

**2001 AIChE NATIONAL STUDENT DESIGN COMPETITION**

**Economic Recovery of Edible Protein from  
Cheese Whey by Ultrafiltration**

**Design Solution**

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## Executive Summary

Whey is a major byproduct of the production of cheddar cheese. Currently it is being evaporated and sold at little profit as animal food. As the whey contains valuable proteins, the cheese manufacturer would like to investigate the use of ultrafiltration to isolate the protein.

Ultrafiltration allows small molecular particles to pass through the filtration membrane, while retaining larger ones. By this method, the other components of the whey can be removed, obtaining a higher protein concentration.

Three protein products are to be produced, 35 percent protein by dry weight, 75 percent and 85 percent. As the solution becomes too viscous when the protein concentration is 55 percent, diafiltration must be used to obtain the higher concentration products. The plants capacity will increase 4 percent each year of the project life of 10-years.

Careful design by considering many different options resulted in a multi-staged feed-and-bleed continuous system. It consists of three portions, one for each product. The exit from the first portion provides the 35 percent product, as well as the feed to the second portion. The first portion consists of ten stages with 22 cartridges per stage. The second portion consists of one stage of ultrafiltration to 55 percent protein, and one stage of diafiltration to achieve the 75 percent product. The third portion has one stage of diafiltration to achieve the 85 percent product.

Any opportunity for savings was implemented into the project. Instead of simply disposing of the permeate waste, the existing drying system is used when not drying the protein products to concentrate the permeate. It is then given to local farmers, who remove it at no cost. This method saves \$12 million over the project life due saved cost of removing the permeate as wastewater.

Additional savings were found by recycling water through the system. By using the water evaporated from the drying system as water for diafiltration and cleaning rather than purchasing water, there is a savings of \$529,000.

The equipment cost for this project is \$2 million, while the engineering costs are \$1 million, and the installation costs are \$1 million. The total capital investment of the project is \$4 million.

In the final year, the total product expenses are \$2.2 million, the general expenses are \$1.3 million, and the operation expenses are \$3.5 million. The largest cost is the utilities, mainly the steam.

This project has a minimum rate of return of 12 percent. By using the discounted cash flow method, it was found that this project has a rate of return of 29.2 percent. This indicates that this project is desirable and should be implemented.

## Introduction

As whey encompass a major portion of the waste from the production of cheddar cheese, recovery of whey products can substantially change the financial aspect associated with whey disposal.

Currently, whey is dried to produce a dry product sold as animal food at \$0.15 per pound. Though very little profit is made, the system does eliminate whey as a waste stream.

The whey stream consists of proteins, lactose, ash, butter fat, and water. Whey proteins are used in many consumer products as a food additive. Therefore, separation and recovery of whey proteins has a substantial demand. New technology in the form of ultrafiltration has made protein recovery possible. By selectively allowing low molecular particles, such as ash and lactose, to pass through the membranes, the whey protein concentration can be increased. Due to viscosity complications, diafiltration must be used to obtain protein concentration above 55 percent. Diafiltration is simply adding water to the solution to aid in flushing out the low molecular compounds through the membranes. Dry weight concentration as high as 90 percent protein can be achieved though ultrafiltration and diafiltration.

The task at hand is to design an ultrafiltration process to produce three dry whey products. Designing will include process equipment as well as a cleaning system. Full cost of the equipment, installation supervision, and start-up supervision will be included as well as a complete financial analysis.

## Summary

Careful consideration of the system design and waste removal were involved in the analysis of this project. By examining the different options for the ultrafiltration system, the most cost effective method was found, consisting of ten stages of ultrafiltration to achieve a 35 percent product, one stage of ultrafiltration and one stage of diafiltration to achieve the 75 percent product, and one stage of diafiltration to achieve the 85 percent product. Each line builds off of the previous one.

Savings were made by sending a portion of the permeate to be evaporated, instead of disposing of the permeate waste. It is concentrated to 20 percent solids and is taken away from the plant at no charge. By using the existing drying system when it is not in use, the savings for the life project is \$12 million.

Integrated into the design were several other ways of saving money. Water is recycled in the system to eliminate bringing in additional water, and the number of cartridges used is decreased when the system is not running at 100 percent capacity.

This project had a minimum IRR of 12 percent. The actual IRR was 29.2 percent, and has a payback period of four years. This project should be implemented.

## Conclusions

Wastewater removal is one of the largest costs associated with running the plant. In fact, by sending all the permeate waste to wastewater treatment, it is so costly that it makes the project uneconomical. By using the current drying system, there is no capital requirement. As the amount of material the current drying equipment will be reduced with the new protein products from prior to the change, the equipment will not be running at full capacity. By assuming that the equipment can handle as much material as prior to

the plant conversion, the drying equipment can dry a good portion of the permeate material. This will be combined with non-evaporated permeate material, resulting in a 20 percent product that will be taken away by farmers for cattle feed at no charge. Though the steam requirement of the drying equipment will be greater, the elimination of the additional waste more than makes up for the costs. The savings over the project life is \$12 million. In fact, without this means of disposing of the permeate, the IRR would be 8.9 percent, an unacceptable rate of return, where with this means of disposal, the IRR is 29.2 percent.

