

The background of the slide is a grayscale photograph of industrial machinery. On the left side, there is a circular pressure gauge with a white face and black markings, ranging from 0 to 1.0. The needle is positioned around 0.4. To the right of the gauge, there are various pipes, valves, and mechanical components, including a large vertical pipe with a valve handle. The overall scene is a close-up of an industrial process.

# Strategies for Source and Load Reduction in Industrial Effluent

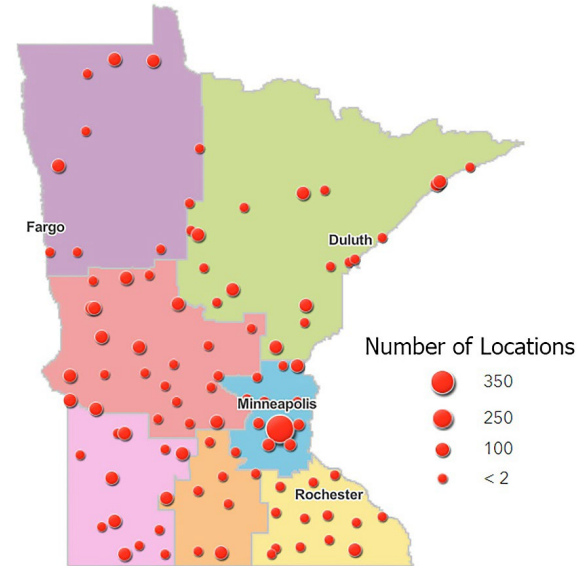
Kevin Philpy  
Senior Engineer  
Minnesota Technical Assistance Program



UNIVERSITY OF MINNESOTA  
**Driven to Discover<sup>SM</sup>**

# Minnesota Technical Assistance Program

- **Confidential, grant-funded environmental support for MN businesses**
  - Prevent pollution at the source
  - Optimize resource consumption
  - Reduce waste and energy use
- **11 engineers and professionals**
- **Based in School of Public Health at University of Minnesota**

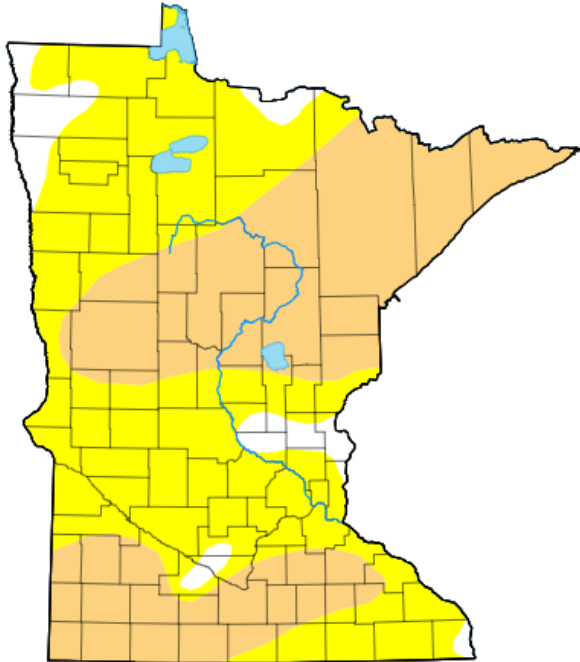


Supported Facilities 2017-2021

# Food Industry – Economic Impact

NAICS	NAICS Description	Businesses	Employees	Annual Sales (\$MM)
311511	Fluid Milk Manufacturing	34	1,040	\$576.2
311512	Creamery Butter Manufacturing	13	812	\$65.2
311513	Cheese Manufacturing	26	874	\$22.9
311514	Dry, Condensed, and Evaporated Dairy Product Manufacturing	40	1,523	\$1,321.0
311520	Ice Cream and Frozen Dessert Manufacturing	29	456	\$68.3
<b>3115</b>	<b><i>Total – Dairy Product Manufacturing</i></b>	<b>142</b>	<b>4,705</b>	<b>\$2,053.6</b>
<b>3116</b>	<b><i>Total – Animal Slaughtering and Processing</i></b>	<b>246</b>	<b>16,143</b>	<b>\$16,397.3</b>
<b>3121</b>	<b><i>Total – Beverage Manufacturing</i></b>	<b>201</b>	<b>1,638</b>	<b>\$383.3</b>
	<b>Total Manufacturers in Focus Areas</b>	<b>589</b>	<b>22,486</b>	<b>\$18,834.2</b>

# Water Conservation



Map released: Thurs. October 3, 2024

Data valid: October 1, 2024 at 8 a.m. EDT

## Intensity

- None
- D0 (Abnormally Dry)
- D1 (Moderate Drought)
- D2 (Severe Drought)
- D3 (Extreme Drought)
- D4 (Exceptional Drought)
- No Data

