any one or more of the following review and/or approval boards: Zoning Board of Adjustment (ZBOA), Planning Board, or Board of County Commissioners. Only complete submissions will be included for board review. Please provide the relevant information for each section below. A complete submission provides all of the following: commenter name and address, comment subject, and commentary on the subject issue(s). If additional space is needed for commentary, please attach additional sheets to this form. Completed forms may be submitted in person at the Planning Division office or by email at planningcomments@cascadecountymt.gov.

Commenter Information

Name: Carolyn K. Craven

Complete Address: 101 14th Avenue South, Great Falls MT 59405

Comment Subject (please check one):

- ☐ Special Use Permit Application
- ☐ Subdivision
- ■ Zoning Text and/or Map Amendment
- ■ Growth Policy
- ☐ Variance
- ☐ Floodplain Regulation Amendment
- ☐ Subdivision Regulation Amendment
- ☐ County Road Abandonment/ Discontinuation of County Street
- ■ Other (describe): Big Sky Cheese

Comment

06.19.19 Cascade County & City of Great Falls
06.19.19 New & Revised Definitions
06.20.19 Special Use Permit
06.20.19 Commercial Dairy Zoning
06.22.19 Carbon Footprint of Cheese Production

For Office Use Only					
Date Received:	6/24/2019	Date Reviewed:	6/27/2019	Complete:	☒ Yes ☐ No

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Understand the Carbon Footprint

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SPONSORS:

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Environmental Resources Center

Wisconsin Center for Dairy Research

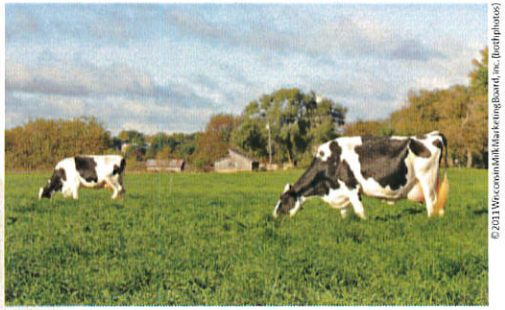
USDA Rural Development

Innovation Center for U.S. Dairy

Many dairy processors, farmers, and consumers are concerned with energy use and global sustainability. Energy use is directly related to the cost of production and affects dairy product profitability.

WCMA/Mike Roemer Photography

Buyers and consumers want to know the environmental impact of products. Lack of knowledge or transparency about a product's environmental impact may make a business less appealing to a consumer. Since much of the energy we use is linked to production of greenhouse gases, using less energy saves money and reduces potential climate change.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0185

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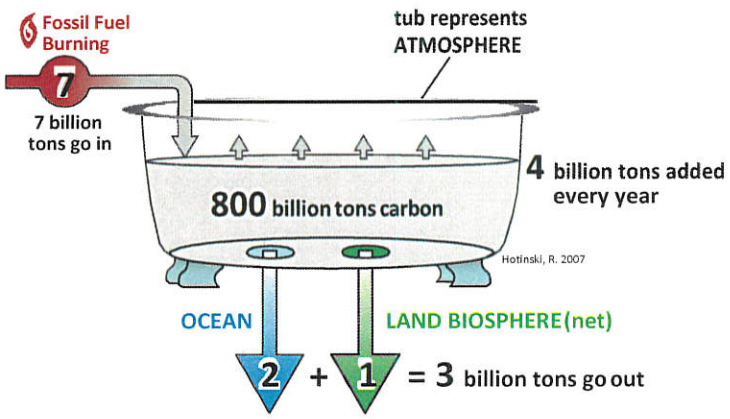
Mill Creek Cheese, Arena Wis, Courtesy of WCDR

How much impact do dairy plants have on climate change? Can you reduce greenhouse gas emissions effectively and still make a quality product with a competitive price? How do you calculate the carbon footprint of a dairy plant?

Recent research at the University of Wisconsin and other institutions gives us solid data to answer these questions. This publication will guide you through an understanding of the factors that influence the carbon footprint of cheese. It will help you look at your operation and identify ways you can lessen the amount of greenhouse gases produced during the manufacture and sale of your product. You'll learn how to understand, calculate and discuss the carbon footprint of cheese.

0186



The atmosphere as a bathtub, with current annual inputs and outputs of carbon. The level in the tub is rising by about 4 billion tons per year.

What is meant by "carbon footprint"?

Activities such as farming, manufacturing, packaging, and transportation cause carbon dioxide (CO_2) and other gases to be released into the atmosphere. Some of these gases cause warming of the earth's climate since they re-emit solar radiation back to the earth. These gases are called "greenhouse gases" (GHG).[1]

Carbon footprint is the overall amount of CO_2 and other greenhouse gas emissions associated with a product.[2] The carbon footprint is quantified using indicators such as the Global Warming Potential (GWP), which reflects the relative effect of a greenhouse gas in terms of climate change over time. This value expresses the overall contribution to climate change of these emissions.[2] Levels of CO_2 are increasing in the atmosphere.[3]

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Greenhouse gases

Greenhouse gases are gases that trap heat in the atmosphere and create a warming layer like a blanket that warms the earth. They absorb heat reflected off the earth's surface. Some of this heat goes into space and some is emitted back to earth. Greenhouse gases occur naturally and as a result of human activities. Human activity has increased the amount of greenhouse gases, as evidenced by studies of the CO_2 level in air bubbles in cores of ice formed thousands of years ago in Greenland and Antarctica. Before human activity, the level of CO_2 in the atmosphere was never more than 300 ppm. Now it is 390 ppm, and rising by about 2 ppm every year. Earth is also warming at a rapid rate. Scientists believe a level of 350 ppm is the safe upper limit for CO_2 in the atmosphere. We need to curb CO_2 emission to prevent climate catastrophe such as the melting of the Greenland ice sheet and major flooding.

"Greenhouse gases can be thought of as pollutants that are invisible."

Carbon dioxide is not the only greenhouse gas. Methane, nitrous oxide, ozone, and water vapor are also naturally occurring greenhouse gases. Other greenhouse gases are human-made, such chlorofluorocarbons commonly used as refrigerants and aerosol propellants. We are concerned not only with CO_2 but with methane and other greenhouse gases because they have a much higher potential to warm the earth than CO_2 does. Not only do greenhouse gases warm the earth, but some cause conditions which help increase the ozone hole in the upper atmosphere. Greenhouse gases can be thought of as pollutants that are invisible.

0187

Global warming potential of greenhouse gases

When thinking about greenhouse gas emissions, it is useful to think in terms of CO_2 equivalents (CO_2-eq). Carbon dioxide equivalents are used to compare greenhouse gases based on their global warming potential, having CO_2 as the reference value (Table 1). Methane, for example, has a CO_2 equivalent of 25 in a 100 year period. If you can reduce methane emission by 100 lbs it is as if you have reduced your CO_2 emission by 2,500 lbs, because methane has a much higher global warming potential than CO_2.

Table 1. Greenhouse gases and their potential for global warming over a 100-year period[4,5,6]

Gas	Formula or Designation	Global warming potential, or CO_2 equivalent	Causes ozone depletion?
Common Greenhouse Gases			
Carbon Dioxide	CO_2	1	No
Methane	CH_4	25	No
Nitrous Oxide	N_2O	298	No
Refrigerants			
Freon	CFC-12 (R-12)	10,900	Yes
Arcton	HCFC (R-22)	1,810	Yes
Genetron	HFC-134a (R-134a)	1,430	No
Ammonia	NH_3	0	No
Fire Extinguisher Gas			
Halon	Halon 1301	7,140	Yes

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Are the refrigerants that leak from my cooling system greenhouse gases?

Some refrigerants are greenhouse gases and some are not. Freon (R-12) and some other ozone depleting compounds have been phased out since the late 1980s. Since that time we have seen the ozone hole in the Antarctic shrink, which is a good example of how human action can reverse environmental damage by making changes based on scientific evidence. Arcton (R-22) and genetron (R-134a) are greenhouse gases but ammonia is not.

Babcock Dairy, UW-Madison, F.X. Milani

Regulation of greenhouse gases

Greenhouse gases became a federal pollutant through an EPA and Department of Transportation rule as of January 1, 2011. Large emitters, over 25,000 metric tons of CO_2-eq per year, are required to report. However, there is no enforcement for reduction. Only the largest dairy plants would fall into that category. Further regulation limiting greenhouse gas emissions is politically contentious; so we expect lengthy delays in further actions.

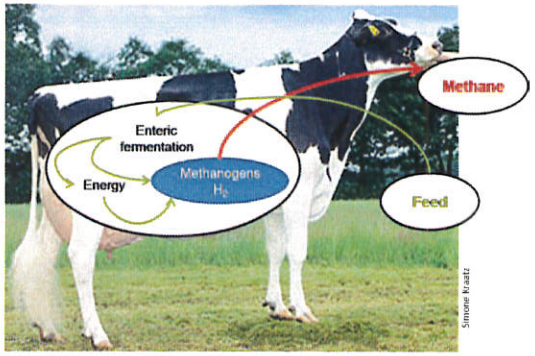
0188

How does this relate to cheese making?

stock.XCHNG

During the processes to make cheese and deliver it to the consumer, there are several potential sources of greenhouse gas emissions. The largest percentage of cheese GHG emissions occurs during milk production at the dairy farm (greater than 90%).

Modern dairy practices produce about 1.2 kg CO_2-eq per kg milk, or 1.2 lbs CO_2-eq per lb of milk.[7,8] Nearly 10 pounds of milk are needed to produce one pound of cheese. Farm greenhouse gas emissions come mostly from rumen methane, nitrous oxide from fertilizer, and methane from manure. When cows and other ruminants eat, microbes in their rumen break down the food and produce methane. This is called enteric methane, and most is expelled as burps. Enteric methane is the major single contributor to farm greenhouse gas emissions. When farmers apply fertilizer or manure to fields, nitrous oxide is emitted, another potent greenhouse gas. Nitrogen leaching and runoff into water also causes nitrous oxide to escape into the air.



Simone Kraatz

Farmers can lower their GHG emissions in several ways. They can alter the feed composition to reduce methane, manage fertilizer to

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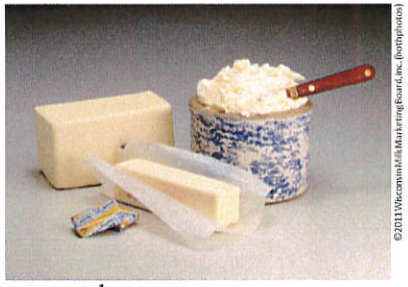
limit excess nitrogen and runoff, and continue to aim for more efficient milk production. Farmers can also capture manure methane and use it to make biogas in a digester. Any improvement at the dairy farm level will result in a substantive reduction in GHG emissions.

Dairy manufacturing, including packaging, contributes the second highest percentage of cheese GHG (the dairy farm is the first). A dairy plant that produces a hard cheese emits about 0.4 to 0.6 kg CO_2-eq/kg of cheese[9] or 0.4 to 0.6 lbs CO_2-eq/lb. The emissions resulting from this stage can vary significantly and there are a lot of ways you can reduce GHG emissions. Some factors that influence emissions at this stage are:

- Type of cheese. For example, a higher moisture Monterey Jack needs less energy per pound than a drier Cheddar cheese for aging.
- Length and type of aging. Cheeses that require storage at low temperatures will use more energy for refrigeration than those that do not.



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- Production of co-products, such as whey cream or butter. You might be able to lower the GHG of your primary product by making a second product, thus distributing the impact over more products.
- Recovery of energy from permeate. You can dramatically reduce your GHG emissions if you make heat or electricity by feeding your permeate into a digester to make biogas.

0189

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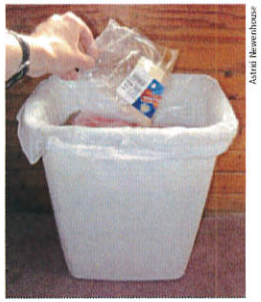
Another, smaller percentage of GHG emissions from cheese production are CO_2 emissions from the combustion of fossil fuel such as gasoline and diesel for transportation, and electricity and natural gas for retail, and final use stages.



Astral Heavenhouse

The remaining GHG emissions in cheese production occur when the consumer eats the cheese and discards the packaging. If you landfill spoiled cheese or packaging, methane and CO_2 are emitted.

In 1995, 27% of food in the U.S. was wasted. The energy lost from producing, transporting, selling, and preparing this wasted food equals 2% of U.S. annual energy consumption.[10] Mold is a large contributor to cheese waste at the consumer level. Besides producing a better quality product, manufacturers who control mold also contribute to a better environment.

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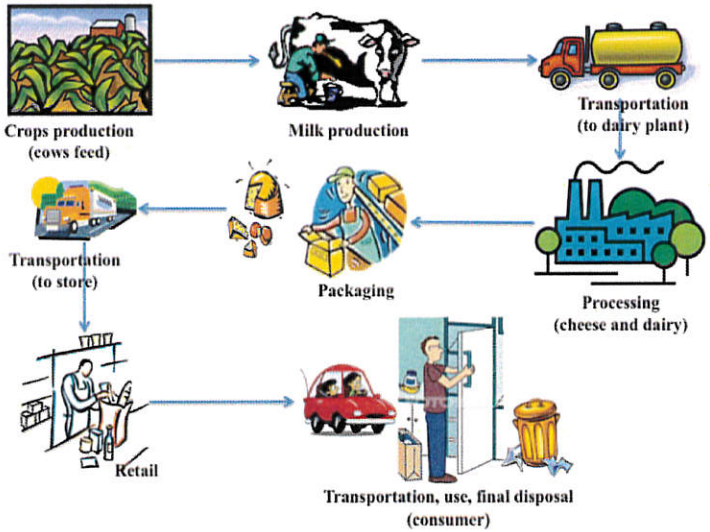
What is a Life Cycle Assessment?

A Life Cycle Assessment (LCA) is a value given to a product that takes into consideration all the environmental and health impacts associated with producing and using that product over its entire life cycle. It's a way to evaluate the sustainability of a production process. The inputs and outputs of an LCA cover how the raw materials are acquired, the emissions given off, and what happens in production, use, recycling, and disposal of the product. Life Cycle Assessment is a structured, comprehensive, and internationally standardized method.[11] A related "eco-indicator" method takes into consideration a product's impact on the ecosystem, human health, and the scarcity of raw materials.[12]



The life cycle GHG emissions of a kilogram of hard cheese is about 8.8 kg CO_2-eq, similar to driving a car 20 miles[13] or leaving an incandescent 100 w light bulb on for one hour.

0190

Carbon Footprint is part of a Life Cycle Assessment

The term "carbon footprint" is a value that only takes into consideration the product's effect on greenhouse gas emissions, sometimes called "carbon emissions." Greenhouse gas emissions are only one part of the Life Cycle Assessment in cheese production.

What is a Carbon Footprint Calculator?

If you know what steps go into making cheese you can calculate its carbon footprint. In the following section we illustrate a simplified calculation method. You can follow the calculations to see how we arrive at the carbon footprint of cheese or calculate the carbon footprint of your own cheese based on some of the parameters of your process. The parameters we use are based on research literature and on the cheese manufacturing process. The calculator includes choices that show what factors matter most.

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Cheese Carbon Footprint Calculator

Unit Process	Your custom calculation, running total	Average for U.S. Cheddar cheese, running total
Milk Production Impact: Average U.S. Dairy Farm (values are based on Fat and Protein Corrected Milk, FPCM, units are "kg CO_2 eq per kg FPCM" (Thoma et al.). FPCM = [(0.0929)(fat% tested)+(0.05882)(protein% tested)+0.192]/[(0.0929)(4%tested)+(0.05882)(3.3%tested)+0.192] GHG emissions calculated by the "Green Cheese" Project in Wisconsin were on average 0.75 kg CO_2-eq per kg ECM (Energy Corrected Milk). The major differences in emissions are because the Green Cheese study considered best management practices for manure handling (e.g. collection and application), crop production (e.g. minimization of chemical fertilizer through manure application) and feeding efficiency; while the Thoma et.al. study used survey data to assess actual practices on farms. When considering the existence of a digester that uses manure to produce biogas, GHG emissions were further reduced up to 25%. This reduction was due to the avoided natural gas production and combustion, and to avoided CH_4 emissions from manure storage. When maximizing DDGS (dried distillers grains with solubles) in the diets, the reductions in GHG emissions could reach up to another 25% due to the avoidance of gasoline production and combustion by ethanol use.		1.2
Cream Removal Impact: If you are removing (or adding) cream, we need to convert standard producer milk into kg CO_2 eq per kg milk solids (U.S. average producer milk is 3.66% fat and 12.31% solids): kg CO_2 eq per kg milk solids = 1.2/0.1231 = 9.75 kg CO_2 eq per kg milk solids. (continued)		1.2+0= 1.2

0191

Cheese Carbon Footprint Calculator (continued)

For each 1% cream (37% fat content) removed, this removes 0.432% solids from milk. Therefore: Solids milk after cream removal = 12.31 – [(____ % cream removed)X(0.432)] Adjust kg CO_2 eq per kg milk solids after cream removal = (9.75 kg CO_2 eq per kg milk solids)X(Solids milk after cream removal) Cheddar cheese will remain at 1.2 kg CO_2 eq per kg FPCM. Typical mozzarella cheese milk will have 3.25% cream removal from the producer milk before, so mozzarella cheese milk contains 10.91 solids. 1.06 kg CO_2 eq per kg will be mozzarella cheese milk.		
Shipping Impact: Shipping impact is based on miles milk traveled from farm to processing plant: U.S. average is 86.75 miles (Newton 2007). Tanker holds 40,000 pounds. Semi mileage rate average is 7.3 mpg. CO_2 eq per gallon diesel fuel= 22.38#. (EPA 2010) Example: Farm to plant shipping CO_2 eq per kg FPCM = [(86.75/7.3)X(22.38)]/(40,000) Then convert to kg (1 lb = 0.454 kg)		1.2+ 0.003= 1.203
Processing Plant Impact: There are a number of major factors with processing impacts. Main contributors are: Electric use, fuel use, caustic use, refrigerant loss, packaging use, and aging time. The majority of the emissions are related to energy use, which is mainly in the forms of electricity for cooling, refrigeration, lighting and mechanical applications; and natural gas for thermal applications. Generally, thermal		8.3

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energy use will result in less "net emissions" because the energy embedded in the production of natural gas is lower than electricity (producing electricity has lower efficiencies than generating heat, therefore more primary fuel is needed to produce the same amount of energy). Also, the emissions will be affected depending on the mix of fuels that is used to produce electricity. For example, in systems where coal is the main fuel to produce electricity the emissions will be higher than in systems that have a bigger inclusion of cleaner energies such as wind, solar, or hydro. We do not have yet all the appropriate in-factory contributions for cheese manufacture. However, we do have total factory contributions, concentration factors for making cheese and whey from milk, and energy allocations from cheese and whey. We are recommending that 0.086 kg CO_2 eq per kg FPCM (FAO 2010) as the amount contribution from dairy processing and the cheese and whey allocation percentage (Feitz et al.). Cheddar manufacture kg CO_2 eq per kg FPCM = (0.086 kg CO_2 eq per kg FPCM) X (5.1 cheese energy factor) = 0.4386 kg CO_2 eq per kg FPCM 0.4386 kg CO_2 eq per kg FPCM + 1.203 kg CO_2 eq per kg FPCM = 1.64 kg CO_2 eq per kg FPCM. (10 raw milk)/(1 finished cheese) X 1.64 X 50.4% solids used from milk for cheese = 8.3 kg CO_2 eq per kg cheddar Whey manufacture kg CO_2 eq per kg FPCM = (0.086 kg CO_2 eq per kg FPCM) X (7.6 whey energy factor) = 0.6536 kg CO_2 eq per kg FPCM 0.6536 kg CO_2 eq per kg FPCM + 1.203 kg CO_2 eq per kg FPCM = 1.87 kg CO_2 eq per kg FPCM. (17.76 raw milk)/(1 finished whey) X 1.87 X 43.2% solids used from milk for whey = **14.3 kg CO_2 eq per kg whey powder.**		

0192

Cheese Carbon Footprint Calculator (continued)

Shipping Distance to Retail Impact: Shipping distance to average U.S. retail (consumer): Geographic center of Wisconsin is Pittsville. Geographic population center of density for the U.S. is Edgar Springs, MO, which is 600 miles from Pittsville, WI. Distance from Edgar Springs, MO to New York City is 1079 miles and to Las Angeles, CA is 1735 miles. We will credit shipping miles as not having to ship to Edgar Springs but rather as direct as ½ the distance of each leg: Average distance to average U.S. customer = (600/2) + [(1079/2)+(1735/2) / 2] = 1003 miles. Semi mileage rate average is 7.3 mpg. CO_2 eq per gallon diesel fuel= 22.38#. Cheddar shipping CO_2 eq per kg cheddar = [(1003/7.3) X(22.38)]/(40,000) = 0.077		**8.3+ 0.077 = 8.377**
Total Carbon Footprint of Cheddar Cheese: Total CO_2 eq per kg cheddar delivered to retail sale. It is not given here, but refrigeration, consumer travel and storage, and the disposal of the package in the land-fill would also contribute to the CO_2 eq per kg cheddar impact with the completion of the cradle-to-grave analysis of cheddar cheese consumption. Estimates are up to another 0.05 CO_2 eq per kg cheddar cheese could be added (Berlin 2002).		**8.377**

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What is meant by allocation?

We may soon be required to adhere to greenhouse gas emissions limits and need to be able to describe the emissions caused by making a product, such as cheese. The process of "allocation" is an important method to accurately describe the energy used and environmental impacts of producing a product. During allocation (or "partitioning"), you describe how the individual inputs and outputs of production are split up among the products and by-products. If possible, allocation should reflect the underlying physical, chemical and biological relationship between the different products.[14] Allocation is a key part of a Life Cycle Assessment.