Careful analysis of different design systems and arrangements resulted in the minimum cost to design, purchase, and install the necessary equipment. The most cost effective arrangement is a continuous system that consists of three parts. The first produces the 35 percent product, as well as the feed to the second portion of the system. The second portion produces the 75 percent product and the feed to the final portion. This final portion produces the 85 percent product. It was found that the optimum number of stages for the first portion was ten, with about 22 cartridges per stage. The second portion consists of one stage of ultrafiltration with 13 cartridges to achieve 55 percent protein, leading to one stage of diafiltration and 18 cartridges to achieve the 75 percent product. This is more cost effective than using diafiltration alone from the 35 percent feed. The final portion will consist of diafiltration with one stage and 7 cartridges.

One of the large savings in this project comes from recycling water in the process. A large quantity of water is removed from the products in drying them. By recycling this water to use for diafiltration and as water to rinse the process when cleaning and making

up cleaning solutions, there is no need to purchase additional water. Further more, there is less water to be disposed of, reducing the cost of waste removal. Recycling process water has a savings of \$529,000 for the project life.

Since the capacity of the plant is increasing each year, the plant was built at maximum capacity. However, this creates a problem in that with the decreased flow rates, the membrane area is too great, resulting in a product with higher concentration than desired. This is undesirable, as we do not want to waste the protein; the amount of area per stage needs to be reduced. This is accomplished by reducing the number of cartridges in use per stage per year, resulting in just enough area to obtain the desired product concentration. Not only does this reduce protein waste, but it also decreases the operation expense for buying additional cartridges which have a life of one-year, a savings of \$290,000 for the project life. Decreasing the number of cartridges also decreases the system volume, reducing the amount of cleaning solution, as savings of about \$33,000 for the project life.

## Recommendations

This project has an IRR of 29.2 percent, higher than the minimum of 12 percent, thereby making this project a good investment and should be implemented. The payback period is 4 years.

The complication of increased capacity each year causes the product to have slightly different composition each year. Careful precautions have been taken to insure that the protein concentration never falls below the minimum required.

## Project Premises

### Provided Data

The following data was provided in the project:

#### Feed composition (weight basis):

True Protein, TP	0.6 %
Non-Protein Nitrogen, NPN	0.3 %
Lactose	4.9 %
Ash	0.8 %
Butter Fat	0.05 %
Remainder is water	Density = 8.5 lbs/gal

#### Product composition (dry basis):

TP and NPN	35.0 wt. %
TP and NPN	75.0 wt. %
TP and NPN	85.0 wt. %
Density = 8.5 lbs/gal	

#### Membrane rejections:

True protein	0.970
Non-protein nitrogen	0.320
Lactose	0.085
Ash	0.115
Butter Fat	1.00

#### Membrane Cartridge (PM 10 from Koch Membrane Systems)

Cost of 26.5 sq. ft. hollow fiber cartridge	\$200 each
Cost of cartridge clamps, gaskets, adapters	\$15 each cartridge
Membrane life	1 year
Cartridge dimensions, 3 in. diameter x 40 in. long	Manifold spacing – 7-in. centers

#### Optimum Cartridge Operation Conditions:

Cartridge inlet pressure	30 psig
Cross flow pressure drop	15 psi
Permeate pressure	5 psig
Recirculation Rate/Cartridge	23 gpm

#### Equation for Membrane Flux:

$$J = 27.9 - 5.3 \cdot \ln(CF)$$

where

$J$  = flux rate in gallons per sq. ft. of membrane per day

$CF$  = concentration factor

#### Utility Costs:



Power cost: \$0.07/kwh  
 Steam cost: \$5.00/million BTU

Financial Data:

Company allocation for Administrative Costs 4% of Sales  
 Allocation for Selling Expense 12% of Sales  
 Allocation for R&D Expense 5% of Sales  
 Allocation for Space \$125,000/year  
 Inventory, days on hand 60 days  
 Accounts Receivable, days 45 days  
 Increase in Fixed Assets/Year (after 1<sup>st</sup> year) 2% of Sales  
 Book value of equipment (evaporator and spray dryer) transferred to cost center. \$300,000

Cost of Concentrates to Formulate Cleaning Solutions:

CIP Acid from Ecolab \$ 9.09/gal  
 Ultrasil 22 from Ecolab \$ 11.86/gal  
 Sodium Hypochlorite from Wal-Mart (5.25 wt. %) \$ 0.90/gal

Feed:

Whey Costs \$ 0.05 per pound protein  
 Feed Rate 1,000,000 lbs/day  
 Increase in production 4% per year

Margins and other information for selling price calculations:

Margin on cartridges 75%  
 Margin on other costs 35%  
 Engineering labor rate \$60/hour

Additional Information:

Maximum concentration by ultrafiltration 55 wt. % (dry solid basis)  
 Maximum residence time in system 4 hours

Product	Selling Price of Products	Max. Product Sale (1 <sup>st</sup> year)
35 %	\$ 0.65 (per pound dry powder)	14,000 lbs/day
75 %	\$ 1.25	4,000
85 %	\$ 2.50	400

Increase in maximum sales 4% per year  
 Sanitary pump manufacturer Tri-Clover, Inc  
 Existing drying system 0.35 lb steam/lb of water evaporated  
 Labor rate<sup>2</sup> \$21/hr  
 Current Marshall and Swift cost index (4<sup>th</sup> quarter 2000)<sup>1</sup> 1094.5

Economics:

Equipment Life 10-years

Scrap Value	None
Depreciation Method	7 year MACRS
Minimum IRR	12%

MACRS Statutory Percentages – 7 years<sup>2</sup>:

Applicable Recovery Year	Applicable Recovery Percentage
1	14.29
2	24.49
3	17.49
4	8.93
5	8.92
7	8.93
8	4.46

Operating Conditions:

Operation Hours	7 days/week, all year
Production	20 hours
Plant Cleaning	4 hours

Engineering Costs:

Basic cost for a manual stage	\$1,200 per cartridge position
Extra cost/stage (when part of a staged system)	\$10,000
Cost to automate each stage	\$6,000
Central control panel including PLC and motor starters	\$48,000
Cleaning System	\$55,000

Waste Treatment:

\$/1000 gallons of hydraulic load	\$1.00
\$/lb of BOD above 300 mg/L	\$0.12
\$/lb of TSS	\$0.10
BOD is 60% of theoretical COD (primarily lactose)	
Can dispose of permeate at no charge by concentrating to 20% TDS	

Limitations:

Pipe Size	4-in. nominal stainless steel
Fluid Velocity	16 ft/sec

Construction Materials:

Process equipment	316 stainless steel for sanitary use
Cleaning system	Plastic

Water Costs:

Soft water for cleaning	\$5.00/1000 gallons
Deionized water for diafiltration	\$15.00/1000 gallons

Taxes:

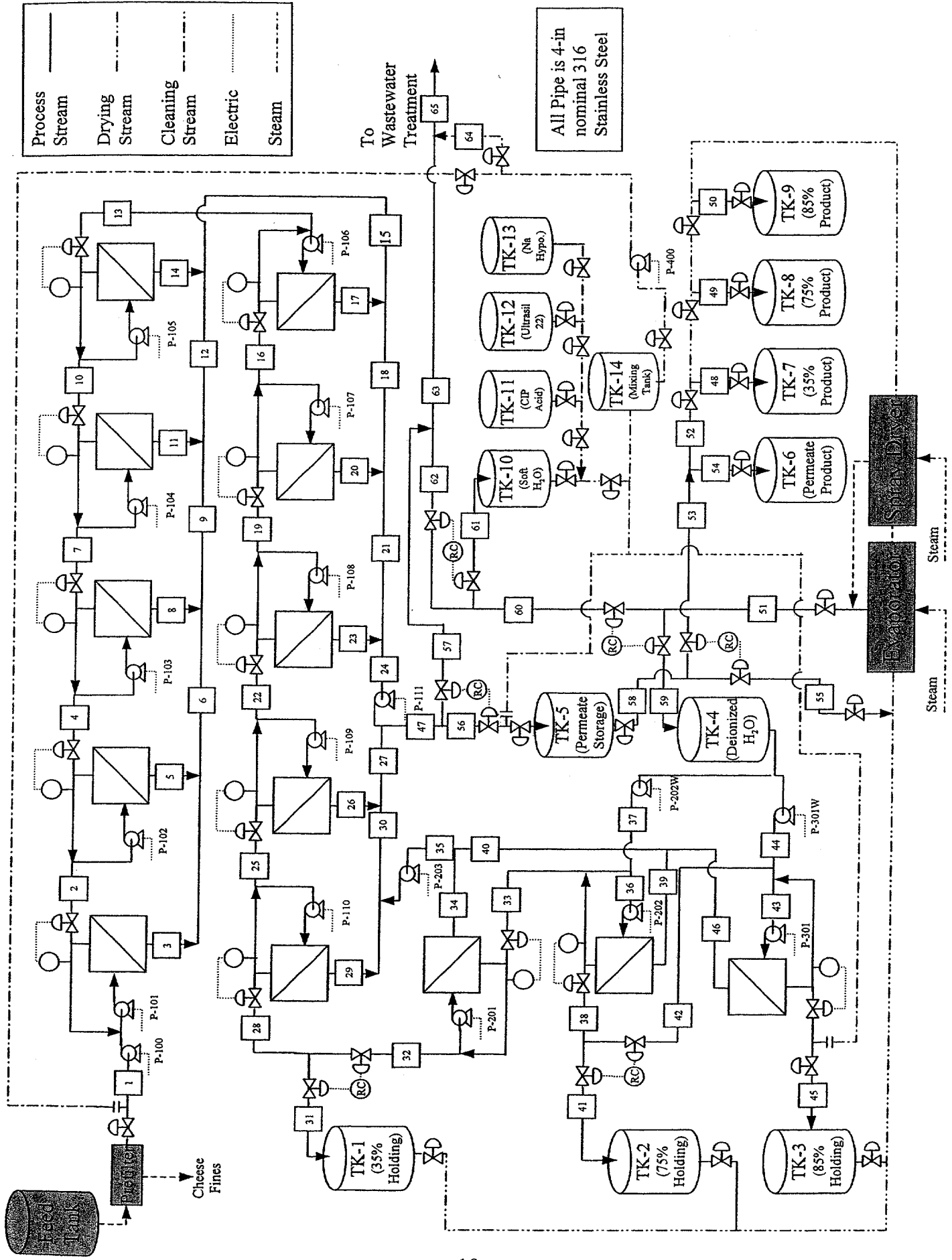
Federal Taxes	34%
State Taxes	6%

### Assumptions

The following are assumptions made during the design of this project:

- 1) The recirculation rate is high compared to the feed rate, the permeate rate and the bleed rate.
- 2) The membrane rejection is constant.
- 3) Whey is already at operating temperature from cheese production. There are no heat losses or gains through the process.
- 4) All streams have the same density (8.5 lb/gal), except those that are only water.
- 5) Tank sizes 25 percent larger than actual volume are sufficient. Intermediate tanks hold one day's capacity.
- 6) Water driven off of the evaporator and dryer is sanitized from the evaporating process, and can be used as deionized water and soft water.
- 7) Evaporator and dryer system can evaporate same amount of water as prior to process changes. For 1,000,000 lbs whey per day, the dryer system can evaporate 933,500 lbs water per day.
- 8) Cleaning system is currently in place for all existing equipment.
- 9) Theoretical COD is for lactose only (waste stream is primarily lactose). All lactose is oxidized, leaving ash and protein as suspended solids.
- 10) There is no inflation.
- 11) Services provided by ultrafiltration engineering company includes design, supervision and training, all of which is included in cost given.
- 12) Material factor for sanitary 316 stainless steel is 3.5 (carbon steel - 1.0).
- 13) Steam is 15 pound saturated steam (1150.06 BTU per pound steam<sup>5</sup>).
- 14) The cleaning solutions to be recycled can only be recycled during the cleaning. In other words, the solutions are recirculated through the system for the 30 minutes required, then disposed of.
- 15) Pressure loss in each stage is 20 psi, 15 psi of which is lost through the cartridges.

### Process Flow Diagram



## Stream Attributes

The stream attributes for the tenth year are shown. The first nine years can be found in Appendix A.

Year 1

Stream/Description	Feed	Bleed	Perm. 1	Bleed 2	Perm. 2	Perm. Mix	Bleed 3	Perm. 3	Perm. Mix	Bleed 4	Perm. 4	Perm. Mix	Bleed 5	Perm. 5	Perm. Mix	Bleed 6	Perm. 6	Perm. Mix	
Stream Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Component																			
lbs/min																			
True Protein	5.00	4.98	0.02	4.96	0.02	0.04	4.95	0.02	0.05	4.92	0.02	0.08	4.90	0.02	0.10	4.87	0.03	0.13	
Non-Protein Nitrogen	2.50	2.32	0.18	2.14	0.17	0.36	1.97	0.18	0.53	1.79	0.18	0.71	1.61	0.18	0.89	1.43	0.18	1.07	
Lactose	40.83	36.89	3.94	33.27	3.62	7.56	29.71	3.56	11.12	26.22	3.49	14.61	22.81	3.41	18.03	19.49	3.32	21.35	
Ash	6.67	6.04	0.62	5.47	0.58	1.20	4.90	0.57	1.77	4.34	0.56	2.33	3.79	0.55	2.88	3.25	0.54	3.41	
Butter Fat	0.42	0.42	0.00	0.42	0.00	0.00	0.42	0.00	0.00	0.42	0.00	0.00	0.42	0.00	0.00	0.42	0.00	0.00	
Water	777.92	695.52	82.39	620.62	74.91	157.30	547.73	72.89	230.19	477.07	70.66	300.85	408.88	68.19	389.04	343.48	65.40	434.43	
Total	633.33	746.17	87.16	666.88	79.29	166.45	589.67	77.21	243.68	514.76	74.91	318.58	442.41	72.35	390.93	372.94	69.46	460.39	
Total Solids	55.42	50.65	4.77	46.26	4.39	9.15	41.94	4.32	13.48	37.69	4.25	17.73	33.53	4.16	21.89	29.46	4.07	25.96	
gal/min																			
Total	98.04	87.78	10.25	78.46	9.33	19.58	69.37	9.08	28.67	60.56	8.81	37.48	52.05	8.51	45.99	43.88	8.17	54.16	
Mass %																			
True Protein	0.60%	0.67%	0.02%	0.74%	0.02%	0.02%	0.84%	0.03%	0.02%	0.86%	0.03%	0.02%	1.11%	0.03%	0.03%	1.31%	0.04%	0.03%	
Non-Protein Nitrogen	0.30%	0.31%	0.21%	0.32%	0.22%	0.21%	0.33%	0.23%	0.22%	0.35%	0.24%	0.22%	0.36%	0.25%	0.23%	0.38%	0.26%	0.23%	
Lactose	4.90%	4.94%	4.52%	4.99%	4.56%	4.54%	5.04%	4.61%	4.56%	5.09%	4.66%	4.59%	5.16%	4.72%	4.61%	5.22%	4.78%	4.64%	
Ash	0.80%	0.81%	0.72%	0.82%	0.73%	0.72%	0.83%	0.74%	0.73%	0.84%	0.75%	0.73%	0.86%	0.76%	0.74%	0.87%	0.77%	0.74%	
Butter Fat	0.05%	0.06%	0.00%	0.06%	0.00%	0.00%	0.07%	0.00%	0.00%	0.08%	0.00%	0.00%	0.09%	0.00%	0.00%	0.11%	0.00%	0.00%	
Water	93.35%	93.21%	94.53%	93.08%	94.47%	94.50%	92.89%	94.40%	94.47%	92.68%	94.33%	94.44%	92.42%	94.24%	94.40%	92.10%	94.15%	94.36%	
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
% Solids	6.7%	6.8%	5.5%	6.9%	5.8%	5.8%	7.1%	5.6%	5.5%	7.3%	5.7%	5.6%	7.6%	5.8%	5.6%	7.9%	5.9%	5.6%	
% Protein of Solids	13.5%	14.4%	4.2%	15.4%	4.4%	4.3%	16.5%	4.5%	4.4%	17.8%	4.7%	4.4%	19.4%	4.9%	4.5%	21.4%	5.1%	4.6%	
Properties																			
Temperature (°C)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	
Pressure (psi)	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	