## Authors

United States and Puerto Rico Author(s):

[Richard Tinker](#), NOAA/NWS/NCEP/CPC

Pacific Islands and Virgin Islands Author(s):

[Denise Gutzmer](#), National Drought Mitigation Center

**U.S. Drought Monitor – Nebraska-Lincoln**

# High-Strength Waste Sources

- **Facility-Specific**

- Equipment sanitization – Most facilities
- Building heating/cooling – Any facility
- Refrigeration – dairy, meat, fruit/vegetable

- **Industry-Specific**

- Breweries/distilleries – Intermediate processes
- Milk/juice beverage producers – Organic waste
- Packaged food manufacturers – Edible oil



# Common Parameters – Food/Beverage

Parameter	Dairy	Vegetables	Meat	Bakery
BOD/COD	X	X	X	X
FOG	X		X	
TSS	X	X	X	X
Cl-, N, P		X	X	
Metals		X		
High Flow	X	X	X	X

- **Variation within industry – not all plants are the same**
- **Keep slug plans and product lists updated**

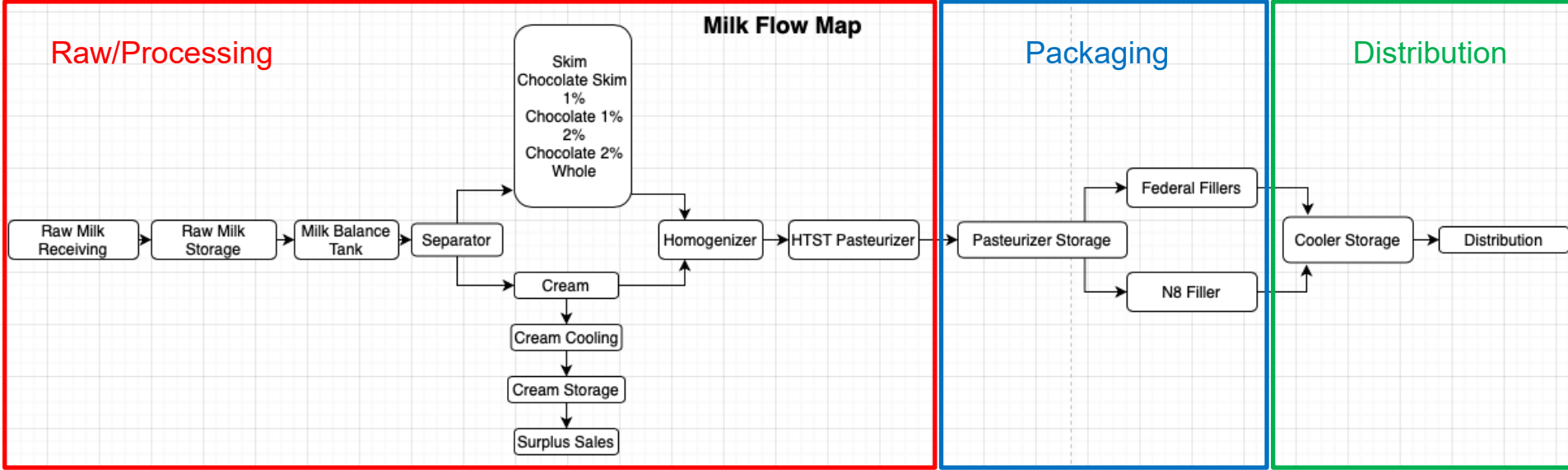
# 2023 Dairy Internships



# Dairy Processing

## Raw/Processing

### Milk Flow Map



# Dairy Product Conservation

- **Reduce product lost to wastewater**
  - Average Shrink of 2%
  - Shrink: 100 jugs made, 98 jugs make it to distribution
- **Evaluate key processes for milk loss**
- **Decrease strength charges resulting from milk loss to drain**



# Federal Fillers

Rotary filler for half and full gallon jugs

- **Start Up:**
  - Milk is run through to rinse out sanitizer
  - Milk flow is shut off manually once sanitizer is removed
- **Shut Down:**
  - At end of run, remaining milk is discharged to floor drain
  - Bowl and lines are rinsed before cleaning



# Recommendations for Federal Fillers

## Proposed Solution for Start Up

- Implement an inline conductivity sensor before bowl of filler
- Eliminates operator variability in shutoff time
- Cost: TBD

## Potential Annual Savings

- 94,000 gallons of milk
- \$114,000 in revenue
- \$38,000 in strength charges



# Recommendations for Federal Fillers

## Proposed Solution for Shut Down

- Best practice sharing between operators
- Reduce milk left in bowl before filler is shut down
- Cost: \$1,000