As an example of LCA allocation we can look at the greenhouse gas emissions allocation of a passenger on an airline. The input of fuel consumption needs to be partitioned into the fuel used to transport the passenger and the fuel used to transport mail and cargo on the same flight. Passengers who fly coach take up less space (and therefore use fewer resources) than those flying firstclass.

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0193

How does energy use affect your carbon footprint?

Energy used is the main driver of emissions at the processing and transportation stages. You can lower your emissions by increasing your energy efficiency or by using renewable energy with lower overall emissions. The best place to start is to improve your energy efficiency. If you reduce electricity consumption by 1 kilowatt hour you avoid the production of 3 kilowatt hours of primary energy, which come mainly from fossil fuels.

Janice Kopka

Typically, energy efficiency measures are the cheapest way to reduce energy costs. After improving energy efficiency, a conversion to renewable energy systems causes a dramatic reduction in greenhouse gas emissions. If you switch to renewable energy you will lower your greenhouse gas emissions at least 90% (Table 2).

Table 2. Approximate greenhouse gas emissions from different electricity generation systems[15]

Energy Source	kg CO_2-eq/MWh
Coal or Oil	1,030
Natural Gas	622
Anaerobic Digester	46
Solar PV	39
Nuclear	17
Wind	14

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How does nutrient value affect carbon footprint?

Typically, the carbon footprint of a food is expressed as pounds of CO_2 per pound of food produced. But if we ignore the nutrient content of food we may be missing some key comparisons. On a pound for pound basis, milk, cheese, and yoghurt are very nutritious. As an example, let's look at cow milk compared to soy milk. Compared on the basis of weight, cow milk has 3 times the carbon footprint of soy milk, but when you compare them on the basis of nutrient density, cow milk has half the carbon footprint of soy milk.[16] Cow milk is more nutrient dense than soy milk. It makes a lot of sense to consider the functional unit when you talk about carbon footprint, especially the carbon footprint of food.

J.S. Bailey Ltd

What about recycling?

Astrid Heavenhouse

Recycling can make a big impact on reducing the carbon footprint of a product. As an example, consider the blow-mold plastic used for milk gallons. If you recycle the plastic into another plastic product such as a doormat, you save the energy needed to refine that plastic from crude oil and you prevent the disposal of the plastic into a landfill. In the landfill, the plastic will produce methane as it decomposes. That methane in the atmosphere is 25 times more potent to global warming as compared to the CO_2 given off if the plastic had been incinerated.

0194

Environmental impacts

The earth is a complex system consisting of many closely interconnected subsystems. If everything on our planet would function according to the simple principle of cause and effect, it would be possible to solve problems simply by intervening at one point. But the earth's systems are more complex than that. As we try to solve the problem of reducing greenhouse gas emission, it is important to avoid creating

Is burning wood really "green"?

We think of wood as a renewable energy source because we can replenish it by growing more. While trees grow, they capture carbon from the atmosphere and energy from the sun during photosynthesis. Keep in mind that even though fossil fuels also captured carbon from photosynthesis, that occurred millions of years ago and doesn't help us today. When biofuels are burned, they reduce the amount of carbon released to the atmosphere by greater than 80% because we give credit to account for the carbon captured from the atmosphere during growth of the tree.[17] However, this amount is not 100% because burning biofuels also releases some pollutants.

Andreas Meckanckas, Switzerland

There is a big difference between wood versus other biofuels such as corn ethanol because of the time it takes to grow a tree. Consider for example an old oak tree. It would take this tree many years to capture the carbon, but that

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new problems. Cheese production has impacts on global warming, ozone depletion, acidification of lakes and streams, biodiversity, land use, and other environmental issues. The results of our management decisions often appear much later, are unpredictable, and can therefore not be entirely planned. We must understand cheese production as a whole to maintain environmental, social, and economic sustainability.

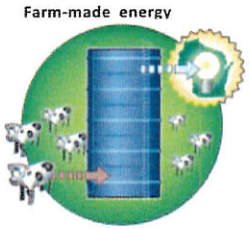
carbon is released instantaneously when you burn the wood in your fireplace. Since we live in an age where we are adding more carbon to the atmosphere than can be absorbed by the natural carbon cycle, the impact of that carbon release is greater now. It is as if years of carbon accumulation are released to the atmosphere in an instant.

The efficiency of the wood stove affects the fuel's impact on greenhouse gases, and stoves vary greatly. Many wood heating systems may not be as efficient as fossil fuel systems. Generally, larger biofuel burning systems are more efficient than small. A fireplace wastes heat. Also, burning wood could release particulate air pollution if not combusted efficiently.

If you burn wood to heat your pasteurizer you can claim a reduction in CO_2 emissions if you have these factors: a high efficiency energy system, good energy conservation, optimal firebox design, and optimal flue design. You should have a regeneration configuration to recycle heat on your pasteurizer. If you know you have excellent process designs, you can support a statement that is an ethical declaration of your biofuel use and near zero carbon emission.

0195

How does a digester make energy from waste?



With 26 on-farm bio-energy systems in operation and more on the way, Wisconsin leads the nation in converting manure into renewable energy.

Organic waste contains nutrients which, when fermented by certain types of bacteria in the absence of air (anaerobic conditions), release methane and carbon dioxide. The combination of these gases from this process is named biogas. Microorganisms break down the short chain hydrocarbons, cellulose and hemicelluloses and release biogas. Biogas is composed of 60-65% CH_4, 35%-40% CO_2, trace amounts of other compounds, and has an energy content[18] of 20 to 25 MJ/m3. Biogas can be used to generate heat or electricity.

Anaerobic digestion is a valuable way to recover energy from organic waste with high water content, such as dairy manure.

Clearflow Limited

In confined herds where liquid manure is stored in lagoons, anaerobic digesters also improve nutrient and manure management, reduce odor, and decrease the population of weed seeds and pathogens in manure. The by-products of anaerobic digestion are liquids and solids, both of which can be used as fertilizers or for other purposes.

If you produce heat or electricity by burning methane that would otherwise have been given off from liquid manure stored in lagoons, you reduce GHG emissions in two ways. You replace a fossil fuel used to produce heat or electricity, and you convert methane into CO_2 which is a less potent greenhouse gas. A Midwest study of food and beverage companies that use anaerobic digesters to make energy from their waste has recently been published.[19]

Illustration source: Wisconsin Focus on Energy
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You can make decisions today to reduce greenhouse gas emissions

Some of the greenhouse gas emissions occur during processes that are beyond our control. Other sources of greenhouse gas emissions are within our control. Along the way, you can make decisions that affect the amount of greenhouse gases given off. Here are some examples of areas where your choices can make a difference:

Simple first steps to take to reduce your greenhouse gas emissions:

1. Since most GHG emissions come from producing milk on the farm, keep your cheese yield as high as possible with moisture and vat optimization.
2. Conduct a cleaning and pasteurization energy use audit, as these areas typically use the most energy in your plant. Remember that for every kilowatt hour saved you reduce global energy use by 3 kilowatt hours in transmission losses.
3. At the retail store, are there ways to save energy? A full display case is more energy efficient than half empty, and is more appealing to customers. Keep your refrigerant systems well maintained to stop leaks and losses.

0196

Next steps that can further reduce your greenhouse gas emissions:

1. Think about how many heat recovery projects are waiting to be done in your plant. If the air in your plant is greater than 50° F ambient, or the temperature of discharge flows greater than 30° F ambient to water, there should be payback for heat recovery projects.

2. Are there ways to age cheese using shorter time periods? Think of adjunct (aging) starter cultures. Or less energy? Consider in-ground aging caves.
3. Can you package your product with less waste?
4. Design your product for less waste at the consumer level: mold control, package size, and yummy rinds.
5. Try not to landfill any waste from your plant ("zero landfill"). This reduces the greenhouse gases given off at disposal.
6. Look at the energy you use to transport cheese to market. Can you increase fuel efficiency or replace fossil fuels with renewable fuels?

Going further to reduce greenhouse gas emissions:

1. What renewable sources of energy would fit for your situation? A windmill installation if you are in a remote location? Anaerobic digestion and production of biogas from your wastewater or unwanted permeate? Does it make sense to build a digester that other regional food processing plants or farms can share? Can you add solar power and make it pay back within a reasonable amount of time?

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2. Are you aware of all the tax incentives, aid programs, manufacturers' rebates, and government incentive programs for energy conservation and alternative energy systems? If not, please contact these agencies: Focus on Energy, EPA, Wisconsin State Energy Office, and Energy.gov. You may also contact the authors of this publication.
3. Source milk from farms that have a lower carbon footprint because they use manure instead of synthetic fertilizers that require high fossil fuel energy inputs, reduce manure storage time (from collection to application) in warm weather, minimize the surface area of manure lagoons, cover manure storage lagoons, flare methane emissions from manure storage facilities or digesters, inject manure into the soil to reduce volatilization of methane and nitrous oxide, and prevent runoff into lakes and streams.

University of Wisconsin research

Professor Doug Reinemann leads a "Green Cheese" research team that is creating a decision making tool for dairy farmers and dairy processors to help them calculate the energy impact of different practices they use to produce cheese.[20] For example, if a cheese plant adds an anaerobic digester, how much will that reduce the carbon footprint of the cheese? If a farmer grows and sells biofuels as part of their dairy business, how does that reduce the carbon footprint of cheese produced from the milk? Researchers from Bolivia, Brazil, and Germany are working together on the project.

The researchers are (from left): Doug Reinemann, Franco Milani, Horacio Aguirre-Villegas, Simone Kraatz, Thais Passos-Fonseca and Astrid Newenhouse.

0197

What Can Consumers Do?

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The biggest impact consumers can have on the carbon footprint of dairy products is not to waste food. So much energy goes into food production, packaging, transportation, and sale that with every ounce of cheese left uneaten, more than half a pound of CO_2 emissions are given off. It may not sound like a lot, but it adds up.
A single slice of cheese is about ¾ of an ounce. Purchase only what you think you will use. Save leftovers and regularly check the fridge so you eat what's available. Avoid buying a special ingredient for a recipe that you will only use once. Take leftovers home from the restaurant. Teach your kids not to throw away food.

Conclusion

There are many ways to think about the carbon footprint of cheese and the impact cheese production has on climate change. This publication will help you get started. Life cycle assessment demonstrates a useful tool for this analysis.
A focus on sustainability will lead to other benefits such as energy savings, monetary savings, and a cleaner environment. Contact the authors for more information on how to calculate the carbon footprint of your cheese.

Compiled 06/27/2019

Citations

1. Carbon Footprint - What it is and How to Measure it. 2007. European Platform on Life Cycle Assessment, European Commission Joint Research Centre. http://lca.jrc.ec.europa.eu/Carbon_footprint.pdf
2. Archer, D., Eby, M., Brovkin, V., Ridgwell, A., Cao, L., Mikolajewicz, U., Caldeira, K., Matsumoto, K., Munhoven, G., Montenegro, A., and K. Tokos. 2009. Atmospheric Lifetime of Fossil Fuel Carbon Dioxide. Annu. Rev. Earth Planet. Sci. 37:117–34.
3. Hotinski, R. 2007. Stabilization Wedges: a Concept and Game. Carbon Mitigation Initiative, Princeton, NJ. http://www.princeton.edu/~cmi
4. Forster, P., V. Ramaswamy, P. Artaxo, T. Berntsen, R. Betts, D. W. Fahey, J. Haywood, J. Lean, D. C. Lowe, G. Myhre, J. Nganga, R. Prinn, G. Raga, M. Schulz, and R. Van Dorland. 2007. Changes in Atmospheric Constituents and in Radiative Forcing. In Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller ed. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.
5. EPA, 2011. High Global Warming Potential Greenhouse Gases. http://www.epa.gov/highgwp1/scientific.html
6. Carbonify.com. 2010. Carbon Dioxide Emissions Calculator. 2010. http://www.carbonify.com/carbon-calculator.htm
7. Thoma, G., Popp, J., Shonnard, D., Nutter, D., Ulrich, R., Matlock, M., Kim, D, Neiderman, Z., East, C., Adom, F., Kemper, N., and Mayes, A. 2010. Greenhouse Gas Emissions from Production in Fluid Milk in the US. Dairy Management, Inc., Rosemount, IL, USA.
8. FAO. 2010. Greenhouse Gas Emissions from the Dairy Sector – A Life Cycle Assessment. Food and Agriculture Organization of the United Nations.
9. Berlin, J., 2002. Environmental Life Cycle Assessment (LCA) of Swedish Semi-hard Cheese. International Dairy Journal, 12:939-953.
10. Cuéllar, A., and Webber, M., 2010. Wasted Food, Wasted Energy: The Embedded Energy in Food Waste in the United States. Environ. Sci. Technol., 44(16):6464–6469.
11. International Organization for Standardization (ISO) 14040:2006. Environmental Management - Life Cycle Assessment – Principles and Framework.
12. International Dairy Federation (IDF) 2009. Environmental / Ecological Impact of the Dairy Sector: Literature Review on Dairy Products for an Inventory of Key Issues.
13. EPA, 2005. Emission Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle. http://www.epa.gov/oms/climate/420f05004.htm
14. International Organization for Standardization (ISO) 14044:2006 Environmental Management - Life Cycle Assessment - Requirements and Guidelines.
15. Meier, P.J. 2002. Life-Cycle Assessment of Electricity Generation Systems and Applications for Climate Change Policy Analysis, Ph.D. thesis, University of Wisconsin, Madison.
16. Smedman, A., Lindmark Månsson, H., Drewnowski, A., and A.K. Edman. 2010. Nutrient Density of Beverages in Relation to Climate Impact. Food and Nutrition Research 54:5170.
17. U.S. Energy Information Administration (EIA) Energy Kids. Renewable Biomass. http://www.eia.doe.gov/kids/energy.cfm?page=biomass_home-basics
18. Møller, H., Sommerand, S., and B. Ahring. 2004. Methane Productivity of Manure, Straw, and Solid Fractions of Manure. Biomass and Bioenergy 26(5):485-495.
19. Kramer, J. 2011. Great Lakes Region Food Industry Biogas Casebook. Energy Center of Wisconsin. http://www.ecw.org/ecwresults/261-1.pdf
20. Passos-Fonseca, T., Aguirre-Villegas, H., Reinemann, D., Armentano, L., Cabrera, V., Norman, J. 2010. Green Cheese: LCA of Energy Intensity and GHG Emissions of Integrated Dairy/Bio-fuels Systems in Wisconsin. ASABE Paper Number 1008719.

Understand the Carbon Footprint of Cheese

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University of Wisconsin-Extension
Department of Food Science

Department of Biological Systems Engineering

Environmental Resources Center

Wisconsin Center for Dairy Research

USDA Rural Development

Innovation Center for U.S. Dairy

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Graphic design by Jeffrey J. Strobel, UW-Extension Environmental Resources Center

UWEX: A 3934

0198

Public Comment Form

Cascade County Public Works Department Planning Division
121 4th St N, Suite 2H-2I Great Falls, MT 59401
Phone: 406-454-6905 | Fax: 406-454-6919
Email: planningcomments@cascadecountymt.gov

Instructions

This form is for providing public comment to the Cascade County Planning Division for review by any one or more of the following review and/or approval boards: Zoning Board of Adjustment (ZBOA), Planning Board, or Board of County Commissioners. Only complete submissions will be included for board review. Please provide the relevant information for each section below. A complete submission provides all of the following: commenter name and address, comment subject, and commentary on the subject issue(s). If additional space is needed for commentary, please attach additional sheets to this form. Completed forms may be submitted in person at the Planning Division office or by email at planningcomments@cascadecountymt.gov.

Commenter Information

Name: Carolyn K. Craven

Complete Address: 101 14th Avenue South, Great Falls MT 59405

Comment Subject (please check one):

- ☐ Special Use Permit Application
- ☐ Subdivision
- ■ Zoning Text and/or Map Amendment
- ■ Growth Policy
- ☐ Variance
- ☐ Floodplain Regulation Amendment
- ☐ Subdivision Regulation Amendment
- ☐ County Road Abandonment/ Discontinuation of County Street
- ■ Other (describe): Big Sky Cheese

Comment

06.19.19 Cascade County & City of Great Falls
06.19.19 New & Revised Definitions
06.20.19 Special Use Permit
06.20.19 Commercial Dairy Zoning
06.22.19 Carbon Footprint of Cheese Production ZBOA
06.25.19 Highlights MT Milk Study ZBOA
06.26.19 Waste Management Issues for Dairy Processors ZBOA
06.26.19 Big Sky Cheese Recommendations ZBOA
06.26.19 Public Participation ZBOA
06.26.19 Life Cycle Assessment of Cheese & Whey ZBOA
06.26.19 Treatment of Dairy Wastewater ZBOA
06.27.19 Big Sky Cheese Parcels Public Notice

For Office Use Only					
Date Received:	6/27/2019	Date Reviewed:	6/27/2019	Complete:	☒ Yes ☐ No

Carolyn K. Craven
101 14th Avenue South
Great Falls, MT 59405

June 27, 2019

PUBLIC COMMENTS ZBOA
PUBLIC NOTICE

From Kate McMahon, Consultant – Excerpts from memo sent to Planning on 6-23-1

1) The public notice, staff report and application do not contain any legal description for the subject properties. These materials only contain references the Montana Cadastral parcel numbers and geocodes for one parcel. (See Attachment 1) As properties are combined or subdivided, these reference numbers can, and frequently do, change. A legal description for the property does not change and that is why the Cascade County Zoning ordinance in Section 10.2(1) requires a legal description.

2) The property boundaries in Exhibit A, Exhibit C, and Exhibit D of the application include 14 separate parcels. The parcel numbers for these properties are shown in Exhibit B. Exhibit C includes a blow-up of a portion of the properties that will include actual operations and infrastructure associated with the proposed cheese plant. The plant operations, access roads, holding ponds and irrigation areas are spread across four parcels. (See Attachment 2)

3) Since the public notice and staff report only refer to one parcel, a member of the public that is relying on the public notice or staff report, would not be aware of the scope of the proposal. It is not clear if the SUP is being issued for the one parcel included in the legal notice or the four parcels that include the plant operations and accompanying infrastructure or the entire 14 parcels that are shown on Exhibits A, C and D.

4) In order for the public to make meaningful comments the applicant and county must clarify which parcels are being included in the special use permit. In attempting to conduct analysis for the purpose of submitting comments, we need to know whether such comments should be limited to the one parcel in the public notice, the four parcels shown in Exhibit E or the entire 14 parcels show as the property boundary in Exhibit A, C & D.

My Question to Staff

1) How many parcels in the MFP land will be used for the cheese plant and supporting structures?
A: The facility is on one parcel, they have not stated or shown definitively on their application that there will be supporting structures on other parcels.

Although the structure is only on one parcel, the access road is on the adjacent parcel to the north. Without this access the property is landlocked so it is important that both parcels be included in the Special Use. Right now, the site plan indicates there are "potential holding ponds" and "spray irrigation areas". If these are added in the future, it should be clear that the special use will need to be amended to add these parcels and that will require another public hearing. KM
I would request that this clarification be part of the conditions of approval.

Public Comment Form

Cascade County Public Works Department Planning Division
121 4th St N, Suite 2H-2I Great Falls, MT 59401
Phone: 406-454-6905 | Fax: 406-454-6919
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Date Received:	6/26/2019	Date Reviewed:	6/27/2019	Complete:	☒ Yes ☐ No

INNOVATION CENTER FOR U.S. DAIRY.
HEALTHY PEOPLE • HEALTHY PRODUCTS • HEALTHY PLANET

The Comprehensive Life Cycle Assessment for Greenhouse Gas and Energy Use for Cheese and Whey Products Summary

The Comprehensive Life Cycle Assessment for Cheese and Whey Products was completed in early 2012 and is intended to provide those in the cheese industry with timely, science-based information to help them innovate to reduce greenhouse gas (GHG) emissions and energy demand from farm gate to consumer table. This report summarizes the GHG and energy results. The additional study components of water use and other impacts are now under review and will be released later in 2012.

Introduction

Over the past few years, consumers have become increasingly aware of the environment, from their own impact to that of manufacturers who provide them with the products they want and use. This awareness and interest further extends to the foods they eat.

Many of today's consumers are asking questions about — and expanding their knowledge of — how particular foods got on their plate or in their glass. At the same time, activist organizations are trying to reach consumers with their own messages, such as the statement by the *Environmental Working Group* that if Americans stopped eating meat and cheese for a week, it would have the same result as people driving 91 billion fewer miles a year.

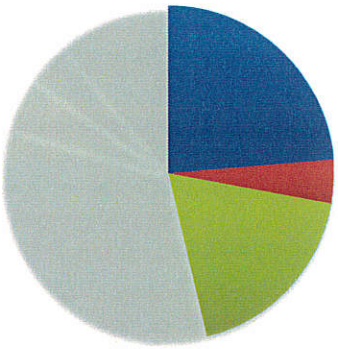
Given such statements, and with growing consumer interest in natural foods and foods produced in a sustainable way, those associated with the food value chain — from farmers to processors to retailers — are looking to assess the environmental impact of their products. Ultimately, the goal is to identify and improve the product's respective carbon footprint and communicate that back to consumers.

All members in the supply chain increasingly are adding environmental reporting requirements for their raw material and ingredients suppliers as they meet the information demands of their consumers. For commodities such as meat and dairy, the industry has taken the lead in researching the true environmental impact of finished products to provide that information throughout the farm-to-table value chain.