Year 1

Stream/Description	Bleed 19	Perm 7	Perm Mix 20	Bleed 21	Bleed 22	Perm 8	Perm Mix 23	Bleed 24	Perm 9	Perm Mix 26	Bleed 27	Perm 10	Perm Mix 29	Bleed 30	Perm Mix 31	55% Wet	55% Feed	55% Bleed	55% Perm	Perm Mix 34	Perm Mix 35	
Component																						
Ibs/min																						
True Protein	4.84	0.03	0.16	0.04	4.80	0.04	0.20	4.76	0.04	0.27	4.72	0.04	0.23	4.72	0.04	3.53	1.19	1.14	0.06	0.19	0.19	
Non-Protein Nitrogen	1.25	0.18	1.25	0.18	1.06	0.18	1.44	0.88	0.18	0.48	0.75	0.13	0.30	0.56	0.19	0.09	0.09	0.09	0.10	0.10	0.17	
Lactose	16.27	3.21	24.56	3.08	13.20	3.08	27.64	10.29	2.91	6.84	8.30	1.99	3.92	6.20	2.10	0.83	1.26	0.83	1.26	1.26	1.94	
Ash	2.73	0.52	3.93	0.50	2.23	0.50	4.44	1.75	0.48	1.14	1.42	0.33	0.66	1.06	0.36	0.15	0.21	0.15	0.21	0.21	0.33	
Butter Fat	0.42	0.00	0.00	0.00	0.42	0.00	0.00	0.42	0.00	0.00	0.42	0.00	0.00	0.31	0.11	0.00	0.00	0.00	0.00	0.00	0.00	
Water	281.27	62.21	496.65	222.75	58.82	58.82	555.16	168.61	54.14	171.47	132.40	36.21	117.32	98.97	33.43	11.72	21.71	11.72	21.71	21.71	81.11	
Total	306.78	66.16	526.55	244.46	62.32	62.32	586.87	186.70	57.76	180.19	148.01	38.70	122.43	110.64	37.37	14.03	23.34	14.03	23.34	23.34	83.74	
Total Solids	25.51	3.95	29.90	21.71	3.80	3.80	33.71	18.09	3.62	8.73	15.61	2.48	5.11	11.67	3.94	2.31	1.64	2.31	1.64	1.64	2.63	
gall/min																						
Total	36.09	7.78	61.95	28.78	7.33	7.33	69.28	21.97	6.80	21.33	17.41	4.55	14.54	13.02	4.40	1.65	2.75	1.65	2.75	2.75	9.98	
Mass %																						
True Protein	1.56%	0.05%	0.03%	0.06%	1.97%	0.06%	0.03%	2.65%	0.08%	0.15%	3.19%	0.10%	0.19%	0.15%	0.19%	3.19%	0.15%	8.10%	0.24%	0.24%	0.23%	
Non-Protein Nitrogen	0.41%	0.28%	0.24%	0.30%	0.43%	0.30%	0.24%	0.47%	0.32%	0.27%	0.50%	0.34%	0.24%	0.50%	0.27%	0.63%	0.27%	0.63%	0.43%	0.43%	0.20%	
Lactose	5.30%	4.85%	4.66%	4.94%	5.40%	4.94%	4.69%	5.51%	5.04%	3.79%	5.61%	5.13%	3.20%	5.61%	3.79%	5.92%	5.92%	5.92%	5.42%	5.42%	2.31%	
Ash	0.89%	0.79%	0.75%	0.81%	0.81%	0.81%	0.75%	0.84%	0.83%	0.63%	0.96%	0.85%	0.54%	0.96%	0.63%	1.03%	0.92%	1.03%	0.92%	0.92%	0.39%	
Butter Fat	0.14%	0.00%	0.00%	0.00%	0.17%	0.00%	0.00%	0.22%	0.00%	0.00%	0.28%	0.00%	0.00%	0.28%	0.00%	0.75%	0.00%	0.75%	0.00%	0.00%	0.00%	
Water	91.68%	94.03%	94.32%	91.12%	93.80%	93.80%	94.28%	90.31%	93.73%	95.16%	89.46%	93.58%	95.83%	89.46%	95.16%	83.87%	92.99%	83.87%	92.99%	92.99%	96.86%	
Total	500%	100%	100%	100%	600%	100%	100%	700%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
% Solids	8.3%	6.0%	5.7%	6.1%	8.9%	6.1%	5.7%	9.7%	6.3%	4.8%	10.5%	6.4%	4.2%	10.5%	4.2%	16.4%	7.0%	16.4%	7.0%	7.0%	3.1%	
% Protein of Solids	23.9%	5.4%	4.7%	27.0%	5.8%	5.8%	4.8%	31.2%	6.3%	8.7%	35.0%	6.8%	10.3%	35.0%	35.0%	53.1%	9.6%	53.1%	9.6%	9.6%	13.6%	
Properties																						
Temperature (°C)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	
Pressure (psi)	15	5	5	5	15	5	5	15	5	5	15	5	5	15	5	15	5	15	5	5	5	