## Potential Annual Savings

- 29,000 gallons of milk
- \$35,000 in revenue
- \$11,700 in strength charges



# CIP (Clean-in-Place) Systems

- CIP systems clean tanks/product lines
- May include:
  - Pre-rinse
  - Intermediate-rinse
  - Post-rinse
  - Caustic/acid wash
  - Sanitize
- Remove product, scale and biofouling
- Each system is responsible for multiple tanks/lines called circuits
- Trended system data



# Decrease Post/Intermediate-Rinse Time

## Water Savings

- Utilized trended data
- Monitored the conductivity to find when it reached a low point for each circuit
- Added a safety net of 20 seconds to the new rinse time

## Fuel Savings

- Due to lower water usage, fuel was also saved
- Only applied to some circuits

# Decrease Pre-Rinse Time

## Water Savings

- Trended data was utilized
- There was no turbidity sensor present
- Used post/intermediate-rinse time for new pre-rinse time
- Safety net of 20 seconds utilized

## Fuel Savings

- Same as post/intermediate-rinse



**Natural gas boiler**

[10 Ton Natural Gas Fired Steam Boiler  
\(aac-autoclave.com\)](http://aac-autoclave.com)

# Condensate Recovery

- Food production is a wet process
- Not all water comes into contact with product
- Condensate can be recovered

## Solutions

- Save final rinsate for pre-rinse
- Close the loop on cooling water



# 2024 Internship

Padon Kinzley – U of M

Junior – Bioproducts/Biosystems Eng.

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**MICHAEL  
FOODS** INC.

- Water conservation at Chaska facility
- Hashbrowns, diced and mashed potatoes
- 259 million pounds produced per year



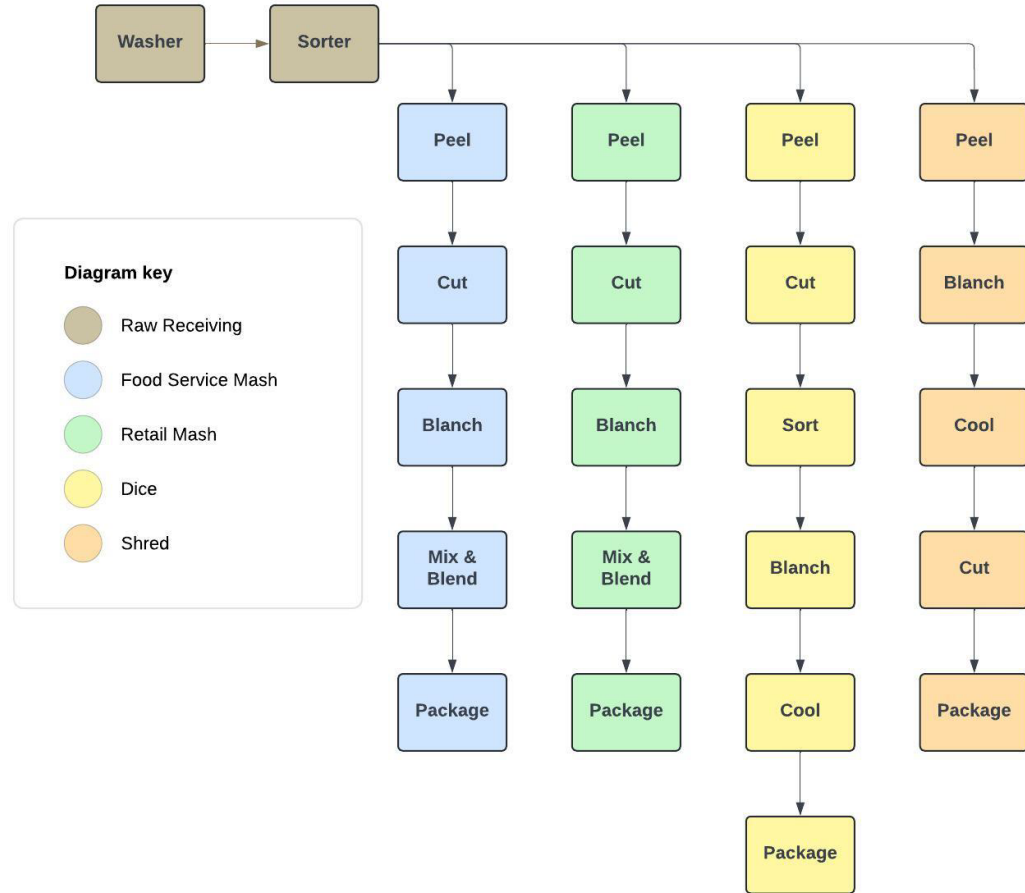
# Incentive to Change

- **Corporate Goal:**
  - Waste minimization
  - Water conservation
- **Plant Goal:**
  - Water-intensive process
  - Switch from well to municipal water
  - 160 million gallons used annually