The U.S. dairy industry, for its part, has worked to proactively anticipate and meet the needs of consumers with a commitment to improving its environmental performance. In 2009, the Innovation Center for U.S. Dairy endorsed a voluntary goal to reduce GHG emissions for fluid milk 25 percent by 2020 and subsequently launched a GHG life cycle assessment (LCA) for fluid milk to determine points in the farm-to-table value chain at which the dairy industry can

help reduce GHG emissions. Results of that LCA identified manure management, feed production and enteric methane as key areas for improvement and innovation research.

Following the fluid milk LCA, the Innovation Center for U.S. Dairy focused on cheese and whey, which comprise a significant portion of the dairy products purchased and consumed in the U.S. Per Figure 1, of the approximately 190 billion pounds of milk produced each year, 33 percent is used for cheese, while 24 percent is used for fluid milk. Average per capita consumption of cheese in the U.S. is 24.5 pounds.



Completed in early 2012, the *Comprehensive Life Cycle Assessment for Cheese and Whey Products* was intended to provide those in the cheese industry with timely, science-based information to help them innovate to reduce GHG emissions and energy demand from gate to plate. The study provided a benchmark for cheese manufacturers to measure the industry's progress toward achieving its voluntary reduction goal and compare it to a 2009 average.

The Innovation Center for U.S. Dairy chose the Applied Sustainability Center at the University of Arkansas to conduct the LCA for cheese and whey. The study was led by principal investigator Greg Thoma, Ph.D.

This summary focuses on GHG emissions and energy use. The additional study components of water use and other impacts use are now under review and will be released later in 2012.

LCA Methods

The *Comprehensive Life Cycle Assessment for Cheese and Whey Products* study followed the International Organization for Standardization (ISO) protocols for credibility, transparency and objectivity of methods, data and results.

A third-party review is required by ISO standards. The ISO review process parallels the LCA study and includes three steps: 1. Goal and scope definition; 2. Data collection; and 3. Calculation and interpretation. The ISO review panel included: Manuele Margni, Ph.D.,

Interuniversity Research Centre for the Life Cycle of Products, Processes and Services, Ecole Polytechnique de Montréal; Moshe Rosenberg, D.Sc., Professor and Specialist, Dairy Technology and Engineering Department of Food Science and Technology, University of California, Davis; and Ulf Sonesson, Ph.D., Vice Director, Sustainable Food Production SIK - The Swedish Institute for Food and Biotechnology.

An industry review consisted of a presentation of the LCA results to the Sustainability Council and a one-on-one examination of data with the researchers. An academic review and an NGO review of the findings also were part of the study process.

Researchers chose to study the carbon footprint of two varieties of natural cheese: mozzarella and Cheddar. Cheddar and mozzarella cheese are the most frequently enjoyed cheeses in the U.S., together accounting for two-thirds of per capita consumption.

Researchers followed the entire journey of each natural mozzarella and Cheddar cheese and whey (on a dry weight basis), from the beginning of the life cycle when feed crops are grown to the disposal of the cheese package by the consumer. The farm-to-table chain was divided into nine stages: feed production, milk production, delivery to processor, processing/cheese manufacturing, packaging, distribution, retail, consumption and disposal, as shown in Figure 2. Each of those stages were analyzed separately and later combined to provide a total footprint analysis.

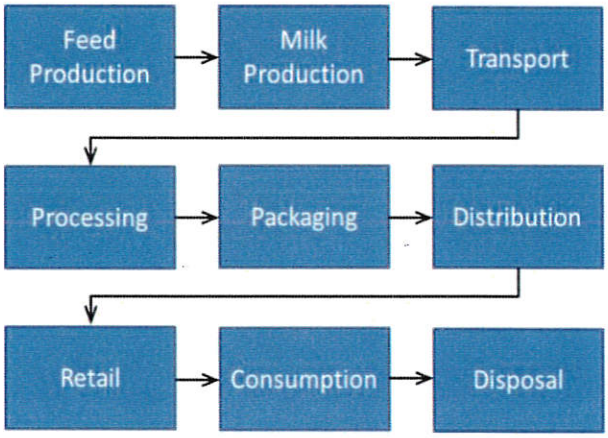


Figure 2. Cheese production and supply system.

Researchers collected data from ten Cheddar manufacturing locations (representing 38 percent of annual U.S. Cheddar production) and six mozzarella production facilities (representing 24 percent of annual U.S. mozzarella production). At each facility, data were collected on the purchase of materials and energy, the production of cheese and other products, and emissions, including solid and liquid waste streams. Results from the 2009 fluid milk LCA were used as background for the milk production step in the manufacture of cheese and whey products.

The study assessed the relative climate change contributions of Cheddar and mozzarella cheese across life cycle stages. Post-farm gate GHG emissions for dry whey production were

also evaluated. A detailed breakdown of the sources of GHG in the Cheddar and mozzarella life cycle *after* the farm gate was also derived.

Researchers used *SimaPro 7.3* as the primary modeling software, along with an *EcoInvent* database that showed "upstream" burdens associated with materials like primary fuels and plant chemicals.

GHG and Energy Use Findings

According to this study, the total carbon footprint from the cheese sector is approximately 54 million metric tons (MMT) of CO_2e, or 0.7 percent of the total GHG emissions in the U.S. The cumulative energy demand from the entire cheese sector is 0.3 percent of total U.S. energy consumption. These are field to customer gate estimates and, therefore, do not include retail or consumption impacts.

As shown in Table 1 the average carbon footprint of cheddar cheese is 8.7 kg of CO_2e per kg of cheese. In comparative context, consuming one kilogram of cheddar cheese contributes GHG emissions equivalent to driving 24 miles in an average fuel-efficient car.

	Carbon Footprint kg CO_2 eq per kg consumed (95% confidence band)	**Cumulative Energy Demand MJ/ kg consumed (95% confidence band)**
Cheddar cheese (dry basis)	13.8 (9.5 – 19.7)	77.7 (46.7 – 166)
Cheddar cheese (36.8% moisture)	8.7 (6.0 – 12.5)	51.1 (30.3 – 111)
Mozzarella cheese (dry basis)	14.6 (10.4 – 20.5)	91.1 (53.6 – 202)
Mozzarella cheese (48.6% moisture)	7.5 (5.3 – 10.7)	46.0 (27.6 – 97.7)
Average natural cheese (dry basis)	14.1	82.5
Average natural cheese (assumed moisture basis)	8.3	49.3
Dry whey (dry basis) [field to customer]	12.4 (9.3 – 16.3)	59.4 (40.6 – 90.4)
Wet whey (dry basis) [field to customer]	10.2	45.3

Table 1. Summary product footprint results for cheese and whey

The average carbon footprint of mozzarella cheese is 7.5 kg of CO_2e per kg of cheese. The carbon footprint of dry whey is 12.4 kg of CO_2e per kg (dry basis), while the impact of wet

whey is 10.2 kg of CO_2e per kg (dry basis). (Note: The whey life cycle does not include impacts from the retail and consumption stages.).

As for the footprint itself, the production of milk used in cheese comprises most of the GHG emissions associated with cheese production.

Hence, evaluating the cheese life cycle *after* the point of milk production is helpful in indentifying ways in which cheesemakers can best innovate to reduce their GHG emissions.

The study suggests that most of the GHG emissions in cheese production (excluding milk production) are energy related, such as CO_2 emissions due to electricity production or the use of fossil fuels in heating or transportation.

Meanwhile, a majority of the energy demand in the production of dry whey stems from electricity and natural gas used for the concentration and drying of whey solids.

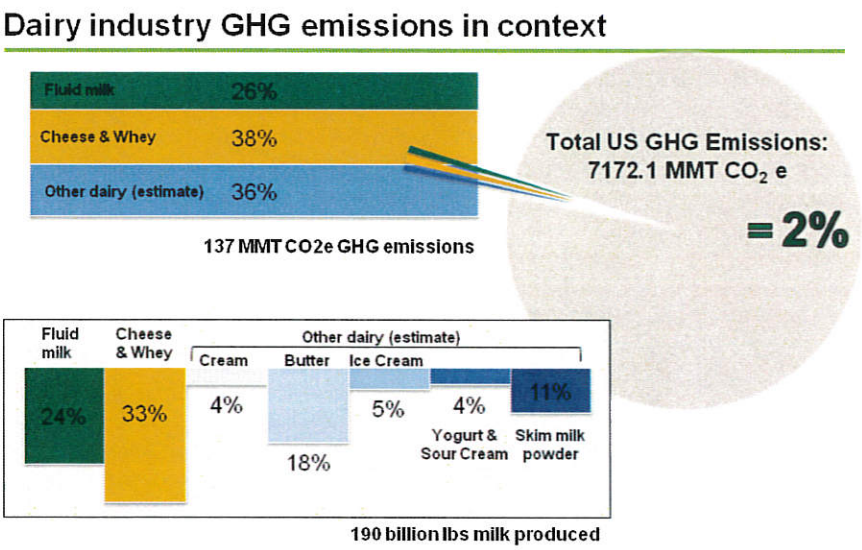


Figure 3. dairy industry GHG emissions in context

From a big picture standpoint, as shown in Figure 3, cheese and whey comprise 38 percent of GHG emissions in the dairy industry, compared with 26 percent for fluid milk and 35 percent for other dairy products combined. Currently, the dairy industry accounts for approximately 2 percent of the total GHG emissions (those from all sources, not just agricultural sources) in the United States.

Energy use and water use findings from the LCA study will be reported later in 2012 and will provide additional insight into the entire impact of cheese and whey production.

Variability

This work is intended to provide a benchmark for the industry to assess future improvements in environmental performance. Public statements by individual brand owners regarding the footprint of cheese or whey alone should be made cautiously, since results are very sensitive to the allocation between cheese and whey processes in a given processing facility.

Conclusions

This GHG and energy demand LCA for cheese and whey was intended to provide a benchmark for the industry to assess future improvement in environmental performance. Based on the results of the study, cheese manufacturers can reduce their respective GHG emissions and increase their energy efficiency by addressing the largest contributors under their direct control.

Cheese manufacturers may also consider a formal energy management program, such as a program supported by the U.S. Environmental Protection Agency's ENERGY STAR program and their ENERGY STAR Focus on Energy Efficiency in Dairy Processing and/or the U.S. Department of Energy's Save Energy Now program.

The Innovation Center for U.S. Dairy has established additional projects, such as Dairy Plant Smart™, to explore options within the cheese and whey sector to identify and develop optimal configurations to improve the sustainability of the category as well as the overall industry. Multiple sustainability projects are under way in areas such as nutrient management practices, feeding rations, manure management, energy efficiency, improved packaging formats, new processing technologies and fuel efficiency.

Public Comment Form

Cascade County Public Works Department Planning Division
121 4th St N, Suite 2H-2I Great Falls, MT 59401
Phone: 406-454-6905 | Fax: 406-454-6919
Email: planningcomments@cascadecountymt.gov

Instructions

This form is for providing public comment to the Cascade County Planning Division for review by any one or more of the following review and/or approval boards: Zoning Board of Adjustment (ZBOA), Planning Board, or Board of County Commissioners. Only complete submissions will be included for board review. Please provide the relevant information for each section below. A complete submission provides all of the following: commenter name and address, comment subject, and commentary on the subject issue(s). If additional space is needed for commentary, please attach additional sheets to this form. Completed forms may be submitted in person at the Planning Division office or by email at planningcomments@cascadecountymt.gov.

Commenter Information

Name: Carolyn K. Craven

Complete Address: 101 14th Avenue South, Great Falls MT 59405

Comment Subject (please check one):

- ☐ Special Use Permit Application
- ☐ Subdivision
- ■ Zoning Text and/or Map Amendment
- ■ Growth Policy
- ☐ Variance
- ☐ Floodplain Regulation Amendment
- ☐ Subdivision Regulation Amendment
- ☐ County Road Abandonment/ Discontinuation of County Street
- ■ Other (describe): Big Sky Cheese

Comment

06.19.19 Cascade County & City of Great Falls
06.19.19 New & Revised Definitions
06.20.19 Special Use Permit
06.20.19 Commercial Dairy Zoning
06.22.19 Carbon Footprint of Cheese Production ZBOA
06.25.19 Highlights MT Milk Study ZBOA
06.26.19 Waste Management Issues for Dairy Processors ZBOA
06.26.19 Big Sky Cheese Recommendations ZBOA
06.26.19 Public Participation ZBOA

For Office Use Only					
Date Received:	6/26/2019	Date Reviewed:	6/27/2019	Complete:	☒ Yes ☐ No

Carolyn K. Craven
101 14th Avenue South
Great Falls, MT 59405

June 26, 2019

PUBLIC COMMENTS ZBOA

MFP BIG SKY CHEESE SUP
PUBLIC PARTICIPATION

I respectfully request that the ZBOA table voting on the Big Sky Cheese SUP on June 27 so that the applicant can obtain required permits and reviews from relevant agencies. That will then allow for a public comment period and public hearing to allow questions on the permits and reviews required for this proposed project.

THANK YOU FOR YOUR CONSIDERATION

MT CONSTITUTION 1972
ARTICLE II DECLARATION OF RIGHTS
Section 8. RIGHT OF PARTICIPATION
The public has the right to expect governmental agencies to afford such reasonable opportunity for citizen participation in the operation of the agencies prior to the final decision as may be provided by law. Public has a right to know and review all documents that are part of the decision-making process."

Respectfully submitted,

Carolyn K. Craven
101 14th Avenue South
Great Falls, MT 5940

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06.26.19 Life Cycle Assessment of Cheese & Whey ZBOA
06.26.19 Treatment of Dairy Wastewater ZBOA

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review

General Characteristics and Treatment Possibilities of Dairy Wastewater – A Review

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Summary

The milk processing industry is one of the world's staple industries, thus the treatment possibilities of dairy effluents have been attracting more and more attention. The purpose of the paper is to review contemporary research on dairy wastewater. The origin, categories, as well as liquid by-products and general indicators of real dairy wastewater are described. Different procedures applied for dairy wastewater management are summarised. Attention is focused on in-factory treatment technologies with the emphasis on biological processes. Aerobic and anaerobic methods with both their advantages and disadvantages are discussed in detail. Consecutive anaerobic and aerobic systems are analysed, too. Finally, future research niches are identified.

Key words: dairy wastewater, wastewater composition, whey, biological treatment

Introduction

The dairy industry includes the transformation of raw milk into pasteurised and sour milk, yoghurt, hard, soft and cottage cheese, cream and butter products, ice cream, milk and whey powders, lactose, condensed milk, as well as various types of desserts (*1–6*). The general distinctions among these foods are due to the reuse of non-fat milk and whey (a by-product in cheese manufacturing) and the evaporation of the free water from the coagulum as well as from milk and whey powders (*5*). With the rapid industrialisation observed in the last century (*4*) and the growing rate of milk production (around 2.8 % per annum), dairy processing is usually considered the largest industrial food wastewater source, especially in Europe (*1–3,7*). Moreover, in around 50 % of the world's whey production, especially concerning acid whey, it is untreated prior to disposal (*8–10*). The effluents originating from various production technologies are not discharged simultaneously, thus forming a stream with wide qualitative and quantitative variations (*4*). Notwithstanding the differences in composition, attributable to the manufactured product and technological operations (*11,12*), dairy effluents are distinguished by their relatively increased temperature, high organic content (*13–15*) and a wide pH range, which requires special purification in order to eliminate or reduce environmental damage (*1*). Treatments of dairy wastewaters include the application of mechanical, physicochemical and biological methods. Mechanical treatment is necessary to equalise volumetric and mass flow changes. It also reduces parts of the suspended solids. Physicochemical processes are effective in the removal of emulsified compounds, but reagent addition increases water treatment costs. Another disadvantage is the very low elimination of soluble chemical oxygen demand (COD). Therefore, biological wastewater treatment systems are preferred due to the highly biodegradable contaminants (*7,11,16,17*).

The purpose of the paper is to review the data on the basic composition and treatment possibilities of milk-processing effluents. Their origin and major characteristics are summarised. Various methods for wastewater utilisation are discussed. Finally, suggestions for future research are made.

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Dairy Wastewater Characteristics

Wastewater volume

Water plays a key role in milk processing. It is used in every step of the technological lines, including cleaning and washing, disinfection, heating and cooling. Water requirements are huge (*14*).

The bulk of wastewater comes from manufacturing processes (*6*). Contaminated water, including sanitary activities, reaches 50–80 % of the total water consumed in the dairy factory, whereas the remaining 20–50 % is conditionally clean (*6,18*). It has been estimated that the amount of wastewater is approx. 2.5 times higher than that of processed milk in units of volume. The amount and characteristics of the wastewater depend largely on the factory size, applied technology, effectiveness and complexity of clean-in-place (CIP) methods, good manufacture practices (GMP), *etc.* (*3,4*). However, the introduction of GMP can reduce the world's wastewater mean volume from 0.5–37 to 0.5–2 m^3 of effluent per m^3 of processed milk (*3,19*). Nowadays, the designed volumetric load is 1 m^3 of effluent per tonne of manufactured milk (*4*).

In dairy plants, the great fluctuations in wastewater quality and quantity are very problematic because each milk product needs a separate technological line (*1,5*). This results in the change of dairy effluent composition with the start of a new cycle in the manufacturing process, which impedes the work of in-factory wastewater treatment plants. Furthermore, intensive effluent volumetric variations in time are commonly observed. Daily and hourly changes are the consequence of washing the equipment and floors as the final step in every process cycle. Seasonal variations can be attributed to a higher dairy plant load in summer than in winter (*20*). One way of explaining hourly homogeneity is by coefficients in the range of 1.4–2.0 (*6*). The diurnal inequality coefficient depends on the seasonal character of dairy processing, varying from 1.5 for 2- and 3-shift work in summer to 2.6 for winter shifts. The actual concentration of polluting dairy effluents varies widely depending on the profile and capacity of the company, the production technology, the type of equipment used, the degree of wastewater reuse, the loss of raw materials, waste management, *etc.* (*1,18*). A major factor in the volumetric loading of dairy wastewater treatment plants are the immediate discharges produced in the cleaning of tank trucks, pipelines or equipment at the end of each cycle. In such cases, the effluent volumes are higher than those of manufactured milk (*4,21*). On average, wastewater discharge is 70 % of the amount of the fresh water used at the plant (*6*).

Dairy processing effluents mostly include milk or milk products lost in the technological cycles (spilled milk, spoiled milk, skimmed milk and curd pieces); starter cultures used in manufacturing; by-products of processing operations (whey, milk and whey permeates); contaminants from the washing of milk trucks, tanks, cans, equipment, bottles and floors; reagents applied in CIP procedures, cooling of milk and milk products, for sanitary needs, in equipment damage or operational problems; and various additives introduced in manufacturing (*13,18,22,23*). Milk loss in wastewater is around 0.5–2.5 % of processed milk, but it can increase to 3–4 % (*20*).

Wastewater categories

The wide variety of dairy products presupposes the existence of many wastewater types. However, three major categories can be outlined according to their origin and composition (*1*), explained in the following chapters.

Processing water

Processing water is formed in the cooling of milk in special coolers and condensers, as well as condensates from the evaporation of milk or whey. Milk and whey drying produces vapours which form the cleanest effluent after condensation although it may contain volatile substances as well as milk or whey droplets from evaporators (*6*). In general, processing waters lack pollutants and, after minimal pretreatment, they can be reused or discharged together with stormwater (*1*). Water reusage is possible for installations that are not in direct contact with derived products. Typical applications include hot water and steam production as well as membrane cleaning. The water from the cooling of products during pasteurisation after the last rinse of bottles and condensates generated in vacuum installations from secondary vapours can be utilised for room cleaning, lawn irrigation, *etc.* (*6,18*).

Cleaning wastewater

Cleaning wastewater usually comes from washing equipment which is in direct contact with milk or dairy products. It also includes milk and product spillage, whey, pressing and brine, CIP effluents or equipment malfunction and even operational errors. Over 90 % of organic solids in effluents come from milk and manufacturing residues: cheese pieces, whey, cream, water from separation and clarification, starter cultures, yoghurt, fruit concentrates or stabilisers. These effluents are in large quantities and are highly polluted, thus requiring further treatment.

Sanitary wastewater

Sanitary wastewater is found in lavatories, shower rooms, *etc.* Sanitary wastewater is similar in composition to municipal wastewater and is generally piped directly to sewage works (*1,6,21*). It can be used as nitrogen source for unbalanced dairy effluents before a secondary aerobic treatment (*1,12*).

Additionally, the by-products of manufacturing processes, such as whey, milk and whey permeates, can also be grouped separately if they are collected individually from other wastewater streams (*12,24,25*).

The main pollutant in milk processing wastewater is whey due to its high organic and volumetric load. It represents about 85–95 % of the milk volume and 55 % of the milk components. Whey consists of carbohydrates (4–5 %), mostly lactose. Proteins and lactic acid amount to less than 1 %, fats to around 0.4–0.5 %, while salts vary from 1 to 3 % (*2,15,26*). Whey is produced mainly in cheese manufacturing, and its volume depends on the productivity of cheese and the type of processed milk – bovine, goat, sheep, *etc.* (*2,9,27*). On the basis of milk casein coagulation

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procedures, whey can be categorised as cheese whey and second cheese whey. Cheese whey is a by-product in the production of hard, semi-hard and soft cheese, after the addition of rennin to milk. Mild enzyme action produces sweet whey with a pH=6–7 (*2,28*). Second cheese whey is a by-product in cottage cheese production after milk has been fermented, or curdled, with organic or mineral acids. Due to strong acid conditions, whey develops an acidic taste, while the average pH value rarely exceeds 5. Scientific literature also discusses casein whey whose composition is very close to that of second cheese whey (*2*). Sweet and acid whey also differ in mineral and protein content (*9,29*).