Year 1

Stream Description Stream Number	Dia. 1 Feed 35	H2O Feed 37	Dia. 1 Bleed 38	Dia. 1 Perm. 39	Perm. Mix 40	75% Wet 41	Dia. 2 42	Dia. 2 Feed 43	H2O Feed 44	85% Wet 45	Dia. 2 Perm. 46	Total Perm. 47	35% Prod. 48	75% Prod. 49	85% Prod. 50	Evap H2O 51
Component lbs/min													lbs/day	lbs/day	lbs/day	lbs/day
True Protein	1.14	0.00	1.03	0.10	0.13	0.71	0.32	0.32	0.00	0.29	0.03	0.47	4,236.98	853.89	349.68	0.00
Non-Protein Nitrogen	0.08	0.00	0.03	0.06	0.07	0.02	0.01	0.01	0.00	0.00	0.01	1.92	668.86	22.38	3.05	0.00
Lactose	0.83	0.00	0.21	0.63	0.67	0.14	0.06	0.06	0.00	0.02	0.05	34.47	7,445.01	169.79	18.63	0.00
Ash	0.15	0.00	0.04	0.11	0.12	0.03	0.01	0.01	0.00	0.00	0.01	5.58	1,275.38	30.42	3.42	0.00
Butter Fat	0.11	0.00	0.11	0.00	0.00	0.07	0.03	0.03	0.00	0.00	0.00	0.00	373.76	86.98	39.26	0.00
Water	57.55	45.83	12.62	44.93	59.41	8.70	3.92	18.49	14.57	4.02	14.47	726.63	0.00	0.00	0.00	802,286.52
Total	59.86	45.83	14.03	45.83	60.40	9.66	4.36	18.93	14.57	4.36	14.57	769.06	14,000.00	1,163.46	414.04	802,286.52
Total Solids	2.31	0.00	1.41	0.90	0.99	0.97	0.44	0.44	0.00	0.35	0.09	42.44	14,000.00	1,163.46	414.04	0.00
gal/min													gal/day	gal/day	gal/day	gal/day
Total	7.14	5.49	1.65	5.49	7.24	1.14	0.51	2.26	1.75	0.51	1.75	90.61	1,647.06	136.88	48.71	96,139.79
Mass %																
True Protein	1.90%	0.00%	7.36%	0.22%	0.22%	7.36%	7.36%	1.70%	0.00%	6.66%	0.20%	0.06%	30.26%	73.39%	84.46%	0.00%
Non-Protein Nitrogen	0.15%	0.00%	0.19%	0.13%	0.11%	0.19%	0.19%	0.04%	0.00%	0.06%	0.04%	0.25%	4.76%	1.92%	0.74%	0.00%
Lactose	1.39%	0.00%	1.46%	1.36%	1.12%	1.46%	1.48%	0.34%	0.00%	0.36%	0.33%	4.48%	53.18%	14.59%	4.50%	0.00%
Ash	0.24%	0.00%	0.26%	0.24%	0.19%	0.26%	0.26%	0.06%	0.00%	0.07%	0.06%	0.72%	9.11%	2.61%	0.83%	0.00%
Butter Fat	0.18%	0.00%	0.75%	0.00%	0.00%	0.75%	0.75%	0.17%	0.00%	0.75%	0.00%	0.00%	2.67%	7.48%	9.48%	0.00%
Water	96.15%	100%	89.97%	98.04%	98.38%	89.97%	89.97%	97.69%	100%	92.09%	98.36%	94.48%	0.00%	0.00%	0.00%	100%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
% Solids	3.9%	0.0%	10.0%	2.0%	1.6%	10.0%	10.0%	2.3%	0.0%	7.9%	0.6%	5.5%	0.00%	100.0%	100.0%	0.0%
% Protein of Solids	53.1%	0.0%	75.3%	18.3%	20.2%	75.3%	75.3%	75.3%	0.0%	85.2%	38.5%	5.6%	35.0%	75.3%	85.2%	0.0%
Properties																
Temperature (°C)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Pressure (psi)	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15



Year 1

Stream/Description Stream Number	52	53	54	55	56	57	58	59	60	61	62	63	64	65
Component	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day
True Protein	428.76	130.69	559.44	428.76	0.47	0.00	569.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-Protein Nitrogen	1,767.09	538.62	2,305.71	1,767.09	1.92	0.00	2,305.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lactose	31,703.27	9,663.30	41,366.57	31,703.27	34.47	0.00	41,366.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ash	5,127.80	1,562.98	6,690.77	5,127.80	5.58	0.00	6,690.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Butter Fat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water	0.00	203,690.00	203,690.00	668,264.23	726.63	0.00	871,954.23	72,476.52	729,810.00	18,772.16	711,037.84	711,037.84	18,836.23	729,874.07
Total	39,026.91	215,585.58	254,612.49	707,291.14	769.06	0.00	922,876.72	72,476.52	729,810.00	18,772.16	711,037.84	711,037.84	18,836.23	729,874.07
Total Solids	39,026.91	11,895.58	50,922.49	39,026.91	42.44	0.00	50,922.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00
gal/min	gal/day	gal/day	gal/day	gal/day	gal/day	gal/day	gal/day	gal/day	gal/day	gal/day	gal/day	gal/day	gal/day	gal/day
Total	4,591.40	25,363.01	29,954.41	83,210.72	90.48	0.00	108,573.73	8,685.02	87,454.76	2,249.51	85,205.25	85,205.25	2,257.19	87,462.44
Mass %														
True Protein	1.10%	0.06%	0.22%	0.08%	0.06%	0.00%	0.06%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Non-Protein Nitrogen	4.53%	0.25%	0.91%	0.25%	0.25%	0.00%	0.25%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Lactose	81.23%	4.48%	16.25%	4.48%	4.48%	0.00%	4.48%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Ash	13.14%	0.72%	2.63%	0.72%	0.72%	0.00%	0.72%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Butter Fat	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Water	0.00%	94.48%	80.00%	94.48%	94.48%	0.00%	94.48%	100%	100%	100%	100%	100%	100%	100%
Total	100%	100%	100%	100%	100%	0%	100%	100%	100%	100%	100%	100%	100%	100%
% Solids	100.0%	5.5%	20.0%	5.5%	5.5%	0.0%	5.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Protein of Solids	5.6%	5.6%	5.6%	5.6%	5.6%	0.0%	5.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Properties														
Temperature (°C)	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Pressure (psi)	5	5	5	5	5	5	5	5	5	5	5	5	5	5