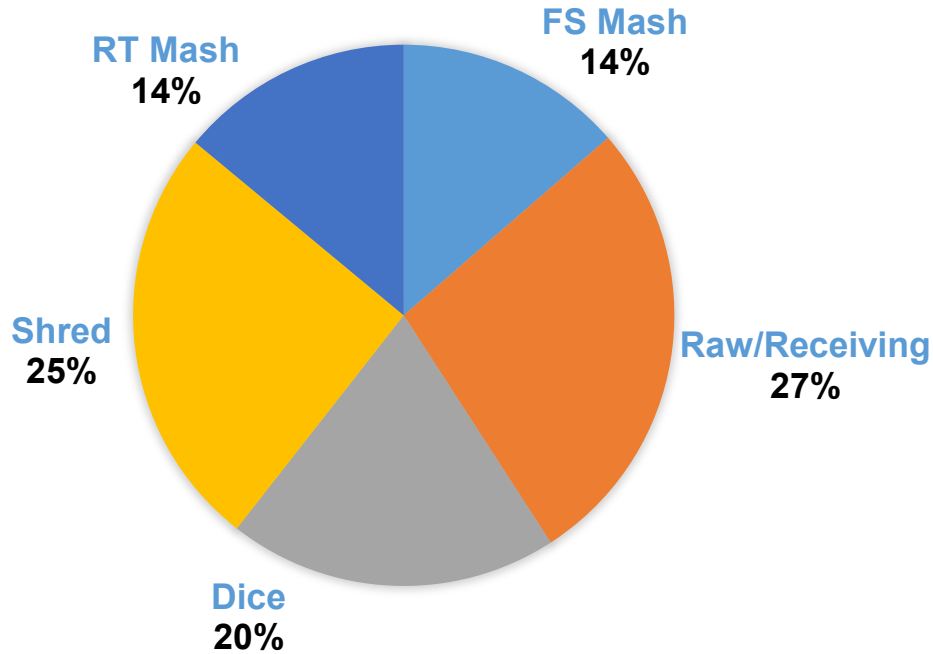


# General Process

- **Raw Receiving**
  - Washing, sorting, storing
- **Peel/Cook**
  - Peeling, brushing, cutting, cooking
- **Clean Room**
  - Flavoring, cooling, packaging



## PROCESS WATER USE



\*Excludes water from Utility Room, Waste Room, CIP

## Approach

- Flow Mapping
- Understanding Equipment
- Researching Options
- Recommending

# Raw Receiving

- **80,000 gallons daily**
  - 25 million gallons annually
  - 27% of annual water use
- **Washer**
  - Uses majority of water in Raw/Receiving
  - Washer fill + sprayers
  - Conveyor system to move potatoes



# Washer Recommendations

- **Install sprayer flow restrictor**

- **Implementation Cost:**

- <\$100

- **Annual Savings:**

- 3.6 million gallons

- \$38,000

- **Automate sprayer shut off**

- **Implementation Cost:**

- \$1,000

- **Annual Savings:**

- 520,000 gallons

- \$5,000



# Peel Starch Separators

## Background

- **Large rotating drum**
  - Require 5 GPM
  - Removes peel
- **Lines 2, 3, and 4**
  - Running almost 24/7
  - Using over 10 GPM

## Recommendations

- **Install flow restrictors**
  - Implementation cost:
    - <\$500
  - **Annual Savings**
    - 4.7 million gallons
    - \$49,000



# Solutions

Recommendation	Annual reduction	Total cost	Annual savings	Payback period	Status
Install Flow Restrictors on Peel Starch Separators	4.7 million gallons	<\$500	\$49,000	4 days	Recommended
Install Flow Restrictor on Washer Sprayers	3.6 million gallons	<\$100	\$38,000	1 day	Recommended
Automate Raw/Receiving Sprayer Shut Off	520,000 gallons	\$1,000	\$5,000	2 months	Recommended
Automate FS Mash Water Shut-Off	180,000 gallons	\$5,000	\$2,000	2.5 years	Tentatively Recommended
Install Nozzle on USDA Hose	75,000 gallons	<\$100	\$800	2 months	Recommended

**5.7% water reduction if all recommendations are implemented**

# Source Reduction is the Goal!

- Divert or limit high-strength waste from wastewater
- Minimize or reuse water
- Minimize the need for chemicals (which can be expensive!)



**Source reduction benefits everyone!**

<https://www.epa.gov/toxics-release-inventory-tri-program/pollution-prevention-p2-and-tri>

# Thank You!

***Strengthening Minnesota businesses by improving efficiency  
while saving money through energy, water, and waste prevention***

[www.mntap.umn.edu](http://www.mntap.umn.edu)



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