During cheese manufacturing, cheese whey wastewater is produced as well. Its volume and composition change with respect to the type of produced cheese, the applied technology, the milk type and the environment. Cheese whey wastewater originates in the addition of surplus cheese whey and second cheese whey to washing effluents. Nevertheless, its contamination level is lower than that of cheese whey (*2,30*).

Cheese whey waste streams are valuable sources of different compounds (protein, lactose, mineral elements) and are utilised in the manufacture of various products, such as lactic acid, single-cell protein, baker's yeast, starter cultures, fermented whey drinks, enzymes, antibiotics, organic acids, vitamins, food gums, *etc*. Nevertheless, it should be taken into account that whey or whey product recovery results in new waste streams which also need to be treated although such effluents are less polluted than whey and their organic loading is comparable to other dairy wastewater (*4,9,31,32*).

Milk and whey permeates are by-products in cheese manufacturing; they are produced during milk and whey ultrafiltration, respectively. Their solid content is lower; they are rich in soluble compounds, over 80 % of which is lactose (*24,25,33*).

Dairy wastewater consists of complex constituents (*11,34*). Knowing the composition of milk and milk products, we can estimate better the wastewater contaminant loading (Table 1) (*22*). Although milk manufacturing produces waste streams analogous to milk and dairy product loss, every process gives an effluent unique in volume and composition (*4*).

Dairy wastewater volumetric and flow rates (depending on the production capacity and work shifts), as well as pH and total suspended solids (TSS) content (as a consequence of applied CIP methods) affect the efficiency of wastewater treatment management (*1*). It is important to know the quantity of the milk to be pasteurised, how much milk is processed into cheese and whether the entire obtained whey is discharged in wastewater or part of it is processed and reused (*6*). Contaminant concentrations in wastewater can be determined by using Eq. 1:

$$C=(L_1 \cdot C_1+L_2 \cdot C_2+\ldots+L_n \cdot C_n)/(N_1+N_2+\ldots+N_n) \qquad /1/$$

where C is contaminant concentration in wastewater (g/m^3), L is the loss of milk and milk products in different technological production cycles expressed in proportional units (m^3 or t), C_1, C_2 and C_n are contaminant concentration per unit of milk or milk product loss (g/t), and N_1, N_2 and N_n are wastewater discharge per unit of milk or generated milk products (m^3/t) (*18*).

Dairy wastewater composition

Milk processing effluents have an increased temperature and large variations in pH, TSS, biological oxygen demand (BOD), COD, total nitrogen (TN), total phosphorus (TP) and fat, oil and grease (FOG) (*1,3,7,13,15,35*). There is little information on industrial-scale dairy effluent composition (*1,11*). The information on the general characteristics of dairy wastewater is shown in Table 2.

Typically, dairy wastewater is white in colour (whey is yellowish-green) and has an unpleasant odour and turbid character (*2,12,36*).

With annual temperatures of 17–25 °C, dairy waste streams are warmer than municipal wastewater (10–20 °C), which results in faster biological degradation compared to sewage treatment plants (*37*). The average temperatures of industrial dairy effluents range from 17–18 °C in winter and 22–25 °C in summer (*6*). Using the Arrhenius equation, the biodegradation rates and oxygen consumption can be predicted to be 1.5 times higher in summer than in winter (*37*). The design winter temperature of 15 °C is adopted for this type of wastewater due to the utilisation of hot water for washing and cleaning of equipment (*6,18*).

Table 1. Composition of different milk products

Product	*w*(dry matter) / %	*w*(fat) / %	*w*(protein) / %	*w*(lactose) / %	COD / g/kg	BOD_u / g/kg	Reference
Whole milk	11.5–12.5	3–4	3.3	4.8	192.9–218.6	135.5–156.2	(*18*)
Skimmed milk	8.3–8.47	0.02–0.06	3.3	4.7–4.9	112–115.3	72.4–75.1	(*18*)
Buttermilk	7.7–8	0.4–0.86	3	4	104.5–111.9	72.4–75.1	(*18*)
Cheese whey	6–6.2	0.05–0.2	0.75–1.0	4.5–4.8	72–77	51.6–55.9	(*9,18*)
Second cheese whey	5.7	< 0.01	0.3	4.6	–	–	(*9*)
Casein whey	6.1	<0.01	0.5	4.7	–	–	(*9*)
Cream	40.4–43	33–35	2	3	871–936.5	695–747	(*18*)
Dried whey permeate	95.2	–	5.9 (as N)	83	1034.3	–	(*25*)
Delactosed permeate	23.5–25	–	2.6–3.7	14–16	–	–	(*9*)

COD=chemical oxygen demand, BOD_u=ultimate biological oxygen demand

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Table 2. Composition of milk processing effluents

Milk processing effluent	Active reaction (pH)	γ/(g/L)								Reference
		BOD_5	COD	FOG	TS	TSS	TN	TP	Alkalinity as $CaCO_3$	
Mixed dairy	4–11	0.24–5.9	0.5–10.4	0.02–1.92	0.71–7	0.06–5.80	0.01–0.66	0–0.6	0.32–1.2	(*1,3–7,9,11,13,14, 17,18,20,22,23,35*)
Milk reception	7.18	0.8	2.54	1.06	–	0.65	–	–	–	(*20*)
Dairy/sewage=7:3	9.1±6.7	1.08–2.81	2.04–4.73	0.24–0.29	–	0.53–1.13	–	0.02–0.03	–	(*13*)
Fluid milk	5–9.5	0.5–1.3	0.95–2.4	–	–	0.09–0.45	–	–	–	(*11*)
Yoghurt	4.53	–	6.5	–	–	–	–	–	–	(*16*)
Butter	12.08	0.22–2.65	8.93	2.88	–	0.7–5.07	–	–	–	(*6,20*)
Ice cream	5.1–6.96	2.45	5.2	–	3.9	3.1	–	0.014	0.22	(*3,25*)
Cheese	3.38–9.5	0.59–5	1–63.3	0.33–2.6	1.92–53.2	0.19–2.5	0.018–0.83	0.005–0.28	–	(*1,6,11,18,20,23*)
Cottage cheese	7.83	2.6	17.65	0.95	–	3.38	–	–	–	(*20*)
Cheese whey	3.92–6.5	27–60	50–102.1	0.9–14	55–70.9	1.27–22.15	0.2–1.76	0.12–0.53	–	(*2,8,10,11,22,23,26, 27*)
Hard cheese whey	5.8	9.48	73.45	0.99	–	7.15	–	–	–	(*20*)
Soft cheese whey	5.35	26.77	58.55	0.49	–	8.31	–	–	–	(*20*)
Cottage cheese whey	4.5	–	79	–	68	–	2	–	–	(*2*)
Cheese whey wastewater	4.6	35	–	0.8	–	–	–	0.64	–	(*1*)
Whey processing effluent	5–9	0.59–1.21	1.07–2.18	–	–	0.08–0.44	–	–	–	(*33*)
Milk permeate	5.55–6.52	–	52.94–57.46	–	11.61–15.39	1.94–3.4	0.3–0.4	0.35–0.45	2.5	(*3,15,24*)
Condensate	8.3	–	–	–	–	–	0.0006	0.0001	–	(*23*)
Washing wastewater	10.37	3.47	14.64	3.11	–	3.82	–	–	–	(*20*)

BOD_5=biological oxygen demand for 5 days, COD=chemical oxygen demand, FOG=fat, oil and grease, TS=total solids, TSS=total suspended solids, TN=total nitrogen, TP=total phosphorus

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A crucial requirement for biological treatment of dairy wastewater is their pH value between 6 and 9 (*37*). Milk and butter factories have effluents with active reaction close to neutral (pH=6.8–7.4). In plants where a certain amount of whey is discharged, the pH of the effluent is reduced to below 6.2. In cheese manufacturing, sweet whey is slightly acidic, with pH=5.9–6.6, while mineral acid coagulation gives an acidic whey with pH=4.3–4.6 (*6,27*). The sharp increase in the short-term pH of the total flow of up to 10–10.5 is attributable to the discharge of alkaline cleaning solutions. The prolonged exposure of wastewater to anaerobic conditions (in the sewer network with sumps) causes liquid acidification by lactic acid fermentation that leads to a decrease in pH (*18*).

Although dairy wastewaters have low concentrations of settleable solids, they may clog sewage pipes. Most of the suspension enters the initial stage of equipment cleaning. The bulk of the sediment (90 %) of organic matter is usually of protein origin, namely particles of solid milk processing (pieces of cheese, coagulated milk, cheese, curd fines, milk film or flavouring agents, *etc.*) and other impurities (soil or sand) that get into the sewage system during equipment washing or packaging (*12,18*). Formation of protein and fat deposits on the inside of the pipes requires periodic cleaning with appropriate chemical or bacterial preparations. The main advantage in the application of such bacteria is that they continue acting in the next stages of wastewater treatment, increasing the purification effect (*38*). The highest amount of total solids (TS) has been reported in whey, with negligible amount of volatiles (*3*). Fats in dairy industry effluents are found in trace amounts in the form of emulsions with a droplet diameter of 1–10 μm (*6*). During homogenisation, the size of milk fat globules is reduced to 1–2 μm. The obtained stable emulsion, when passing into dairy effluents, affects the mechanical wastewater treatment system due to its difficult separation (*4*). Thus, fats remaining in cheese whey wastewater can produce an undesired flotation, which results in the washout of active sludge during biological processes (*2*). In the production of high-fat products (cream, sour cream and butter), larger fat globules are extracted from the milk, due to their coalescence and enlargement, as well as the degradation of the protein shell. That is why fat impurities in the wastewater from these productions are significantly different in type and concentration and their elimination by settling is more efficient than in other dairy effluents. The FOG concentration in the wastewater from dairy plants specialised in the production of high-fat products is 0.2–0.4 g/L although higher values (up to 2.88 g/L in a butter factory have been reported) (*18*). In the wastewater from other dairy plants, it usually does not exceed 0.1 g/L (*18*).

Due to their high organic content, represented mainly by rapidly assimilable carbohydrates and slowly degradable proteins (*20*) and lipids, dairy wastewater is characterised by high BOD and COD values varying from 0.1 to 100 g/L (*3,11,27,39*). It is known that there is a direct relationship between the ultimate 20-day BOD (BOD_u) and COD values in dairy wastewater, as shown in Eq. 2:

$$BOD_u=(0.80–0.84)\cdot COD \qquad /2/$$

It should be taken into account that such a logical connection cannot be made between a 5-day BOD (BOD_5) and BOD_u, and between BOD_5 and COD. Therefore, BOD_5 value of dairy waste streams is not an objective indicator of organic pollution (*18*). Nevertheless, many authors use the BOD_5 value of dairy wastewater in the BOD_5/COD ratio. For dairy effluents this ratio varies between 0.4 and 0.8 (*10,12,20,24*). However, it should be determined separately in every particular case (*40*) and, since dairy wastewater is industrial, the BOD analysis should be conducted with selected microbial consortia, instead of traditional seeding material in order to achieve reliable results (*41*).

The highest whey COD and BOD_5 concentrations have been reported to be between 60–80 and 30–50 g/L, respectively. About 90 % of BOD and COD loading is caused by lactose, while protein removal contributes to only around 12 % of the whey COD reduction. High lactose solubility increases soluble COD part, which is removed mostly by biological units. Like whey, milk and whey permeates have high COD load because they are rich in lactose, which excludes the possibility for a direct discharge in water bodies (*15,24*). Cheese whey wastewater also has increased concentrations of organic matter, the values varying significantly: 0.8–77 g/L of COD and 0.6–16 g/L of BOD_5. The lower lactose concentration reported is due to the fermentation in anaerobic conditions that leads to a lower initial pH and casein precipitation and odour production from the obtained butyric acid (*2*).

The time-consuming BOD analysis requires the application of faster methods that determine aerobically digestible organic matter in dairy wastewater. Many authors show that COD fractionation combined with the calculation of respirometric oxygen uptake rate is a good alternative method for the determination of wastewater biodegradability (*42–44*). However, results were obtained only for mixed dairy wastewater (*45–47*), while the information on single manufacturing processes is insufficient (*48*). Total organic carbon (TOC) calculation also includes organic carbonaceous fractions. It gives immediate results and can be used for online measurements. However, the TOC-BOD relationship should be estimated first (*49*). There is no available scientific data for the online TOC application or the TOC-BOD relationship in dairy wastewater treatment.

Every milk effluent has notably different TN and TP concentrations (*3*). Nitrogen exists mainly in the form of amino groups from milk proteins. Other nitrogenous compounds are also detected: urea, uric acids, and NH_4^+, NO_2^- and NO_3^- ions (*11,27*). Small quantities of nitrogen ammonium salts originating from ammonia compressors can also be found (*18*). Phosphorus compounds are mostly inorganic, phosphate (PO_4^{3-}) and diphosphate ($P_2O_7^{4-}$), but they can also be present in organic form (*11*). Total nitrogen content in the wastewater from urban dairies, dairy and butter plants is 4.2–6 % and that from cheese factories 3.7 % of the BOD_5. The phosphorus concentration is in the 0.6–0.7 % range of the BOD_5. The reported TN and TP values demonstrate an increased eutrophication risk in water receivers. Their concentrations are sufficient for normal biological treatment processes and the respective growth of bacteria involved in the oxidation of dairy wastewater impurities. However, cheese effluents lack in nitrogen for proper aerobic biological treatment due to the following C/N/P ratio of approx. 200:3.5:1 but can easily be treated anaerobically (*50*). During biological

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treatment of cheese factory wastewater, nitrification is less intense than in other dairy industry wastewater treatment facilities because of the lower BOD_5/N ratio (*2,12,18*).

Dairy effluents are characterised by very low alkalinity (approx. 2.5 g/L expressed as $CaCO_3$ in milk permeate), thus bringing about a potential for rapid acidification and increased reagent costs for pH maintenance during purification (*15,24*).

The high salinity of industrial dairy effluents causes a non-volatile suspended solid content increase in the primary and secondary sludge. Inorganic impurities in dairy wastewater are represented by Na^+, K^+, Ca^{2+} and Cl^- ions, with their highest amounts in cheese and cottage cheese production (0.46–10 %), mostly NaCl and KCl (>50 %) as well as $Ca_3(PO_4)_2$, where salt is added in advance. Increased Na^+ amounts indicate the application of alkaline cleaning agents in milk factories. The amount of Ca^{2+} in acidic whey is twice as high as that in sweet whey (*2,12*). The presence of chlorides in dairy wastewater is due to the addition of salt in the production of brine and cooling liquors, and the Cl^- concentration in fresh water and milk. Cl^- concentration in dairy wastewater reaches 0.8–1 g/L but the average value range is 0.15–0.2 g/L.

The additional wastewater pollution due to the used cleaning solutions, additives and other products which enter the drainage pipes should be taken into account (*4,18*). CIP methods produce wastewater streams at 12- or 24-hour time intervals, while sanitisers are used if the dairy factory has been shut down for more than 96 h. Thus, wastewater pH will change widely depending on the cleaning program applied (*23*). Different chemical solutions can be used in accordance with the installation type, water hardness, *etc.* (*4*). The cleaning agents applied in CIP procedures affect principally the effluent pH (mineral and organic acids), contributing less than 10 % to BOD_5 and COD loading and increasing amounts of water for cleaning and disinfection (up to 30 % of total water flow rate). Most of the applied chemicals are very toxic to microorganisms in secondary treatment units. NaOH and HCl increase the mineral scale (*1*), while HNO_3, quaternary ammonium surfactants, and detergents containing H_3PO_4 and P influence TN and TP loading, which leads to an accelerated eutrophication of the environment if not treated properly (*6*). Due to the above-mentioned environmental problems, the trend is to apply more HNO_3 instead of the less desirable H_3PO_4 although the latter is a better cleaner the application of which will not be reduced in the future. The cleaning solutions utilised in CIP procedures are hot (64–82 °C), which causes a temperature increase in the resulting effluents (*4*). Strong oxidants or bleaches (NaOCl and ClO_2) are applied for sanitising installations. Cl-containing bleaching agents can produce dangerous organochlorides which pollute dairy effluents. Enzymes as well as surfactants are the chemicals preferred for cool surface cleaning and cause fewer negative environmental problems (*6*). In minor doses, the following substances can also be found: NH_3, Na_3PO_4, HCl, $HOCH_2COOH$, Na_2SiO_3, hydraulic oil, propylene glycol, emulsifiers, antifoaming agents, sodium azide and chloramphenicol (*4,51*).

Dairy Wastewater Treatment

Dairy manufacturing has a strong impact on the environment, producing large volumes of wastewater with high organic and nutrient loading and extreme pH variations. This requires the application of effective and cheap wastewater treatment procedures which ensure fresh water preservation (*1,4*). There are various dairy effluent treatment strategies (Fig. 1), which are described in the following paragraphs.

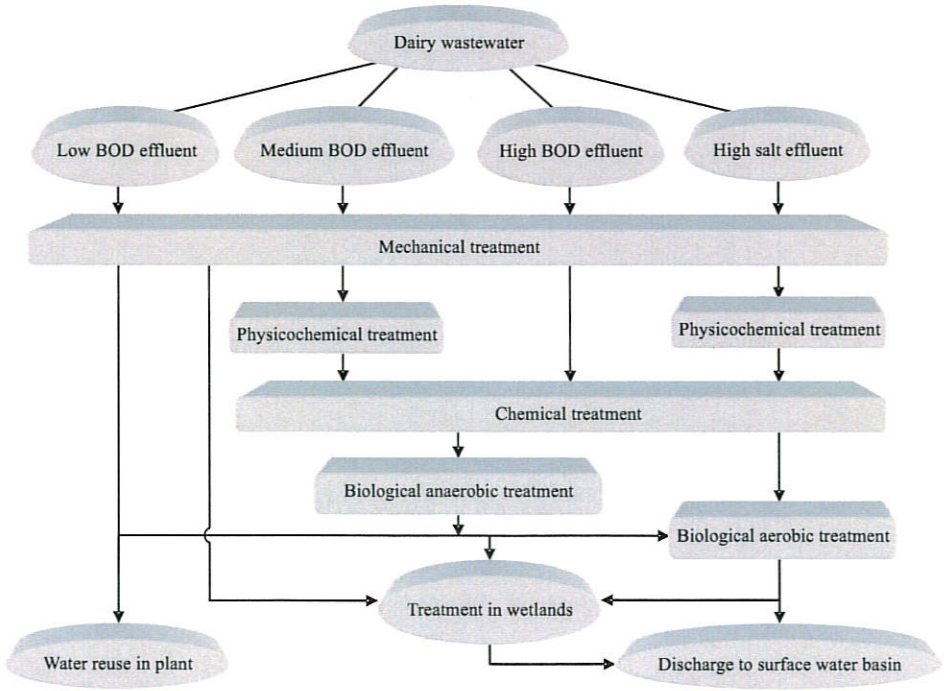

Fig. 1. Dairy wastewater treatment options, adapted from (*19*)

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Discharge in nature without treatment

It is not recommended that raw dairy wastewater be discharged directly into water bodies because this would lead to different pollution problems, including rapid dissolved O_2 depletion due to the high organic loading, which results in anaerobic conditions, the release of volatile toxic substances, aquatic life destruction and subsequent environmental damage. Higher water temperatures decrease O_2 solubility and increase biota sensitivity (*1*).

Treatment in wetlands

Wetland systems use natural processes that include self-supported microbial communities to improve wastewater treatment (*52*). The simple construction and the lack of sludge recycling make them preferable for dairy effluent utilisation in developing communities (*52,53*). The main drawbacks of their application include the need for a large surface area, the potential risks for surface and groundwater pollution, the presence of dangerous volatile substances and the presence of insects. The easy exploitation of the systems counteracts with the complexity of the biological processes, which exceeds that of other treatment systems applied in wastewater purification. Also problematic is the generation of Fe^{3+}, Mn^{3+} and Ca^{2+} ions. They precipitate and reduce bed permeability with time. As a result, anaerobic conditions prevail and the NH_3 removal is limited (*1*).

Generally, dairy wastewater is treated in wetlands under aerobic conditions. Five days are enough for an 85 % BOD_5 reduction in aerobic ponds with milk wastes at 20 °C, while high-load dairy wastewater is treated mostly in facultative wetlands (*1*). In a butyl-covered lagoon, processing effluent was biodegraded at 35 °C, with the organic loading rate (OLR), expressed as COD, of 1.5 kg/(m^3·day), neutral pH and a hydraulic retention time (HRT) of 1–2 days. However, a polishing step in aerated pond is necessary to achieve 99 % total COD reduction (*1,4*). A surface-flow wetland was applied to utilise 2.65 m^3/day of milkhouse wastewater with OLR, expressed as BOD_5, of 7.3 g/(m^2·day) (*54*). The results showed high TSS, BOD_5, TP and total Kjeldahl nitrogen (TKN) biodegradation with respective values of 94, 85, 68 and 53 %. Despite the fact that the lagoon produced NH_3, its outflow concentrations gradually declined over time. Most of the nitrogen was stored in biomass, while denitrification had a minor role (<1 %) (*54*). Clarified effluents needed more BOD_5 reduction to meet water discharge standards (*55*). Cheese wastewater with OLR, expressed as COD, of 5.5 kg/(m^3·day) was consistently treated in a grease trap, an upflow anaerobic sludge blanket (UASB) reactor-type pond, aerobic pond and a final wetland with water hyacinth (*56*). A high quality effluent was obtained: BOD_5, COD, TSS, FOG, organic N and total coliforms were reduced by more than 90 %, except for the phosphorus from PO_4^{3-} (with a decrease of only 62 %).

Purification in urban or in-factory wastewater treatment plant

In-plant effluent treatment is the most common strategy for dairy wastewater purification (*1*). Typically, it includes mechanical, physicochemical, chemical and biological methods.