## Process Description

### Ultrafiltration Process

Whey is feed from an existing holding tank from cheese production. The whey is then filtered to remove cheese fines through an existing filter. The whey is then feed into the first portion of three of the ultrafiltration process. The first portion has a final protein concentration of 35 percent (dry weight), the second of 75 percent, and the third of 85 percent.

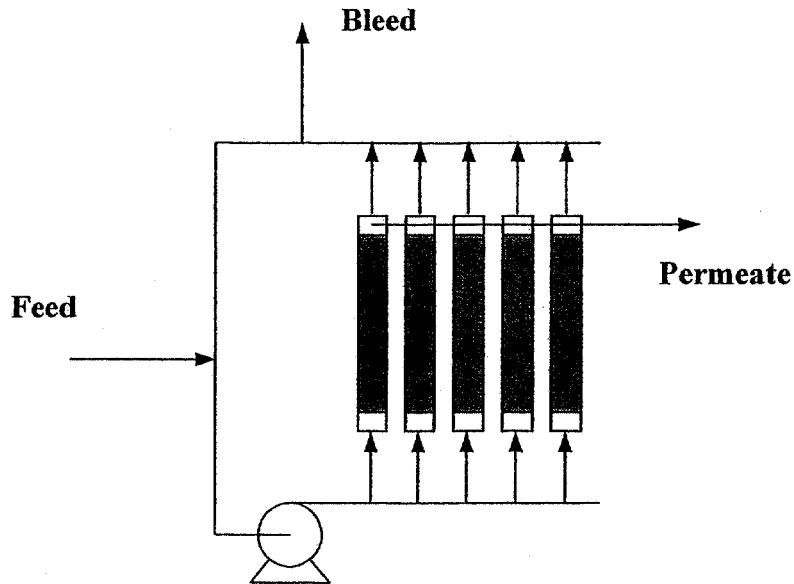
The first portion consists of ten stages with as many as 22 cartridges per stage. The process will be built for maximum conditions in ten years, though will run at less than 100 percent capacity at the lower flow rates. The number of cartridges used per year can be found in Table 1.

**Table 1: Cartridge Use Per Year**

Number of Cartridges	Year									
	1	2	3	4	5	6	7	8	9	10
<b>35%</b>										
1	17	17	18	18	19	20	20	21	21	21
2	17	17	18	18	19	20	20	21	22	22
3	17	17	18	18	19	20	20	21	22	22
4	17	17	18	18	19	20	20	21	22	22
5	17	17	18	18	19	20	20	21	22	22
6	17	17	18	18	19	20	20	21	22	22
7	17	17	18	18	19	20	20	21	22	22
8	17	17	18	18	19	20	20	21	22	22
9	17	17	18	18	19	20	20	21	22	22
10	11	17	13	18	15	12	18	16	14	21
<b>75%</b>										
1	8	8	9	10	10	10	11	11	12	12
2	16	15	14	14	15	18	16	17	18	20
<b>85%</b>										
1	6	5	6	6	6	7	7	7	7	8

Each stage is shown on the process flow diagram in a simplified manner. Figure 1 shows the actual arrangement of each stage. The exit from the cartridges is combined,

with the bleed from one stage becomes the feed to the next. The recycle is 23 gallons per minute per cartridge, which is combined with the feed. It is pumped to increase the pressure of the stream so that the feed to the cartridges has a pressure of 30 pounds per square foot. The permeate from each stage is combined.



**Figure 1: Actual Stage Configuration**

The exit from the tenth stage is split, with one portion leading to the 35 percent product holding tank with the remainder becoming the feed for the second portion of the ultrafiltration process.

In the first stage of the second portion, the feed is concentrated to about 55 percent. The second stage is diafiltration, so water is added to the feed before entering the stage. The exit contains 75 percent protein and is split, sending a portion to the 75 percent holding tank and the remainder sent forward to the final ultrafiltration portion.

In the third portion, water is again added to the feed and the solution is concentrated by diafiltration to 85 percent protein. This is sent to the 85 percent holding tank.

### **Drying System**

The drying system will be run on a time block basis. The protein solutions will be feed to the drying system and then into storage tanks.

The permeate streams are all combined and sent to the permeate holding tank. After year six, a portion of the permeate is sent to wastewater treatment. Part of the stored permeate is sent to the drying process to produce a dry product. This is combined with the remaining permeate to create a 20 percent solid solution that will be removed by local farmers. As purity is not an issue, the drying of the permeate will be preformed after all the other products have been dried and prior to cleaning of the drying system.

Water driven off during the drying process will be used as make-up water for the diafiltration stages. Additional water will be used for the cleaning process as a rinse and dilution agent for the concentrated cleaning solutions. The remaining water will be sent to wastewater treatment.