Mechanical treatment

Mechanical treatment removes suspended solids from wastewater. Conventional mechanical procedures reduce insufficiently the organic load because of the low settleable solid concentration in dairy wastewater (*5*). Nevertheless, the faster the wastewater is screened, the better, due to less TSS biodegradation and a low soluble COD increase (*1*).

High variations of dairy effluents can bring about an instability of the subsequent treatment facilities. Adequate equalisation will smooth the fluctuations in the flow, organic loading, pH and temperature, neutralise residual cleaning agents and completely destroy excess oxidisers. In practice, a 24-hour flow pattern at the highest load can be effectively handled by effluent equalisation for at least 6–12 h with a basin dimension from 25 to 50 % of the total effluent volume (*1,6*).

Physicochemical treatment

Physicochemical treatment destroys and reduces milk fat and protein colloids in the dairy wastewater (*4*). FOG removal is a major problem in the plants producing unskimmed milk, in milk and whey separation, cheese and butter production, as well as milk bottling. Skimmed milk production rarely creates such problems.

Animal fat is solid at room temperature due to the high levels of saturated fatty acids in its composition. Milk fat is no exception. This physical state, combined with the low density of the fat allows its easy removal from the surface of wastewater (*6,57*). If the equalisation unit precedes the FOG trap, a temperature drop will heighten the risk of high fat accumulation on the top of the liquid. Otherwise, the equalisation unit must have a sufficient volume to collect the peak effluent flow. In general, flow balancing is followed by FOG removal. Increased wastewater temperatures can reduce fat separation ability (*1,5*). Dissolved air flotation is more effective because it reduces organic loading *via* protein and fat colloid destabilisation with coagulants ($Al_2(SO_4)_3$, $FeCl_3$ and $FeSO_4$) and flocculants. Nevertheless, this method requires expensive, synthetic chemicals which causes environmental problems and removes soluble matter to a lesser extent (*58*). The resulting scum is very hard to dewater and it is not recommended to mix it with activated sludge. Scum must be treated properly before disposal (*1,4*). If inorganic and synthetic chemicals are replaced by biopolymers (carboxymethyl cellulose (CMC) or chitosan), processed sludge can be used as an animal food ingredient (*59,60*).

According to some authors (*60–62*) natural coagulation in dairy wastewater can be achieved with the application of certain lactic acid bacteria. These bacteria ferment soluble lactose to lactic acid, which denatures milk proteins in the wastewater. In combination with CMC, the total COD was reduced by 65–78 %, while reduction of 49–82 % was obtained when chitosan was used (*60*). At an initial 5 g/L of COD, over 0.01 g/L of proteins and 0.7–0.8 g/L of sugars, 75, >90 and 10–25 % of COD were removed, respectively (*61*).

Chemical treatment

Chemical treatment removes mostly colloids and soluble contaminants from milk processing effluents. It in-

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cludes reagent oxidation or pH correction. During cheese wastewater reaction with $FeSO_4$ and H_2O_2, up to 80 % of fat (initial concentration of 1.93 g/L) is removed (*63*). Extreme pH values of dairy wastewater below 6.5 and above 10 can increase the corrosion of pipes and be highly detrimental to microbiological assemblages in biological processes. Therefore, they should be corrected to reduce side effects. If a dissolved air flotation (DAF) unit is used, then the pH control is a necessary step to achieve optimal coagulant conditions (*64*). However, coagulants work best at an acidic pH, which requires a second pH adjustment to a neutral value before biological treatment (*65*). It is very suitable to collect independently used CIP solutions and outflow them constantly during the whole wastewater plant exploitation (*1,4*).

Biological treatment

One of the most reliable methods for dairy effluent purification is biological removal. Such methods can assimilate all dairy wastewater components but they mostly utilise soluble compounds and small colloids. These processes have not been fully studied. Moreover, because of their unlimited adaptation potential, they can be jointly used in various sequences to meet certain component biodegradation requirements (*1,7*). Biological treatment has two main branches depending on oxygen requirements: aerobic and anaerobic processes (*66*).

Aerobic processes. Nowadays, most dairy wastewater treatment plants are aerobic although they have been less efficient, mainly due to filamentous growth and rapid acidification caused by high lactose levels and low water buffer capacity, respectively (*4,12,67*). Problems generally encountered with activated sludge processes are bulking and foaming, which diminish sludge settling, Fe^{3+} and CO_3^{2-} precipitation, additional biomass production as well as poor activity at low temperatures. It takes a few months for the sludge adaptation before full operational capacity is reached. Nitrogen from NH_3 is easily degraded. Phosphorus removal is less effective and relies on environmental conditions. Aerobic bacteria are less useful in colloid utilisation when compared to anaerobic bacteria. The heightened O_2 depletion (>3 kg of O_2 per kg of BOD_5) requires large energy demands during the aerobic treatment of concentrated dairy wastewater (>2 g of COD per L) (*1,4*). Plug flow systems are better than complete-mix processes since they are less sensitive to high organic load problems like bulking sludge, *etc.* (*21*). Commonly, dairy effluent OLR, expressed as BOD_5, should be less than 0.28–0.30 kg/m^3. To enhance biological removal, a proper pretreatment or adequate wastewater dilution should be applied (*1,68*).

Aerobic biological systems give a very positive response during synthetic dairy wastewater treatment with 4 g/L of COD and 1 g/L of TKN at pH=11.5, with over 96 % of degradation being achieved in a continuous mode (*69*). An artificial effluent similar to milk powder and butter processing wastewater was treated in an anaerobic-anoxic-oxic system at HRT of 7 days and a nominal sludge age of 20 days (*70*). The process was characterised by sludge bulking due to the growth of filamentous bacteria (*Sphaerotilus natans*, Type 0411 and *Haliscomenobacter hydrossis*). TN removal remained unchanged at 66 % without the improvement in the sludge volume index. TP depended on the anoxic selector relative dimensions (from 49 to 20 %) and a respective nitrate rise in the effluent. Nevertheless, more than 90 % of COD reduction was achieved.

Aerobic filters are applied to a lesser extent in the treatment of high-strength dairy effluents rich in FOG. High fat and heavy biofilm blockage are possible, which results in biomass loss, filter fouling and corresponding reduction in productivity (*1*).

The sequencing batch reactor (SBR) is preferred in dairy wastewater treatment because of its various loading capabilities and effluent flexibility. A traditional technology with free sludge flocs is mostly applied. The purification of milk effluents is given by Britz *et al.* (*1*). COD was reduced by 91–97, TS by 63, volatile solids (VS) by 66, TKN by 75, and TN by 38 %. However, mechanical treatment had to be applied first. Another study shows the aerobic SBR as an excellent example of the combination of activated sludge granulation with dairy effluent treatment (*71*). Granulation stability is limited by nutrient concentration in the wastewater, while effluent quality depends on the need for preliminary sludge settling, usually 0.25–0.5 HRT. Up to 90 % of total COD, 80 % of TN and 67 % of TP were reached in an 8-hour cycle and 50 % volume exchange ratio. The results were obtained after fully activated sludge granulation and consecutive biomass sedimentation. The soluble effluent COD was reduced to 125 mg/L. Industrial effluents are more difficult to treat than synthetic ones. The lower maximum OLRs also reduced the SBR granular sludge efficiency (*17*). In a bench-scale SBR, raw industrial dairy wastewater was treated with *Lactobacillus casei* TISTR 1500 (*62*). Microaerobic conditions maintained in the SBR allow for biomass accumulation in large amounts, leading to 85 % lactose reduction *via* rapid fermentation and subsequent protein coagulation by 90 %. As a consequence, 70 % of COD degradation can be achieved. Around 2.67 times higher OLR was achieved in two laboratory aerobic SBRs treated with a mixed landfill and dairy effluent than in traditional SBR processes (*71*). The best BOD_5 removal mode was reached at OLR, expressed as BOD_5, of 0.8 kg/(m^3·day) per a 10-day HRT. The application of flexible fibre as an activated sludge carrier increases the laboratory SBR reliability and it is possible to treat dairy effluents at very high OLRs. At OLR, expressed as COD, of 0.4 kg/(m^3·day), COD was degraded by more than 89 % and up to 97 % at OLR, expressed as COD, of 2.74 kg/(m^3·day) (*72*). Membrane technologies are successfully applied in the treatment of low-load dairy effluents in an SBR. A high BOD removal (over 97 %) and TSS-free wastewater are obtained. Due to low influent loading, TN removal reaches 96 % by means of assimilation only. TP elimination reaches only 80 % after system optimisation due to the limited excess sludge disposal (*73*).

Moving bed biofilm reactor (MBBR) shows very high performance when applied to dairy wastewaters: OLR increases dozens of times compared to conventional activated sludge systems. A milk processing effluent was treated in a MBBR with biomass developed on FLOCOR-RMP® particles (Henderson Plastics Ltd, Norfolk, UK) (*74*). At OLR, expressed as COD, of 5 kg/(m^3·day), more

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than 80 % of total COD degradation was achieved in almost half-order kinetics with partial substrate penetration. TN was decreased by 13.3–96.2 %. The small reactor volume and the high OLR encompass process applications including plant renovation and the introduction of new, limited-space treatment facilities (*74*). A novel MBBR with free-floating plastic elements (with a density slightly less than 1.0 kg/m^3) may give 85 and 60 % COD reduction at OLRs of 12 and 21.6 kg/(m^3·day), respectively. On the basis of test results, we can say that the MBBR should be very suitable for the treatment of dairy industry effluents (*75*).

Good results can be reached in a membrane bioreactor during the treatment of an ice-cream factory effluent with 13.3 kg/m^3 of COD, 6.5 kg/m^3 of BOD_5 at a temperature of 25 °C. Both indicators are reduced by over 95 %, while TKN is decreased by more than 96 and TP by 80 %. Under aerobic conditions, the indigenous microflora composed of lactic acid bacteria may reach over 10^9 CFU/mL, which will downgrade CIP-induced alkaline pH variations (*76*).

Various alternatives for aerobic treatment of dairy effluents are also used. Pure oxygen is another possibility in the biodegradation of milk wastewater. Oxygen can be applied directly in the homogenisation tank during a traditional physicochemical treatment and stable operation is achieved under a broad initial COD and TSS range. This modification improves effluent quality and reduces process costs. Such oxygen injection systems can replace the expensive anaerobic treatment and are naturally safer (*77*). Cheese whey can also be successfully utilised as a cheap medium for edible mushroom cultivation. Some authors report the growth of *Ganoderma lucidum* on protein-free cheese whey. The best soluble COD utilisation was achieved at pH=4.6 and 27.1 °C, while the maximum mycelial yield of 0.35 mg per mg of soluble COD removed was obtained at pH=4.2 and 28.5 °C (*78*). Although there is information on edible fungal growth, dairy wastewater utilisation has not been studied from a COD point of view (*79–82*).

Cheese whey effluents can be treated successfully in municipal wastewater treatment plants. Factories with onsite treatment technologies should collect sanitary wastewater independently from processing effluents and discharge them directly into municipal wastewater treatment plants. Nevertheless, such a treatment option can lead to operational problems with secondary treatment units (*1,12*). Periodic sludge bulking is possible and is caused by intermittent high soluble COD levels in the receiving sewage plant.

Anaerobic processes. Anaerobic systems are more suitable for the direct utilisation of high-strength dairy wastewater and are more cost-effective than aerobic processes. If properly operated, these systems do not produce unpleasant odours (*1,4*). The major problems of anaerobic dairy wastewater treatment include long start-up periods due to complex substrate degradation, preliminary biomass adaptation prior to protein and fat utilisation, fast drop in pH and a resultant inhibition of methane production (as a consequence of the high concentration of easily fermentable lactose and low substrate alkalinity), sludge disintegration by fats in the form of triglyceride emulsions and subsequent biomass flotation, presence of inhibitory compounds (long-chain fatty acids, K^+ and Na^+ ions), inability of ammonia biodegradation and phosphorus removal, careful management, increased sensitivity to various OLRs and shock loadings, *etc*. Notwithstanding the little information on industrial-scale anaerobic plants utilising cheese whey, more than 75 % COD removal and around 10 kg/(m^3·day) of OLRs, expressed as COD, are achieved. The degree of biodegradation depends on the HRT applied (*4,12,22,83–85*).

Milk processing effluents are predominantly treated in conventional one-phase systems: upflow anaerobic sludge blanket (UASB) reactor and anaerobic filter (AF) are most commonly applied (*4*). UASB reactors have been used in industrial dairy wastewater treatment for more than 20 years. They are suitable for treatment of overloaded effluents with COD higher than 42 g/L (*86*). Laboratory scale UASB reactors utilising whey permeates in a continuous regime have been designed (*87*). Kinetic coefficients using the Monod equation are determined per HRT of 0.4–5 days and an initial wastewater COD of 10.4–0.2 g/L (*87*). It was shown by a comparative study of the possibility of using flocculent sludge and the effect of different HRTs (6–16 h) on the anaerobic UASB reactor behaviour applied to dairy wastewater treatment that nearly 80 % of protein mineralisation, soluble COD and volatile fatty acid degradation as well as over 60 % fat removal can be reached at an HRT of at least 12 h and an OLR, expressed as COD, of less than 2.5 g/(L·day) (*88*). Biomass granulation was also achieved in the UASB reactor within 60–70 days. Of all the elements studied, only Ca^{2+} ions had any significant effect (*89*). When treating a synthetic ice-cream effluent in the UASB reactor, TOC was reduced by 86 % at an HRT of 18.4 h, with the highest OLR, expressed as TOC, reaching 3.06 kg/(m^3·day) (*1*). High FOG degradation is also possible in an UASB reactor. A couple of bench-scale UASB reactors were successfully employed during the utilisation of a synthetic milk effluent rich in FOG (0.2, 0.6 and 1 g/L) (*90*). Enzymatic pre-hydrolysis contributed to 8 % more COD removal at the highest FOG concentration (*90*). Cheese effluents are degraded in UASB reactors in laboratory tests and on an industrial scale. A laboratory-scale UASB reactor utilising a cheese factory effluent eliminates around 90 % of effluents at an OLR, expressed as COD, of 31 g/(L·day) (*91*). Organic loads, expressed as COD, over 45 g/(L·day) perform worse (70–80 % only). Moreover, chemicals are needed to support a constant pH. Short-shock OLR during operation increases sludge granulation, improving stability in reactor performance. The results of the laboratory tests on an industrial level have been confirmed (*1*), improving them by 6 % per 10 % higher load. A full-plant UASB reactor can be applied in cheese factory wastewater treatment. With an initial COD of 33 g/L, HRT of 16 h and OLR, expressed as COD, of 49.5 kg/(m^3·day), 86 % degradation can be reached. During the utilisation of an industrial effluent from Edam cheese, butter and milk production, a full-scale UASB reactor can be applied, the COD being decreased by 70 % (*1*).

Dairy effluents with a low TSS can be successfully utilised in AFs in an all-scale range. The COD decreased by between 60 and 98 % at a HRT of 12–48 h and an OLR,

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expressed as COD, of 1.7–20 kg/(m^3·day) (*1*). A large specific surface of the filter media creates a precondition for higher biomass accumulation which is less affected by shear stress. A five-time higher load than with the non-porous filler under the same conditions is achieved. It has been reported that with a couple of mesophilic upflow AFs utilising a milk bottling effluent, the reactor with the porous packing performed better (OLR, expressed as COD, of 21 kg/(m^3·day)) than the same reactor with non-porous packing (OLR, expressed as COD, of 4 kg/(m^3·day)), which is influenced by shear stress to a greater extent (*92*). Different temperature regimes can be analysed during the treatment of dairy wastewater in laboratory upflow AFs. At 12.5, 21 and 30 °C and HRT of 4 days on average, the COD removal in each reactor amounted to 92, 85 and 78 %, respectively (*93*). An AF was used to treat ice-cream wastewater in a comparative study with contact process, UASB reactor and fluidised bed bioreactor (FBB) (*94*). The data showed a COD removal of 67, 80 and 50 % at OLR, expressed as COD, of 6, 1 and 2 kg/(m^3·day) and 60 % of total COD removal, at OLR, expressed as COD, of 2–4 kg/(m^3·day). All reactors had a poor biomass retention resulting from FOG loading. An upflow AF performed better, which allowed its full-scale installation in the manufacturing process (*94*). An upflow AF has been claimed to be unsuitable for the anaerobic digestion of very dilute dairy wastewaters (*95*). In fact, continuous stirred-tank (CSTR), UASB and baffled reactors also cause problems although experimental data show that the baffled reactor performs better with an OLR, expressed as VS, of 0.117–1.303 g/(L·day) and HRTs between 18.8 and 2 days.

Although a CSTR is a good option for scientific research of complete-mix systems (*96*), it is difficult to use it on an industrial scale because of HRT restrictions. Such reactors were studied with a cheese effluent consisting of wash water/whey ratio of 4:1 with 17 g/L of COD. However, problems with sludge loss arise if the HRT drops to below 9 days (*1*).

Milk processing effluents can be treated in hybrid systems too (*4*). An anaerobic contact digester may reach a COD degradation of over 80–95 % under mesophilic conditions. The main disadvantage is the difficult sludge settlement. However, the technology is applied worldwide in dairy plants although it is quite old (*1*). A laboratory-scale experiment analysed the kinetic performance of anaerobic synthetic ice-cream effluent at 37 °C applying the Monod and Contois equations at an HRT range between 2.99 and 7.45 days. A better explanation of the kinetic coefficients can be achieved in the final pilot-scale plant since it allows variations in the initial substrate concentration (*97*).

Anaerobic packed-bed bioreactor (PBB) can be successfully applied for dairy wastewater treatment of various organic loads. A downflow PBB was used for treating deproteinised cheese whey with 59 g/L of COD (*1*). At OLR, expressed as COD, of 12.5 kg/(m^3·day), the system decreased the COD to 90–95 % at HRT of 2–2.5 days. The influent pH was around 2.9, while the pH in the reactor was almost neutral. Good results were obtained in a pilot-scale plant with an up-flow anaerobic PBB (*98*). The initial cheese whey COD was 59.4 g/L. A 16-hour HRT was enough to reach 99.4 % of lactose conversion. Whey wastewater was degraded to 89 % in an anaerobic MBBR at (35±2) °C per 1-day HRT and an OLR, expressed as COD, of 11.6 kg/(m^3·day) (*99*). The cheese whey was decomposed in a laboratory PBB with a polyethylene carrier. The highest COD reduction was achieved at a 3.5-day HRT with OLR, expressed as COD, of 3.8 kg/(m^3·day) and biogas production of 0.42 m^3 per kg of COD per day (*1*). The mesophilic anaerobic fluidized-bed bioreactor system degraded 5.2 g/L of COD in the ice-cream wastewater to 94.4 % at 35 °C, OLR, expressed as COD, of 15.6 kg/(m^3·day) and HRT of 8 h. Under shock loading, the return to steady-state conditions was possible within 6–16 h (*100*). The fluidized-bed bioreactor was used to treat a low-load milk effluent with 0.2–0.5 g/L of COD. At an 8-hour HRT, 80 % of COD was removed (*1*).

Membrane applications in anaerobic systems are good options for improved effluent filtration combined with a higher concentration and an effective differentiation between HRT and solids retention time. A completely mixed anaerobic microfiltration membrane reactor system was used on cheese whey high in COD (63 g/L) (*1*). More than 99 % of organic matter was utilised when HRT was 7.5 days, which allowed authors to upgrade the studies from the pilot plant to a full-scale demonstration. The application of the ultrafiltration system made it possible to achieve a higher biomass retention for more efficient wastewater treatment.

Different temperature conditions have been tested in order to reach a higher COD anaerobic removal. The psychrophilic anaerobic operation in some laboratory hybrid reactors, utilising whey effluents with low (COD of 1 kg/m^3) and high (COD of 10 kg/m^3) load, showed a better COD performance when the OLR reached 70–80 % in the first reactor (at OLRs, expressed as COD, of 0.5–1.3 kg/(m^3·day), in a 20–12 °C range) and more than 90 % in the second (at OLRs, expressed as COD, up to 13.3 kg/(m^3·day), in a 20–14 °C range) (*101*). If the high-load reactor was operated at 12 °C, COD removal decreased to 50–60 % and biogranule decomposition started. These side effects could be eliminated *via* an OLR reduction down to 6.6 kg/(m^3·day). However, dairy wastewater has higher average temperature, which makes it possible to apply high-load wastewater treatment technologies (*6,18*). Another study showed that mesophilic conditions ((36±1) °C) generate more H_2 compared to thermophilic ones ((55±1) °C) during the treatment of cheese whey wastewater, with 9.2 and 8.1 mmol of H_2 per g of COD, respectively. The specific H_2 production was 4.6 times higher at 36 than at 55 °C (*102*).

Separated-phase systems are preferred from technological point of view. They have the highest organic loading and shortest HRT compared to other anaerobic digesters. The consecutive acidogenic-methanogenic phase division of anaerobic digestion is suitable for the treatment of dairy wastewater with an unbalanced composition (high C:N ratios which acidify very quickly). In such separated-phase systems, the acidogenic reactor has a major role as it supplies short-chain volatile fatty acids which can be easily fermented to CH_4 in the methanogenic reactor. The easily utilisable lactose requires a shorter HRT and a smaller volume of the acidogenic reactor than

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the methanogenic digester (*1,4,103*). Such a system was used to treat a dairy effluent with 50 kg/m^3 of COD and pH=4.5. The COD was decreased by 72 % at 35 °C and the following operating conditions: OLR, expressed as COD, of 50 and 9 kg/(m^3·day), when HRT was only 1 and 3.3 days in the acidogenic and the methanogenic reactors, respectively (*1*). The CSTR was the preferable model for the acidogenic phase. In a 9-month operation study, a two-phase anaerobic reactor comprising an acidogenic-phase CSTR and a methanogenic-phase upflow AF was used to treat dairy waste streams (*104*). The effluent COD was reduced by 90 % and the BOD_5 by 95 %, while an OLR, expressed as COD, of 5 kg/(m^3·day) and a 2-day HRT were obtained. The H_2 and subsequent CH_4 production from fresh cheese whey were achieved in a CSTR, at 35 °C and HRT of 1 day. The mixed liquor was consequently fermented to CH_4 in a baffled bioreactor, operated at HRTs of 20, 10 and 4.4 days. At the lowest HRT, the COD reduction reached 94 % (*105*). An acidogenic CSTR and a final methanogenic upflow AF were used to utilise cheese whey. The results showed that a maximum acidogenesis of up to 50 %, with the same OLR (expressed as COD) range (0.5–2 g per mixed liquor suspended solids per day) could be achieved at an HRT of 24 h. The effluent was fed subsequently to the upflow AF where the initial soluble COD was decreased by 90 % during HRT of 4 days (*106*). A two-stage hybrid UASB reactor, filled respectively with polyurethane foam and polyvinyl chloride rings in each phase, was supposed to exceed other anaerobic methods in the treatment of dairy effluents. The combined COD removal in the reactor in a stable equilibrium (10.7 to 19.2 kg/(m^3·day)) changed from 97 to 99 % (*39*). Anaerobic rotating biological contact reactors are also discussed in the literature for anaerobic separate phase treatment (*1*). Carrier incorporation into anaerobic reactors for biomass support greatly increases their specific activity. Depending on the operating temperature, dairy wastewater can be treated in a two-phase separation. The basic configuration presupposes that thermophilic acidogenesis is followed by mesophilic methanogenesis. The information on these processes in the literature is scarce (*107–109*). An experiment compared two couples of anaerobic SBRs working at the following temperatures: the first couple (thermophilic-mesophilic system) at 55–35 °C and the second (mesophilic-mesophilic system) at 35–35 °C. At an OLR, expressed as VS, varying between 2–4 g/(L·day), the thermophilic-mesophilic system performs better (VS removal rate of 43.8–44.1 % when HRT is 3 days and 37.1–38.9 % when HRT is 6 days) than the mesophilic-mesophilic system (VS removal rate of 29.3– 30.2 % when HRT is 3 days and 26.1–29.1 % when HRT is 6 days). The overall improved performance showed that the thermophilic-mesophilic system with respect to total coliform reduction, TSS removal and biogas production, is preferable to the mesophilic-mesophilic SBR couple. Despite that, higher energy consumption during the thermophilic phase should be taken into account from an economical point of view (*84*). During a set of experiments, a high-temperature-based technology including acetic and butyric acid fermentation followed by CH_4 production achieved 116 % COD reduction and 43 % CH_4 biosynthesis, thus performing better than single-phased processes (*110*).

Combined (anaerobic-aerobic) processes. Since an anaerobic technology reduces mostly C-containing contaminants and has a weaker effect on nutrient removal, it needs to be considered as only a preliminary step which must be polished. This can be achieved by incorporating a local aerobic step or, occasionally, by directly discharging anaerobic effluent into the municipal wastewater treatment plants (*4*).

A mixed dairy wastewater was purified on a full-scale level in consecutive UASB reactor and aerobic denitrification steps. When 95 % COD removal was achieved, the produced CH_4 was sufficient to cover the plant energy requirements (*1*).

SBR great flexibility makes it an adequate post-aerobic step in combined dairy wastewater treatment. A new downflow-upflow hybrid reactor containing downflow pre-acidification and upflow methanation chambers was designed to treat high-load cheese wastewater at an average OLR, expressed as COD, of 10 g/(L·day). COD (98 %) was converted into biogas, while the discharged soluble COD reached 1 g/L. The process was maintained at stable pH values without chemical addition. After treatment in the SBR, more than 90 % of COD, nitrogen from NH_3 and TP were removed (*32*). Wastewaters from raw milk quality laboratories, containing milk preservatives (sodium azide or chloramphenicol), were utilised in an industrial-scale plant with an AF and SBR. Influent FOG were completely treated in the anaerobic step without biomass washout for more than 2 years of operation, the COD decrease being more than 90 % at an OLR, expressed as COD, of 5–6 kg/(m^3·day). However, alkali had to be added to reduce the critical pH drop. The outgoing stream from the anaerobic process was polished in SBR until the final COD dropped to 200 mg/L and the TN to less than 10 mg/L (*52*).

The consecutive anaerobic-aerobic technology was used to purify reconstituted whey wastewater in a single reactor at low oxygen concentration and 20 °C. Maximum COD removal of (98±2) % was reached at total cycle time of 4 days and OLR, expressed as COD, of 0.78 g/(L·day). In accordance with specific biomass activity, trophic differentiation can be seen in the system: methanogens predominantly live at the bottom of the bulk liquid, while acidogens inhabit suspended flocs. When the soluble O_2 rose to 0.5 mg/L during the aerobic phase, the COD was reduced to (88±3) % in a 2-day total cycle time at 1.55 kg/(m^3·day) (*111*).

Conclusions

The discontinuous manufacturing process and high production heterogeneity in milk processing make it hard to outline the general dairy wastewater characteristics. Nevertheless, it can be concluded that dairy factories are large water consumers and therefore produce unstable waste streams with increased temperatures, variable pH values, high COD, BOD, FOG, N and P concentrations in combination with inhibiting cleaning agents and strong fluctuations in all factors. However, there is little information on the composition of wastewater streams from certain dairy industry branches, such as the production of

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yoghurt and whey products, which require more attention in future research.

Conventional aerobic activated sludge systems and percolating filters are not appropriate for dairy wastewater treatment. The high soluble COD values in wastewater account for the vast filamentous growth, which obstructs proper treatment and plant management. The application of immobilised biofilm technologies offers the opportunity to treat concentrated wastewater. MBBR are promising systems. However, many studies should be performed on other dairy wastewater streams, such as high FOG effluents, acid whey, *etc.*

High organic contamination levels create conditions for the preference of anaerobic digestion over aerobic processes in dairy wastewater utilisation although anaerobic treatment rarely produces clear streams. This necessitates the development of novel, more effective fermentation technologies to deal with high-strength dairy effluents. Insufficient information on temperature-phased anaerobic biodegradation paves the way for new research on dairy wastewater management. A major problem in the anaerobic fermentation of dairy wastewater is ammonia, known for its toxicity if generated in high concentrations. Research can contribute a lot to the anaerobic ammonium oxidation application in the treatment of anaerobic effluents from dairy manufacturing for an improved nitrogen removal.

The consecutive combination of fermentative and oxygen processes may be a solution for appropriate milk processing wastewater treatment. However, innovative and more compact equipment should be designed to meet the challenges associated with wastewater treatment limitations and water-quality requirements. Moreover, the replacement of outdated equipment with new machines needs to be supported by more, real-case studies, which will help us understand better dairy wastewater treatment.

References

1. Britz JT, van Schalwyk C, Hung YT. Treatment of dairy processing wastewaters. In: Wang LK, Hung YT, Lo HH, Yapijakis C, editors. Waste treatment in the food processing industry. Boca Raton, FL, USA: CRC Press; 2006. pp.1–25.
2. Carvalho F, Prazeres AR, Rivas J. Cheese whey wastewater: characterization and treatment. Sci Tot Env. 2013;445-446: 385–96. http://dx.doi.org/10.1016/j.scitotenv.2012.12.038
3. Karadag D, Köroğlu OE, Ozkaya B, Cakmakci M. A review on anaerobic biofilm reactors for the treatment of dairy industry wastewater. Process Biochem. 2015;50:262–71. http://dx.doi.org/10.1016/j.procbio.2014.11.005
4. Nadais MHGAG, Capela MIAPF, Arroja LMGA, Hung YT. Anaerobic treatment of milk processing wastewater. In: Wang LK, Tay JH, Tay STL, Hung YT, editors. Handbook of environmental engineering, vol. 11. Environmental bioengineering. New York, NY, USA: Humana Press, Springer; 2010. pp. 555–618. http://dx.doi.org/10.1007/978-1-60327-031-1_17
5. Rosenwinkel KH, Austermann-Haun U, Meyer H. Industrial wastewater sources and treatment strategies. Dairy industry. In: Rehm HJ, Reed G, Pühler A, Stadler P, editors. Environmental processes I, vol. 11a. Biotechnology. Weinheim, Germany: Wiley-VCH; 1999. pp. 208–9.
6. Tsachev T. Dairy industry wastewater treatment. In: Industrial wastewater treatment. Sofia, Bulgaria: State Publishing House Technique; 1982. pp. 239–41 (in Bulgarian).
7. Cristian O. Characteristics of the untreated wastewater produced by food industry. Analele Universității din Oradea, Fascicula: Protecția Mediului. 2010;15:709–14. Available from: http://protmed.uoradea.ro/facultate/anale/protectia_mediului/2010/im/29.%20Onet%20Cristian%201.pdf.
8. Najafpour GD, Hashemiyeh BA, Asadi M, Ghasemi MB. Biological treatment of dairy wastewater in an upflow anaerobic sludge-fixed film bioreactor. Am-Euras J Agric Environ Sci. 2008;4:251–7.
9. Pesta G, Meyer-Pittroff R, Russ W. Utilization of whey. In: Oreopoulou W, Russ W, editors. Utilization of by-products and treatment of waste in the food industry. New York, NY, USA: Springer; 2007. pp. 193–205. http://dx.doi.org/10.1007/978-0-387-35766-9_10
10. Saddoud A, Hassaïri I, Sayadi S. Anaerobic membrane reactor with phase separation for the treatment of cheese whey. Bioresour Technol. 2007;98:2102–8. http://dx.doi.org/10.1016/j.biortech.2006.08.013
11. Demirel B, Yenigun O, Onay TT. Anaerobic treatment of dairy wastewaters: a review. Process Biochem. 2005;40:2583–95. http://dx.doi.org/10.1016/j.procbio.2004.12.015
12. Prazeres AR, Carvalho F, Rivas J. Cheese whey management: a review. J Envir Man. 2012;110:48–68. http://dx.doi.org/10.1016/j.jenvman.2012.05.018
13. Tawfik A, Sobhey M, Badawy M. Treatment of a combined dairy and domestic wastewater in an up-flow anaerobic sludge blanket (UASB) reactor followed by activated sludge (AS system). Desalination. 2008;227:167–77. http://dx.doi.org/10.1016/j.desal.2007.06.023
14. Sarkar B, Chakrabarti PP, Vijaykumar A, Kale V. Wastewater treatment in dairy industries – possibility of reuse. Desalination. 2006;195:141–52. http://dx.doi.org/10.1016/j.desal.2005.11.015
15. Farizoglu B, Keskinler B, Yildiz E, Nuhoglu A. Simultaneous removal of C, N, P from cheese whey by jet loop membrane bioreactor (JLMBR). J Hazard Mater. 2007;146:399–407. http://dx.doi.org/10.1016/j.jhazmat.2006.12.051
16. Un UT, Ozel E. Electrocoagulation of yoghurt industry wastewater and the production of ceramic pigments from the sludge. Sep Purif Technol. 2013;120:386–91. http://dx.doi.org/10.1016/j.seppur.2013.09.031
17. Schwarzenbeck N, Borges JM, Wilderer PA. Treatment of dairy effluents in an aerobic granular sludge sequencing batch reactor. Appl Microbiol Biotechnol. 2005;66:711–8. http://dx.doi.org/10.1007/s00253-004-1748-6
18. Schifrin SM, Ivanov GV, Mishukov BG, Feodanov YuA. Wastewaters from dairy industry. In: Arkhangelskaya EP, editor. Wastewater treatment of meat and dairy industry. Moscow, Russia: Light and Food Industry; 1981. pp. 11–9 (in Russian).
19. Environment Protection Authority (EPA). Environmental guidelines for the dairy processing industry. Melbourne, Australia; 1997. Available from: www.epa.vic.gov.au/~/media/Publications/570.pdf.
20. Janczukowicz W, Zieliński M, Dębowski M. Biodegradability evaluation of dairy effluents originated in selected sections of dairy production. Bioresour Technol. 2008;99:4199–205. http://dx.doi.org/10.1016/j.biortech.2007.08.077
21. Rosenwinkel KH, Austermann-Haun U, Meyer H. Industrial wastewater sources and treatment strategies. In: Jördening HJ, Winter J, editors. Environmental biotechnology: concepts and applications. Weinheim, Germany: Wiley-VCH Verlag GmbH & Co. KGaA; 2005. pp. 69–70.

Compiled 06/27/2019

22. Doble M, Kumar A. Treatment of waste from food and dairy industries. In: Biotreatment of industrial effluents. Burlington, VT, USA: Elsevier Butterworth-Heinemann; 2005. pp. 183–5. http://dx.doi.org/10.1016/B978-075067838-4/50018-X
23. Watkins M, Nash D. Dairy factory wastewaters, their use on land and possible environmental impacts – a mini review. The Open Agric J. 2010;4:1–9. http://dx.doi.org/10.2174/1874331501004010001
24. Wang S, Rao NC, Qui R, Moletta R. Performance and kinetic evaluation of anaerobic moving bed biofilm reactor for treating milk permeate from dairy industry. Bioresour Technol. 2009;100:5641–7. http://dx.doi.org/10.1016/j.biortech.2009.06.028
25. Yang P, Zhang R, McGarvey JA, Benemann JR. Biohydrogen production from cheese processing wastewater by anaerobic fermentation using mixed microbial communities. Int J Hydrogen Energ. 2007;32:4761–71. http://dx.doi.org/10.1016/j.ijhydene.2007.07.038
26. Gannoun H, Khelifi E, Bouallagui H, Touhami Y, Hamdi M. Ecological clarification of cheese whey prior to anaerobic digestion in upflow anaerobic filter. Bioresour Technol. 2008; 99:6105–11. http://dx.doi.org/10.1016/j.biortech.2007.12.037
27. Venetsaneas N, Antonopoulou G, Stamatelatou K, Kornaros M, Lyberatos G. Using cheese whey for hydrogen and methane generation in a two-stage continuous process with alternative pH controlling approaches. Bioresour Technol. 2009; 100:3713–7. http://dx.doi.org/10.1016/j.biortech.2009.01.025
28. Okigbo LM, Richardson GH, Brown RJ, Ernstrom CA. Interactions of calcium, pH, temperature and chymosin during milk coagulation. J Dairy Sci. 1985;68:3135–42. http://dx.doi.org/10.3168/jds.S0022-0302(85)81218-2
29. Chatzipaschali A, Stamatis AG. Biotechnological utilization with a focus on anaerobic treatment of cheese whey: current status and prospects. Energies. 2012;5:3492–525. http://dx.doi.org/10.3390/en5093492
30. Potter N, Hotchkiss J. Waste solids upgrading and treatment. In: Food science. New York, NY, USA: Springer; 2012. pp. 526–7. http://dx.doi.org/10.1007/978-1-4615-4985-7
31. Göblös S, Portörő P, Bordás D, Kálmán M, Kiss I. Comparison of the effectivities of two-phase and single-phase anaerobic sequencing batch reactors during dairy wastewater treatment. Renew Energ. 2008;33:960–5. http://dx.doi.org/10.1016/j.renene.2007.06.006
32. Malaspina F, Stante, L, Cellamare CM, Tilche A. Cheese whey and cheese factory wastewater treatment with a biological anaerobic-aerobic process. Water Sci Technol. 1995;32:59–72. http://dx.doi.org/10.1016/0273-1223(96)00139-4
33. Geilman WG, Schmitd D, Herfurth-Kennedy C, Path J, Cullor J. Production of an electrolyte beverage from milk permeate. J Dairy Sci. 1992;75:2364–9. http://dx.doi.org/10.3168/jds.S0022-0302(92)77996-X
34. Borja R, Banks CJ. Anaerobic digestion of ice-cream wastewater: a comparison of single and two-phase reactor systems. Bull Environ Contam Toxicol. 1995;54:466–71. http://dx.doi.org/10.1007/BF00195122
35. Mohan SV, Babu VL, Sarma PN. Effect of various pretreatment methods on anaerobic mixed microflora to enhance biohydrogen production utilizing dairy wastewater as substrate. Bioresour Technol. 2008;99:59–67. http://dx.doi.org/10.1016/j.biortech.2006.12.004
36. Quasim W, Mane AV. Characterization and treatment of selected food industrial effluents by coagulation and adsorption techniques. Water Res Ind. 2013;4:1–12. http://dx.doi.org/10.1016/j.wri.2013.09.005
37. Water Environment Federation. Temperature. Chapter 17. Characterization and sampling of wastewater. In: Operation of municipal wastewater treatment plants, no. 11. New York, NY, USA: WEF Press; 2007. p. 5. Available from: http://www.wefnet.org/mopnew/Operation_of_Municipal_Wastewater_Treatment_Plants/Chapter%2017%20Revised_6th%20Edition.pdf.
38. Cammarota MC, Freire DMG. A review on hydrolytic enzymes in the treatment of wastewater with high oil and grease content. Bioresour Technol. 2006;97:2195–210. http://dx.doi.org/10.1016/j.biortech.2006.02.030
39. Kotoupas A, Rigas F, Chalaris M. Computer-aided process design, economic evaluation and environmental impact assessment for treatment of cheese whey wastewater. Desalination. 2007;213:238–52. http://dx.doi.org/10.1016/j.desal.2006.03.611
40. Chapter 22. Dairy effluent. In: Dairy processing handbook. Pully, Switzerland: Tetra Pak International SA; 2016. Available from: http://www.dairyprocessinghandbook.com/chapter/dairy-effluent.
41. Dhall P, Siddiqi TO, Ahmad A, Kumar R, Kumar A. Restructuring BOD:COD ratio of dairy milk industrial wastewaters in BOD analysis by formulating a specific microbial seed. Sci World J. 2012;2012:Article ID 105712. http://dx.doi.org/10.1100/2012/105712
42. Rahman MS, Islam MA, Habib S, Sarker J. Measuring biodegradability of industrial wastewater by a low-cost differential respirometer. Res J Eng Sci. 2013;2:1–4.
43. Mecler H, Dold PL, Jones RM, Bye CM, Takacs I, Stensel HD, et al. OUR for readily biodegradable COD utilization. Chapter 7.3. OUR response in batch test. Readily biodegradable COD. In: Methods for wastewater characterization in activated sludge modeling. Aleksandria, VA, USA: Water Environment Foundation (WERF)/London, UK: IWA Publishing; 2003. p. 7.
44. Orhon D, Çokgör EU. COD fractionation in wastewater characterization – the state of the art. J Chem Technol Biotechnol. 1997;68:283–93. http://dx.doi.org/10.1002/(SICI)1097-4660(199703)68:3<283::AID-JCTB633>3.0.CO;2-X
45. Leonard AM. Activated sludge treatment of dairy processing wastewaters: the role of selectors for the control of sludge bulking [PhD Thesis]. Palmerston North, New Zealand: Massey University; 1996.
46. Hayet C, Saida BA, Youssef T, Hédi S. Study of biodegradability for municipal and industrial Tunisian wastewater by respirometric technique and batch reactor test. Sustain Environ Res. 2016;26:55–62. http://dx.doi.org/10.1016/j.serj.2015.11.001
47. Çokgör UE, Sözen S, Insel G, Orhon. Respirometric evaluation of biodegradation characteristics of dairy wastewater for organic carbon removal. Environ Technol. 2009;30:1169–76. http://dx.doi.org/10.1080/09593330903144041
48. Loperena L, Saravia V, Murro D, Ferrari MD, Lareo C. Kinetic properties of a commercial and a native inoculum for aerobic milk fat degradation. Bioresour Technol. 2005;97: 2160–5. http://dx.doi.org/10.1016/j.biortech.2005.09.032
49. Method 5310. Total organic carbon (TOC). Part 5000. Aggregate organic constituents. In: Eaton AD, Clesceri LS, Greenberg AE, Franson MAH, editors. Standard methods for the examination of water and wastewater. Washington DC, USA: American Public Health Association; 1998.
50. Henze M, Harremoës P. Anaerobic treatment of wastewaters in fixed film reactors – a literature review. Water Sci Technol. 1983;15:1–101.
51. Omil F, Garrido JM, Arrojo B, Méndez R. Anaerobic filter reactor performance for the treatment of complex dairy waste-

Compiled 06/27/2019

water at industrial scale. Water Res. 2003;37:4099–108. http://dx.doi.org/10.1016/S0043-1354(03)00346-4

52. Ibekwe AM, Grieve CM, Lyon SR. Characterization of microbial communities and composition in constructed dairy wetland wastewater effluent. Appl Environ Microbiol. 2003;69: 5060–9. http://dx.doi.org/10.1128/AEM.69.9.5060-5069.2003
53. Haberl R, Perfler R, Mayer H. Constructed wetlands in Europe. Water Sci Technol. 1995;32:305–15. http://dx.doi.org/10.1016/0273-1223(95)00631-1
54. Newman JM, Clausen JC, Neafsey JA. Seasonal performance of a wetland constructed to process dairy milkhouse wastewater in Connecticut. Ecol Eng. 1999;14:181–98. http://dx.doi.org/10.1016/S0925-8574(99)00028-2
55. 91/271/EEC. Council directive of 21 May 1991 concerning urban waste water treatment. Off J Eur Commun. 1991. Available from: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31991L0271&from=EN.
56. Monroy OH, Vázquez FM, Derramadero JC, Guyot JP. Anaerobic-aerobic treatment of cheese wastewater with national technology in Mexico: The case of "El Sauz". Water Sci Technol. 1995;32:149–56. http://dx.doi.org/10.1016/0273-1223(96)00149-7
57. Vaclavik VA, Christian EV. Composition of dietary fats and oils. Chapter 12. Fat and oil products. In: Heldman DR, editor. Essentials of food science. New York, NY, USA: Springer; 2008. p. 284.
58. Gupta BS, Ako JE. Application of guar gum as a flocculant aid in food processing and potable water treatment. Eur Food Res Technol. 2005;221:746–51. http://dx.doi.org/10.1007/s00217-005-0056-4
59. Selmer-Olsen E, Ratnaweera HC, Pehrson R. A novel treatment process for dairy wastewater with chitosan produced from shrimp-shell waste. Water Sci Technol. 1996;34:33–40. http://dx.doi.org/10.1016/S0273-1223(96)00818-9
60. Dyrset N, Selmer-Olsen E, Havrevoll Ø, Rathaweera H, Storrø I, Birkeland SE. Feed supplement recovered from dairy wastewater by biological and chemical pretreatment. J Chem Technol Biotechnol. 1998;73:175–82. http://dx.doi.org/10.1002/(SICI)1097-4660(1998110)73:3<175::AID-JCTB936>3.0.CO;2-0
61. Seesurichan P. Dairy wastewater treatment by lactic acid bacteria [PhD Thesis]. Bangkok, Thailand: Kasetsart University; 1997 (in Thai).
62. Seesuriyachan P, Kuntiya A, Sasaki K, Techapun C. Biocoagulation of dairy wastewater by Lactobacillus casei TISTR 1500 for protein recovery using micro-aerobic sequencing batch reactor (micro-aerobic SBR). Process Biochem. 2009;44: 406–11. http://dx.doi.org/10.1016/j.procbio.2008.12.006
63. Vlyssides AG, Tsimas ES, Barampouti EMP, Mai ST. Anaerobic digestion of cheese dairy wastewater following chemical oxidation. Biosyst Eng. 2012;113:253–8. http://dx.doi.org/10.1016/j.biosystemseng.2012.09.001
64. Shammas N, Wang L, Hahn H. Costs of flotation. Flotation technology. Chapter 4. Fundamentals of wastewater flotation. In: Wang L, Shammas N, Selke W, Aulenbach D, editors. Handbook of environmental engineering, vol. 12. New York, NY, USA: Humana Press; 2010. p. 150. http://dx.doi.org/10.1007/978-1-60327-133-2
65. Adams CE Jr, Aulenbach DB, Bollyky JL, Boyd JL, Buchanan RD, Burns DE, et al. Chemical sludge production. Chapter 7. Wastewater treatment. In: Liu DHF, Liptak BG, editors. Environmental engineer's handbook. New York, NY, USA: CRC press LLC; 1999. p. 762.
66. Grady L Jr, Daigger G, Lim H. 1.3.1 Suspended growth bioreactors. In: Grady LCP Jr, Daigger GT, Lim HC, editors. Biological wastewater treatment. New York, NY, USA: Marcel Dekker Inc.; 1999. pp. 10–6.
67. Banu JR, Anandan S, Kaliappan S, Yeom IT. Two-stage anaerobic treatment of dairy wastewater using HUASB with PUF and PVC carrier. Biotechnol Bioprocess Eng. 2007;12: 257–64. http://dx.doi.org/10.1007/BF02931101
68. Rivas J, Prazeres AR, Carvalho F. Aerobic biodegradation of precoagulated cheese whey wastewater. J Agric Food Chem. 2011;59:2511–7. http://dx.doi.org/10.1021/jf104252w
69. Carta-Escobar F, Pereda-Marín J, Álvarez-Mateos P, Romero-Guzmán F, Durán-Barrantes MM, Barriga-Mateos F. Aerobic purification of dairy wastewater in continuous regime: Part I: Analysis of the biodegradation process in two reactor configurations. Biochem Eng J. 2004;21:183–91. http://dx.doi.org/10.1016/j.bej.2004.06.007
70. Donkin MJ, Russell JM. Treatment of a milk powder/butter wastewater using the AAO activated sludge configuration. Water Sci Technol. 1997;36:79–86. http://dx.doi.org/10.1016/S0273-1223(97)00644-6
71. Neczaj E, Kacpzak M, Kamizela T, Lach J, Okoniewska E. Sequencing batch reactor system for the co-treatment of landfill leachate and dairy wastewater. Desalination. 2008;222: 404–9. http://dx.doi.org/10.1016/j.desal.2007.01.133
72. Abdulgader M, Yu QJ, Zinatizadeh A, Williams P. Biological treatment of milk processing wastewater in a sequencing batch flexible fibre biofilm reactor. Asia-Pac J Chem Eng. 2009;4:698–703. http://dx.doi.org/10.1002/apj.320
73. Bae TH, Han SS, Tak TM. Membrane sequencing batch reactor system for the treatment of dairy industry wastewater. Process Biochem. 2003;39:221–31. http://dx.doi.org/10.1016/S0032-9592(03)00063-3
74. Andreottola G, Foladori P, Ragazzi M, Villa R. Dairy wastewater treatment in a moving bed biofilm reactor. Water Sci Technol. 2002;45:321–8.
75. Rusten B, Ødegaard H, Lundar A. Treatment of dairy wastewater in a novel moving bed biofilm reactor. Water Sci Technol. 1992;26:703–11.
76. Scott JA, Smith, KL. A bioreactor coupled to a membrane to provide aeration and filtration in ice-cream factory wastewater remediation. Water Res. 1997;31:69–74. http://dx.doi.org/10.1016/S0043-1354(96)00234-5
77. Martín-Rilo S, Coimbra RN, Martín-Villacorta J, Otero M. Treatment of dairy industry wastewater by oxygen injection: performance and outplay parameters from the full scale implementation. J Clean Prod. 2015;86:15–23. http://dx.doi.org/10.1016/j.jclepro.2014.08.026
78. Lee H, Song M, Hwang S. Optimizing bioconversion of deproteinated cheese whey to mycelia of Ganoderma lucidum. Process Biochem. 2003;38:1685–93. http://dx.doi.org/10.1016/S0032-9592(02)00259-5
79. Gothwal R, Gupta A, Kumar A, Sharma S, Alappat BJ. Feasibility of dairy waste water (DWW) and distillery spent wash (DSW) effluents in increasing the yield potential of Pleurotus flabellatus (PF 1832) and Pleurotus sajor-caju (PS 1610) on bagasse. 3 Biotech. 2012;2:249–57. http://dx.doi.org/10.1007/s13205-012-0053-9
80. Wu X. Effects of whey permeate medium on mushroom mycelia composition and antioxidant properties [PhD Thesis]. Logan, UT, USA: Utah State University; 2008.
81. Mukhopadhyay R, Chatterjee S, Chatterjee BP, Guha AK. Enhancement of biomass production of edible mushroom Pleu-

Compiled 06/27/2019

torus sajor-caju grown in whey by plant growth hormones. Process Biochem. 2005;40:1241–4. http://dx.doi.org/10.1016/j.procbio.2004.05.006

82. Asada C, Okumura R, Sasaki C, Nakamura Y. Acceleration of Hericium erinaceum mycelial growth in submerged culture using yogurt whey as an alternative nitrogen source. Adv Biosci Biotechnol. 2012;3:828–32. http://dx.doi.org/10.4236/abb.2012.37103

83. Dugba PN, Zhang R. Treatment of dairy wastewater with two-stage anaerobic sequencing batch reactor systems – thermophilic versus mesophilic operations. Bioresour Technol. 1999;68:225–33. http://dx.doi.org/10.1016/S0960-8524(98)00156-4

84. Fang H, Yu H. Effect of HRT on mesophilic acidogenesis of dairy wastewater. J Environ Eng. 2000;126:1145–8. http://dx.doi.org/10.1061/(ASCE)0733-9372(2000)126:12(1145)

85. Perle M, Kimchie S, Shelef G. Some biochemical aspects of the anaerobic degradation of dairy wastewater. Water Res. 1995;29:1549–54. http://dx.doi.org/10.1016/0043-1354(94)00248-6

86. Gavala HN, Kopsinis H, Skiadas IV, Stamatelatou K, Lyberatos G. Treatment of dairy wastewater using an upflow anaerobic sludge blanket reactor. J Agric Engng Res. 1999;73: 59–63. http://dx.doi.org/10.1006/jaer.1998.0391

87. Borja R, Banks CJ. Kinetics of an upflow anaerobic sludge blanket reactor treating ice-cream wastewater. Environ Technol. 1994;15:219–32. http://dx.doi.org/10.1080/09593339409385423

88. Nadais H, Capela I, Arroja L, Duarte A. Treatment of dairy wastewater in UASB reactors inoculated with flocculent biomass. Water SA. 2005;31:603–7. http://dx.doi.org/10.4314/wsa.v31i4.5151

89. Goodwin JAS, Wase DAJ, Forster CF. Anaerobic digestion of ice-cream wastewaters using the UASB process. Biol Wastes. 1990;32:125–44. http://dx.doi.org/10.1016/0269-7483(90)90077-6

90. Leal MCMR, Freire DMG, Cammarota MC, Sant'Anna Jr GL. Effect of enzymatic hydrolysis on anaerobic treatment of dairy wastewater. Process Biochem. 2006;41:1173–8. http://dx.doi.org/10.1016/j.procbio.2005.12.014

91. Gutiérrez JLR, Encina PAG, Fdz-Polanco F. Anaerobic treatment of cheese-production wastewater using a UASB reactor. Bioresour Technol. 1991;37:271–6. http://dx.doi.org/10.1016/0960-8524(91)90194-O

92. Anderson GK, Kasapgil B, Ince O. Comparison of porous and non-porous media in upflow anaerobic filters when treating dairy wastewater. Water Res. 1994;28:1619–24. http://dx.doi.org/10.1016/0043-1354(94)90229-1

93. Viraraghavan T, Kikkeri SR. Effect of temperature on anaerobic filter treatment of dairy wastewater. Water Sci Technol. 1990;22:191–8.

94. Hawkes FR, Donnelly T, Anderson GK. Comparative performance of anaerobic digesters operating on ice-cream wastewater. Water Res. 1995;29:525–33. http://dx.doi.org/10.1016/0043-1354(94)00163-2

95. Chen TH, Shyu WH. Performance of four types of anaerobic reactors in treating very dilute dairy wastewater. Biomat Bioeng. 1996;11:431–40. http://dx.doi.org/10.1016/S0961-9534(96)00038-4

96. Usack JG, Spirito CM, Angenent LT. Continuously-stirred anaerobic digester to convert organic wastes into biogas: system setup and basic operation. J Vis Exp. 2012;65:e3978. http://dx.doi.org/10.3791/3978

97. Hu WC, Thayanithy K, Forster CF. A kinetic study of the anaerobic digestion of ice-cream wastewater. Process Biochem. 2002;37:965–71. http://dx.doi.org/10.1016/S0032-9592(01)00310-7

98. Najafpour GD, Tajallipour M, Komeili M, Mohammadi M. Kinetic model for an up-flow anaerobic packed bed bioreactor: dairy wastewater treatment. Afr J Biotechnol. 2009;8: 3590–6.

99. Rodgers M, Zhan XM, Dolan B. Mixing characteristics and whey wastewater treatment of a novel moving anaerobic biofilm reactor. J Environ Sci Health A Tox Hazard Subst Environ Eng. 2007;39:2183–93. http://dx.doi.org/10.1081/ESE-120039383

100. Borja R, Banks CJ. Response of an anaerobic fluidized bed reactor treating ice-cream wastewater to organic, hydraulic, temperature and pH shocks. J Biotechnol. 1995;39:251–9. http://dx.doi.org/10.1016/0168-1656(95)00021-H

101. McHugh S, Collins G, O'Flaherty V. Long-term, high-rate anaerobic biological treatment of whey wastewaters at psychrophilic temperatures. Bioresour Technol. 2006;97:1669–78. http://dx.doi.org/10.1016/j.biortech.2005.07.020

102. Azbar N, Dokgöz FT, Keskin T, Eltem R, Korkmaz KS, Gezgin Y, et al. Comparative evaluation of bio-hydrogen production from cheese whey wastewater under thermophilic and mesophilic anaerobic conditions. Int J Green Energy. 2009;6:192–200. http://dx.doi.org/10.1080/15435070902785027

103. Lo KV, Liao PH. Two-stage anaerobic digestion of cheese whey. Biomass. 1986;10:319–22. http://dx.doi.org/10.1016/0144-4565(86)90005-3

104. Ince O. Performance of a two-phase anaerobic digestion system when treating dairy wastewater. Water Res. 1998;32: 2707–13. http://dx.doi.org/10.1016/S0043-1354(98)00036-0

105. Antonopoulou G, Stamatelatou K, Venetsaneas N, Kornaros M, Lyberatos G. Biohydrogen and methane production from cheese whey in a two-stage anaerobic process. Ind Eng Chem Res. 2008;47:5227–33. http://dx.doi.org/10.1021/ie071622x

106. Yilmazer G, Yenigün O. Two-phase anaerobic treatment of cheese whey. Water Sci Technol. 1999;40:289–95. http://dx.doi.org/10.1016/S0273-1223(99)00397-2

107. Beux S, Nunes E, Barana AC. Effect of temperature on two-phase anaerobic reactors treating slaughterhouse wastewater. Braz Arch Biol Technol. 2007;50:1061–72. http://dx.doi.org/10.1590/S1516-89132007000700017

108. Fernández-Rodríguez J, Pérez M, Romero LI. Semicontinuous temperature-phased anaerobic digestion (TPAD) of organic fraction of municipal solid waste (OFMSW). Comparison with single-stage processes. Chem Eng J. 2016;285:409–16. http://dx.doi.org/10.1016/j.cej.2015.10.027

109. Ke S, Shi Z, Fang HHP. Applications of two-phase anaerobic degradation in industrial wastewater treatment. Int J Environ Pollut. 2005;23:65–80.

110. Yang K, Yu Y, Hwang S. Selective optimization in thermophilic acidogenesis of cheese-whey wastewater to acetic and butyric acids: partial acidification and methanation. Water Res. 2003;37:2467–77. http://dx.doi.org/10.1016/S0043-1354(03)00006-X

111. Frigon JC, Breton J, Bruneau T, Moletta R, Guiot SR. The treatment of cheese whey wastewater by sequential anaerobic and aerobic steps in a single digester at pilot scale. Bioresour Technol. 2009;100:4156–63. http://dx.doi.org/10.1016/j.biortech.2009.03.077

Public Comment Form

Cascade County Public Works Department Planning Division
121 4th St N, Suite 2H-2I Great Falls, MT 59401
Phone: 406-454-6905 | Fax: 406-454-6919
Email: planningcomments@cascadecountymt.gov

Instructions

This form is for providing public comment to the Cascade County Planning Division for review by any one or more of the following review and/or approval boards: Zoning Board of Adjustment (ZBOA), Planning Board, or Board of County Commissioners. Only complete submissions will be included for board review. Please provide the relevant information for each section below. A complete submission provides all of the following: commenter name and address, comment subject, and commentary on the subject issue(s). If additional space is needed for commentary, please attach additional sheets to this form. Completed forms may be submitted in person at the Planning Division office or by email at planningcomments@cascadecountymt.gov.

Commenter Information

Name: Carolyn K. Craven

Complete Address: 101 14th Avenue South, Great Falls MT 59405

Comment Subject (please check one):

- ☐ Special Use Permit Application
- ☐ Subdivision
- ■ Zoning Text and/or Map Amendment
- ■ Growth Policy
- ☐ Variance
- ☐ Floodplain Regulation Amendment
- ☐ Subdivision Regulation Amendment
- ☐ County Road Abandonment/ Discontinuation of County Street
- ■ Other (describe): Big Sky Cheese

Comment

06.19.19 Cascade County & City of Great Falls
06.19.19 New & Revised Definitions
06.20.19 Special Use Permit
06.20.19 Commercial Dairy Zoning
06.22.19 Carbon Footprint of Cheese Production
06.25.19 Highlights MT Milk Study

For Office Use Only					
Date Received:	6/25/2019	Date Reviewed:	6/27/2019	Complete:	☒ Yes ☐ No

Carolyn K. Craven
101 14th Avenue South
Great Falls, MT 59405

June 24, 2019

PUBLIC COMMENTS FOR ZBOA

MFP BIG SKY CHEESE
MT MILK STUDY HIGHLIGHTS

The following information is taken from the *MT Milk Market Regulation Study Final Report.*
This is a 93-page report submitted by Dairy Technomics on June 4, 2018.
The MT Board of Milk Control adopted citing this study.

Montana is one of the smallest dairy consuming states in the nation and its Class I fluid milk consumption has declined in line with the national trend.

- Montana's milk supply is either too small or too large depending on the type of product desired
  - Producing commodity cheese requires a plant with a very low production cost. This requires large volumes of milk (minimum of 1 million to 2 million pounds per day). Montana is not currently in a position to do this.
  - Alternatively, smaller facilities produce smaller quantities of product at a higher cost, but this requires a branding strategy to be profitable. Typical plants of this size might start out between 3,000 and 30,000 pounds of milk per day. This will not have a very large effect on the Surplus Milk situation in the State

- The largest volume opportunity for Montana is cheese, assuming that it is simple cheddar or something similar. Again, assuming a 20% market share of Montana's cheese sales would equate to 5.36 million pounds of cheese requiring 53 million pounds of milk, or just over 1 million pounds of milk per week. In today's market, commodity cheese plants need to process about 1 million pounds per day to be sustainably profitable. The Agropur plant in South Dakota recently announced an expansion that is targeted to ultimately process 9 million pounds of milk per day. For perspective, all of Montana's current milk production does not equal 1 million pounds of milk per day. Such an investment would have to be based on obtaining significant out-of-state volume in competition with large national plants, and multiple plants in the region, with established shares of the market. Given the above, we do not see much opportunity for establishing a large cheese operation. However, it may be feasible to start small and produce cheese that would be sold as a premium private label cheddar or other specialty cheese, at a premium price. Once established, it may be possible to expand the plant to offer additional products that target certain commodity cheese on the open market. We reviewed 2 studies on costing a small artisan cheese plant.

C. K. Craven
Homeowner

- Nebraska Specialty Cheese Plant 2002, Reports from the Food Processing Center, University of Nebraska – Lincoln
  - The Nebraska study estimated the cost of a larger cheese plant, processing 30,000 pounds of milk per day (7.8 million pounds of milk per year assuming a 5-day week, which will produce about 780,000 pounds of cheese per year). The plant cost is estimated at between $500,000 and $1 million and does not include any facility for aging the cheese. Adjusting for inflation, the cost today would be between $650,000 and $1.3 million. Estimated production cost was $2.32 per pound, or just over $3.00 adjusted for inflation. This reflects about 312 cows, given Montana's average production per cow.
- Oregon State University start-up and operating costs for artisan cheese companies, American Dairy Science Association, 2014, Andrea Bouma, Catherine A. Durham, and Lisbeth Meunier-Goddik
  - The Oregon Study concluded that a very small cheese plant, producing 30,000 to 60,000 pounds per year (13,000 kg to 27,000 kg / 3,488 to 6,976 gallons) could be built for $350K to $600K. This is 2,300 pounds (267 gallons) of milk per day, assuming a 5-day week, and reflects the production from about 35 cows, given Montana's average production per cow. The estimated production cost in the first year is just over $10.00 per pound. Note that commodity block cheese on the CME is currently selling for about $1.50 per pound.

- Cost Summary
  The total milk supply in Montana for calendar 2017 was about 280 million pounds of which about 147 million pounds (17.093 million gallons) was utilized for Class I sales in Montana. This leaves about 364,000 pounds (42,325 gallons) per day of potentially available milk with some seasonal swings. This puts Montana in the position of too much milk for small plants and not enough for large plants. In other words, small plants, such as described above, may be viable, but will not go very far in utilizing the current volume of Surplus milk in Montana whereas large plants would require much more.

Montana is not in the position to enter the commodity cheese market, which requires plants with low productions costs that could process 1-2 million pounds of cheese daily, the report states. But smaller facilities, which require a strong branding strategy, could produce specialty products (i.e. artisan cheese), typically using 3,000 to 30,000 pounds (348 to 3,488 gallons) of milk daily. Such plants would not have much of an impact on the surplus milk situation in Montana, the report finds.

Respectfully submitted,

Carolyn K. Craven
101 14th Avenue South

C. K. Craven
Homeowner

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06.26.19 Waste Management Issues for Dairy Processors

For Office Use Only					
Date Received:	6\26\2019	Date Reviewed:	6\27\2019	Complete:	☒ Yes ☐ No

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

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December 1998

WASTE MANAGEMENT ISSUES FOR DAIRY PROCESSORS

A. Introduction

As it would be expected in "Americas Dairyland" the dairy industry is a significant factor in this Department's regulatory activities in terms of numbers of facilities and wastewater volumes. Although the total number of dairies in Wisconsin has steadily declined over the years, the dairies that have disappeared were generally smaller dairies that were often consolidated with larger dairies. Often the farmer patron supplying the milk simply diverted their supply to other dairies. A recent market trend has been for small cheese makers to produce a specialty cheese for a niche market. There are 2 main types of dairies that DNR regulates and they are cheese making and whey processing. There are a few dairies that churn butter, bottle milk, produce ice cream and other dairy products, such as yogurt, but except for 2 butter manufactures these dairies tend to discharge their wastewater to publicly owned treatment works (POTW) and are not directly regulated by DNR. In the 1997 issue "Wisconsin Agricultural Statistics" it was reported that the Department of Agriculture Trade and Consumer Protection (DATCP) has 222 licensed dairies of which approximately 140 produce cheese. The DNR regulates approximately 150 of the dairies with a specific Wisconsin Pollutant Discharge Elimination system (WPDES) permit.

B. Cheese Making

Although there are many varieties of cheese being produced, the cheese making process generally starts with whole pasteurized milk. The milk is warmed in vats and a lactic acid forming bacteria is added (starter bacteria). The cheese maker tracks the progress of the batch by checking the acidity which is read as pH. At the correct time an enzyme called rennet (from the stomach of calves) is added which causes the protein to form a curd on top of the milk. The curd is then cut into cubes and the mixture is stirred slowly to collect as much protein as possible into the curd. The cheese yield is approximately 10% with the remaining 90% a liquid by-product called whey. Some cheeses are salted by spreading salt grains on the curds, which then draws out more whey. This additional liquid waste is called "salt whey." While the above statements are a general description for making cheddar cheese there are many process variations to produce just the right taste and texture for each variety of cheese, and the quality of the final product depends on the skill of the cheese maker. Some varieties of cheese are salted by soaking the blocks in a 21% salt solution. Wastewater generated during cheese making comes from washing of the cheese vats, the pipelines, milk separator, milk pasteurizer, the inside of the milk trucks, and other equipment. Most dairies use a "clean in place" (CIP) system which pumps cleaning solutions through all equipment in this order: water rinse, caustic solution (sodium hydroxide) wash, water rinse, acid solution (phosphoric or nitric acid) wash, water rinse, and sodium hypo-chlorite disinfectant. These spent chemicals eventually become waste also.

The 5 day biochemical oxygen demand(BOD_5) is a measure of the organic pollutant concentration

in the wastewater, and is proportional to the amount of milk or whey lost to the sewer. Normal dairy production plant wastewater is in the range of 2000 to 3000 mg/l which is 10 times the strength of domestic sewage. The BOD_5 can go much higher if a milk spill occurs and the pH can fluctuate widely if spent CIP chemicals are carelessly discharged. It is important for dairies to manage their wastewater discharge to avoid upsetting their biological treatment process or a POTW system.

C. Whey Condensing

Whey has generally been considered an unwanted by-product by cheese makers and in addition, a problem to get rid of. Hence, before it was regulated by the DNR it was often dumped in fields and into earthen seepage pits and sometimes fed to hogs. Currently there is a good market for whey due to the development of technological processes that can produce useful products from whey.

1. Shell and Tube Condensers.

Whey processing starts by evaporating off some of the water thus "condensing" the total volume. Raw whey has a 6% dissolved solids concentration and the solids concentration has to be raised to 40% to 50% before a dry powder can be produced by spray drying. There are various types of whey condensers. One type of condenser is to use several evaporative stages or effects that operate under negative pressure so that the whey boils at temperatures much less than 212° Fahrenheit. The vapors from the first effect become the heat source for the second effect (and so on down the line) by giving up their latent heat of vaporization thus making the process energy efficient. The whey being evaporated moves through a tube surrounded by the vapors in the outer shell thus the term shell and tube condenser.

2. Mechanical Vapor Recompression (MVR)

A second type of process is called a mechanical vapor recompression evaporator in which the liquid is recycled in tubes surrounded by hot vapor. At each pass through the tubes some liquid evaporates and is sucked into a large electric powered air compressor. The compressor heats the vapor by compression and forces the hot vapors into contact with the evaporation tubes. The vapors, being hotter than the whey liquid in the tubes, give up their latent heat of vaporization thus making the process more energy efficient. Both condensation processes generate a wastewater called condensate of whey (COW water). The process also generates wastewater from cleaning the processing equipment.

3. Ultra Filtration (U.F.)

The wide spread use of ultra filtration has opened up new markets for whey products. The purpose of ultra filtration is to separate the protein molecule from the lactose sugar and other molecules in the whey. This is done by using a high pressure pump to force the smaller molecules through a molecular membrane thus leaving the large protein molecules in a concentrated stream. The protein stream is then condensed and dried by the same equipment used to process raw whey. Edible protein has found a good market as a food additive or protein supplement.

The lactose sugar fraction (permeate) can also be condensed and dried for use as baking sugar, baby food and in pharmaceuticals as a carrier for medicine. But because of a limited market and fluctuating prices, large volumes of permeate are landspread on crop land for the nitrogen, phosphorus and potassium fertilizer value. There is technology to create products such as ethyl alcohol, methane gas, or to grow yeast cells and harvest protein from lactose but this is not currently in full scale production.

4. Reverse Osmosis (R.O.)

By selecting specific molecular membranes only water molecules will be forced through thus concentrating the whey solids. Whey can be concentrated from 6% solids to about 12% solids by reverse osmosis thus saving trucking costs and evaporator capacity. The water stream from this reverse osmosis process still has enough sugar molecules to cause a BOD_5 high enough (100 to 300 mg/l) to require treatment as a process wastewater.

D. Wastewater Treatment Options

Dairies not served by a POTW have 2 basic choices for wastewater disposal; surface water discharge and/or land application. Dairies with larger flow volumes (over 25,000 gallons per day) tend to prefer treatment and discharge to surface water if there is a receiving stream available. However, this may not be an option if the stream has no additional assimilative capacity, has a high use classification (outstanding or exceptional), or if there are other site restrictions and discharge requirements that the cost of treatment increases to the point of being unaffordable.

The remaining option is land application of wastewater. The choices for land application are between spray irrigation, ridge and furrow, absorption pond or hauling and application by truck. A discussion of each treatment option follows:

1. Aerated Lagoons

Aerated lagoons are have been a commonly used method of wastewater treatment for dairies that directly discharge to surface water. Generally these systems are several large ponds connected in series with floating surface aerators or submerged air diffusers. The advantages of these treatment systems are as follows:

a. The long retention times of 30 days or more provide enough wastewater volume to absorb shock loads.

b. Lagoons are economical to construct and easy to operate.

c. Lagoons generate small volumes of sludge, and therefore can allow sludge to accumulate for years before it has to be dredged out.

The disadvantages of the system are as follows:

a. Because of their large surface area, and cold Wisconsin winters, the wastewater in the lagoons may have a low temperature which causes a decrease in biological activity and treatment efficiency.

b. Algae grow readily in these large lagoons, and algae growth in summer causes violation of effluent suspended solids limits.

c. Earthen lagoons are required to be constructed and maintained in accordance with NR 213, Wis. Adm. Code to prevent leakage and possible contamination of groundwater.

d. It's difficult to meet the effluent phosphorus limitations with phosphorus removal processes available in a lagoon.

2. Activated Sludge

The conventional activated sludge process is effective for dairy wastewater, but it does require more capital and higher operator skills. A sludge management system is also required. The activated sludge process does overcome some of the primary disadvantages of the aerated lagoons such as low waste temperatures and algae growth.

3. Sequencing Batch Reactors (SBR)

A relatively new technology that is used in a few dairies is sequencing batch reactors. This is essentially an activated sludge batch process which operates in cycles. One cycle involves shutting off aeration to the wastewater treatment vessel long enough for the sludge to settle. The clean treated effluent is then decanted off and if necessary, sludge is wasted before the aeration system is restarted.

4. Biological Tower

This could be considered a modern trickling filter in that wastewater is trickled down over a wood or plastic media covered with biological growth. The biological growth uses the organic waste of the wastewater as food and eventually sloughs off for collection in a clarifier. A biological tower is generally used as an initial treatment unit in a full treatment process and it may be used for pretreatment prior to discharging to a POTW. Significant wastewater cooling and a corresponding decrease in efficiency can occur in winter.

5. Spray Irrigation

For large dairies that rely on land application a spray irrigation system is common. Since spray irrigation is generally not practical in winter, a large storage lagoon is required. WPDES permits require that the wastewater be pretreated to approximately 100 mg/l BOD_5 prior to storage in a lagoon. This is necessary to control odors that would develop from storing an unaerated, untreated waste.

During the growing season the wastewater is applied to the fields using some type of irrigation equipment. One type of equipment is a center pivot system in which the wastewater is pumped to the pivot point of the center pivot system. The spray nozzles rotate around the field in a circular pattern, evenly distributing the wastewater. Other methods are a traveling gun system where a wheel mounted sprayer is pulled down a lane trailing a flexible rubber hose and the waste is irrigated over approximately a 100 foot wide strip. Other types of systems are temporary piping laid out in a grid pattern which is moved periodically or the nozzles are relocated such that the different areas of the field can be rested and loaded. The operation of

these systems requires that there be suitable soils and at least 5 feet of separation to ground water and bedrock.

6. Ridge and Furrow Systems

The ridge and furrow system originated in the 1950's as a way to irrigate wastewater all year long. The system consists of a series of parallel, shallow furrows about 1 foot deep and located about 8 feet apart. A header ditch connects all the furrows and feeds the wastewater evenly into each furrow. A cover crop is planted on the ridges to take up water and nutrients. A properly designed system will have more than one cell such that the system can be rested and loaded thus allowing the aerobic bacteria in the soil to degrade the waste. Although the systems were popular in the '60's and '70's (there were 80 in 1984) new systems are not constructed as much today because many of these systems could not achieve compliance with the strict ground water standards for nitrates and chlorides. However, there are dozens of systems still being used by smaller dairies which are regulated and permitted by the Department. A scaled down furrow absorption system may be suitable for wash water from dairy farm milking centers.

7. Absorption Ponds

Absorption ponds were popular for dairy wastewater disposal about 25 years ago (there were 58 in 1984) but as with the ridge and furrow systems they are not constructed as much today because of concern about compliance with the new ground water standards. Typically absorption ponds were used by the smaller dairies where the wastewater volume was less than 10,000 gpd. As these smaller dairy plants have closed, many of these absorption ponds have been taken out of service, however, there are still a few of them being used and regulated by this Department. If a new absorption pond system were to be approved today by the Department there would have to be substantial pretreatment ahead of it so that the system could meet the groundwater standards for nitrate and chlorides.

8. Hauling and Land Application

When other options are not available or the strength of the wastewater is very high, then hauling and land application is generally the only viable option. In this type of operation a truck is used to transport the waste from the factory to a suitable land spreading site. All sites must be approved by the Department prior to use and must meet specific criteria to provide groundwater and surface water protection (NR 214 criteria). The trucks used to spread the wastewater may simply have a spreader bar on the back where the waste is dribbled out as the truck drives along. In some of the more advanced systems a high pressure spray nozzle allows the truck to spray it out 100 feet or more to avoid running over crops. Some systems even set up a small temporary irrigation nozzle so that they can pump the wastewater from a large truck out into a field for distribution. For some types of waste such as permeate, salt whey, and separator desludge the pollutant concentrations are so high that land application is the only practical alternative.

E. WPDES Permit Issuance

WPDES Permits regulate the discharge of treated process wastewater, cooling water or condensate of whey to surface waters and the land application of liquid waste or sludge. Dairies that discharge to POTW's are not regulated by DNR unless they also land apply sludge or high strength wastewater. The DNR also issues general permits to regulate the discharge of noncontact cooling water to surface water or the land application of small volumes of process wastewater, high strength wastewater, or sludge where these discharges are considered to have low environmental risk.

There are approximately 45 dairies that hold a WPDES permit to discharge process wastewater to surface water not counting those discharging only non contact cooling water. Of those 45, twenty dairies treat and discharge all their process wastewater and the remaining 25 discharge only condensate from whey processing. Since many dairies discharge to both surface water and land application, or to a POTW and land application, the total number of dairy permits is around 150.

1. Surface Water Effluent Limits

For cheese making and whey processing, categorical limits for BOD_5, suspended solids and pH are promulgated in NR 240 Wis. Adm. Code, Dairy Products Processing. The first step is to calculate the BOD_5 input to each dairy process using multiplication factors in the code (Table 1). Then the allowable pounds of BOD_5 and suspended solids that can be discharged are calculated from factors in the second table (Table 2). These production based limits are based on the maximum month of production in the year. The pH is limited to a range of 6 to 9. Permit categorical limits for BOD_5 and suspended solids are also the annual mass limits for purposes of determining compliance with NR 207 (antidegradation).

The dairy products processing categorical limitations were promulgated by EPA in the early 1970's and the processes used in the dairy industry have changed since then. For new technologies such as shell and tube and mechanical vapor recompression evaporators or for membrane separation technology the drafter has to rely on best professional judgement (BPJ) to establish an appropriate categorical limit. The EPA categorical limit for whey processing equipment was based on a piece of equipment called a barometric condenser which was popular in the 1970's. However, due to higher energy costs and tighter pollution rules these are being phased out.

For the discharge of COW water from shell and tube or mechanical vapor recompression condensers, a BPJ limit has been determined by industrial wastewater engineering staff after analyzing data from a number of installations. The average BOD_5 limit calculation is based on the permittee achieving a 35 mg/l concentration limit in the COW water. The Department has determined that this limit can be achieved with good management and some COW water recycle. The quantity limit is based on the 35 mg/l concentration limit times the total volume of COW water removed (in millions of gallons per day) from the whey times 8.34 (a conversion factor). To calculate the volume of COW water removed requires a material balance using the beginning and ending solids concentration.

After calculating the categorical effluent limits, the permit drafter's or the effluent limit calculator's will next check the water quality conditions in the receiving stream to be sure that the mass limits will not exceed the water quality limits. For fish and aquatic life streams the BOD_5 assimilative capacity is determined from a model or by using the standard water quality model which predicts that 26 lbs of BOD_5 will be assimilated by each 1 cubic foot per second (CFS) of stream flow (the 26 lb rule). Maximum BOD_5 mass limits will be cut back, if

necessary, to match the BOD_5 assimilative capacity of the stream at the lowest flow that occurs 7 consecutive days in 10 years ($Q_{7,10}$).

Dairy wastewater often has significant concentrations of chlorides. Chloride concentration in excess of 395 mg/l for a long time exposure (chronic criteria) and 757 mg/l for short time exposure (acute criteria) are toxic to aquatic life. The DNR has formed a technical advisory committee to develop a chloride discharge policy. When this policy is finalized existing dischargers will be required to implement source reduction measures to reduce chloride concentrations to levels that are not toxic to aquatic life. For new dischargers WPDES permit effluent limits for chloride will be calculated by applying the chronic criteria concentration to the receiving stream. The effluent flow volume and the stream $Q_{7,10}$ are needed to calculate a dilution ratio and the effluent chloride limits, such that when the effluent is discharged into the receiving stream, the mixture will not exceed 395 mg/l chloride. The maximum end of pipe chloride concentration will be twice the acute criteria which is equal to 1514 mg/l.

The DNR also has an advisory committee to review the ammonia discharge policy. When the policy is finalized effluent ammonia limits will be recalculated taken into account the receiving streams flow, effluent discharge volume, and established ammonia criteria. Since ammonia is more toxic at higher pH's, the pH of the receiving stream and characteristics, after mixing with the effluent, is an important factor.

For marginal and intermediate streams the concentration limits for BOD_5, suspended solids, ammonia and dissolved oxygen are taken directly from NR 104. In those situations the mass limits for BOD_5 and suspended solids are still the categorical limits which are calculated from NR 240.

Dairies that discharge more than 60 lbs of phosphorus per month are subject to a 1 mg/l phosphorus limitation in accordance with NR 217 which became effective in December 1992. This limit is currently being implemented and is discussed later in this paper.

2. Land Application of Wastewater

The regulation of the land application of wastewater began in 1976 with promulgation of the first version of NR 214. In 1983 a second version of 214 included the regulation of whey which had caused groundwater pollution problems at some sites due to mismanagement. The most recent version of 214, that became effective July 1, 1990, entitled "Land Treatment of Industrial Liquid Waste, Byproduct Solids and Sludge" tightened the regulations on the dairy industry by limiting the quantities of chloride and nitrogen applied to the land. These additional design and operational criteria were necessary to comply with the groundwater standards adopted in NR 140. Another new requirement is that all land application systems must have a management plan to achieve optimal environmental operation.

a. Groundwater Monitoring Wells

For fixed location land application systems such as spray irrigation, ridge and furrow, and adsorption pond, groundwater monitoring wells are required for discharges with volumes in excess of 15,000 gallons per day. The permit requires the permittee to

sample groundwater from the top of the groundwater table approximately four times per year for parameters such as nitrate, ammonia, organic nitrogen, BOD_5, COD, chloride and pH. Each parameter has a limit from NR 140 or a preventative action limit (PAL) calculated from background well analysis. If exceedances of the groundwater limits are detected the permittee will be required to improve their land application systems. For example, if nitrate is high, then the nitrogen application should be reduced by applying the waste on more acres or by maximizing cover crop growth and removal to take up more nitrogen.

b. Regulation for Each Type of System

Permits for spray irrigation systems require the permittee to collect a representative wastewater sample and analyze for Kjeldahl nitrogen, chloride, BOD_5 and other parameters on a periodic basis. The volume discharged in one application to each irrigated section is limited to what can be absorbed in the root zone so that water and nutrients are taken up by the cover crop. A rest period between applications is necessary and no runoff or ponding is allowed. Harvesting the cover crop is required to remove nitrogen from the system.

Ridge and furrow systems are managed by loading one cell for several days while the other cells rest so that aerobic organisms can degrade the organic matter in the wastewater. Sampling and analysis of the wastewater and flow measurement is required as with spray irrigation. Cover crop harvesting is encouraged but is often not practical due to the narrow ridges.

Discharge to an absorption pond also requires wastewater sampling and analysis and flow monitoring. The best designed absorption pond systems receive pretreated wastewater that is alternately loaded to multiple cells. However, there are dozens of older ponds that are still being used, generally by small dairies, that have only one cell and receive untreated wastewater. As these permits are reissued the system is evaluated to determine the potential for groundwater pollution and if deemed too high the permittee will get a schedule of compliance to develop an alternative wastewater treatment system.

The management plan for hauling and land application requires the permittee to maintain a log book showing the wastewater hauled to each site and requires them to collect a representative sample to be analyzed for nitrogen and chloride. An annual report showing the total quantities waste and the calculated pounds of nitrogen and chlorides applied to each approved field site is required. All landspreading sites must be approved by this department prior to spreading any waste. Wastewater analysis, all approved sites and the annual loading to each site are permanently recorded in a computerized system called the Land Application Management Program (LAMP). The application rate for chlorides cannot exceed 170 lbs per acre per year. Nitrogen application rates must be equal to crop nitrogen uptake. Dairies are allowed to deposit wastewater, whey or permeate in a farm manure storage structure, up to a maximum of 10% of the volume, if the structure meets Natural Resource Conservation Service designs standards and its use is approved by DNR field staff. The farmer is exempt from 214 regulations when the mixture of wastewater and animal waste is spread onto their cropland.

F. Special Problem Areas

3. Phosphorus Limitations

Dairies which discharge treated process wastewater to surface water are required to meet a 1 mg/l phosphorus limit or an alternative concentration limit, if appropriate. Some dairies have upgraded or modified their treatment facilities to facilitate phosphorus removal by biological uptake or chemical precipitation. Dairies discharging to POTW's that have effluent phosphorus limits may have to provide pretreatment facilities or contribute to the cost of upgrading the POTW.

Discharge data collected during the promulgation of the phosphorus standard showed that dairy wastewater had a range of 10 to 80 mg/l of total P, with an average of 30 to 40 mg/l. Forty to fifty percent of the load was due to phosphorus based cleaners (primarily phosphoric acid). The remainder was from product loss to the sewer. DNR has been working with dairies, through seminars and individually, to encourage use of nonphosphorus based substitutes. Nitric acid appears to be an acceptable (and cost competitive) alternative. A number of dairies have switched over to nitric acid. Through cleaning chemical substitution and controlling product losses most facilities should be able to reduce the phosphorus to a level of 15 to 20 mg/l in the untreated effluent..

Even if a dairy reduces phosphorus to a level of to 15 to 20 mg/l (which is 3 to 4 times the level in domestic wastewater), it may be difficult to achieve 1 mg/l in the effluent using typical treatment technologies. Facilities may be able to justify an alternative concentration limit, as provided for in NR 217.04, in the 3 to 4 mg/l range as being "practically achievable."

4. Chloride Limitations

Large quantities of salt are used in the dairy to salt the cheese. Chloride limitations for surface water and groundwater discharges will require careful management of the salting process to minimize loss of chloride to the wastewater stream. Another source of chloride is from backwashing of water softeners. Experience to date indicates that it will be difficult to reduce the chloride concentration to 125 mg/l which is the desired goal to assure the groundwater standards will not be exceeded. If the dairy does everything technically and economically feasible they would be allowed to increase the groundwater chloride concentration to the enforcement standard (250 mg/l) in accordance with NR 140. Landspreading of high chloride waste at a rate of 170 lbs/acre/year may be the only alternative for some dairies to comply with these chloride limits.

5. Aerated Lagoon Treatment Systems

The use of aerated lagoons may be limited because of the difficulty to remove phosphorus and problems with algae growth. There has been limited experimentation with phosphorus removal so the seriousness of this problem is not yet known. The marginal and intermediate stream suspended solids limits of 20 and 15 mg/l, respectively, are often exceeded when algae blooms occur in these ponds. In the past these algae blooms were controlled by using chemicals, such as copper sulfate, but with the low limits now required for copper there seems to be no effective method for algae control.

6. Winterspreading of Waste

Currently NR 214 allows wastewater, whey, permeate and industrial wastewater treatment sludge to be landspread year around but with more restrictive spreading site limitations for winter. However the municipal wastewater treatment sludge land application rule (NR 204) prohibits all winter application of municipal sludge. Although there are currently no EPA regulations for industrial sludge and no activities ongoing to change NR 214 to ban winter application of industrial sludge, there is concern that industries and cities should be treated alike. While banning the winter application of sludge could be achieved by building large storage structures, the banning of all liquid waste application would be hard for the dairy industry to implement. This is because dairies are land applying large volumes of high strength waste, such as whey permeate, that would create odor problems if stored. It is important that the dairy's waste manager select the best fields and use the best management practices when winterspreading to minimize the runoff potential.

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