### **Cleaning System**

The cleaning system consists of a water storage tank, tanks for concentrated acid (CIP Acid from Ecolab), caustic (Ultrasil 22 from Ecolab), and sodium hypochlorite, and a mixing tank that also acts as a recirculation tank. The water is always added to the tank prior to addition of the concentrated solutions. The cleaning process is described as follows:

- 1) Draining the whey from each portion of the ultrafiltration to the respective holding tanks (i.e. whey drained from stages 1 through 10 is feed to the 35 percent holding tank)
- 2) Soft water rinse followed by draining
- 3) 1.0 volume percent CIP Acid recirculated for 30 minutes, then drained
- 4) Soft water rinse and draining
- 5) 1.0 volume percent Ultrasil 22 recirculated for 30 minutes, then drained
- 6) Soft water rinse and draining
- 7) 200 ppm sodium hypochlorite recirculated for 30 minutes, then drained
- 8) Soft water rinse and draining.

The connections of the cleaning system to the ultrafiltration system are positive disconnects so that when not in use, there is no chance of failure causing contaminate into the whey.

The storage tanks hold 60-days supply of concentrated CIP Acid and Ultrasil 22, 7-days supply of Sodium Hypochlorite, and one-day supply of water. Though a 60-days supply of Sodium Hypochlorite may be kept on hand, the remainder may be stored in the original containers from Wal-Mart. The supply of water is enough for rinsing as well as making up the diluted cleaning solutions.

### **Control Schemes**

Much of the system will be automatically controlled. The composition of each stage is controlled by a composition control. The amount of protein in the stream will be measured and the flow rate of the bleed will be adjusted to maintain the proper concentration. By decreasing the bleed rate, the concentration of protein will increase. This is preferable to a ratio control on the feed to the bleed, as the actual flux across the membrane decreases during the day due to build-up of contaminants on the membrane.

The flow of solutions to be split will be controlled with ratio control. These streams consist of:

- 1) flow of solution to the 35 percent holding tank and continued flow to the 75 percent portion of UF
- 2) flow of solution to the 75 percent holding tank and continued flow to the 85 percent portion of UF
- 3) flow of permeate to the storage tank and waste permeate
- 4) flow of permeate to the drying unit and to the product tank
- 5) flow of evaporated water to the deionized water tank and continuing water
- 6) flow of water to the cleaning water and onto wastewater treatment.

## Safety and Environmental

The system will have suitable alarms for malfunctions for things such as pumps and blockages. This will be determined by flow rates. Lack of flow will cause the shutdown of the system.

As whey carries no hazards, no special precautions need to be taken.

For the cleaning system, the concentrated cleaning solutions should be added to the mixing tank already inventoried with water. Adding water to concentrated acid could cause sufficient heat to cause an explosion.

## Utility Summary

The utilities used in the plant will be electric and steam. Electricity is used by the pumps and the steam is used by the drying equipment to remove water. Table 2 summarizes the electric requirements by pump and gives the usage and cost per year. Table 3 summarizes the steam requirement of the drying system based on 15-pound steam<sup>5</sup>.

**Table 2: Electric Utility Summary**

User	Usage	Yearly utility usage	Cost per unit of utility
Pump Number	kw-hr/day	kw-hr/year	\$/kw-hr/year
P-100	89.48	32,661.65	\$ 2,286.32
P-101	268.45	97,984.96	\$ 6,858.95
P-102	268.45	97,984.96	\$ 6,858.95
P-103	268.45	97,984.96	\$ 6,858.95
P-104	268.45	97,984.96	\$ 6,858.95
P-105	268.45	97,984.96	\$ 6,858.95
P-106	268.45	97,984.96	\$ 6,858.95
P-107	268.45	97,984.96	\$ 6,858.95
P-108	178.97	65,323.31	\$ 4,572.63
P-109	178.97	65,323.31	\$ 4,572.63
P-110	178.97	65,323.31	\$ 4,572.63
P-111	53.69	19,596.99	\$ 1,371.79
P-201	35.79	13,064.66	\$ 914.53
P-202W	26.85	9,798.50	\$ 685.89
P-202	178.97	65,323.31	\$ 4,572.63
P-203	35.79	13,064.66	\$ 914.53
P-301W	17.90	6,532.33	\$ 457.26
P-301	89.48	32,661.65	\$ 2,286.32
P-400	35.79	13,064.66	\$ 914.53
		Total yearly cost	\$ 76,134.32

**Table 3: Steam Utility Summary**

User	Year	Usage		Cost per unit of utility	Yearly utility usage		Total Yearly Cost
		lbs steam/day	BTU/day	\$/lbm BTU/day	lbs steam/year	BTU/year	\$/lbm BTU
Dryer System	1	280800.28	3.23E+08	\$ 1,614.69	102,492,102.38	1.18E+11	\$ 589,360.34
	2	288018.83	3.31E+08	\$ 1,656.19	105,126,871.65	1.21E+11	\$ 604,511.05
	3	298714.59	3.44E+08	\$ 1,717.70	109,030,825.20	1.25E+11	\$ 626,959.95
	4	300945.72	3.46E+08	\$ 1,730.53	109,845,186.33	1.26E+11	\$ 631,642.77
	5	322604.34	3.71E+08	\$ 1,855.07	117,750,582.30	1.35E+11	\$ 677,101.17
	6	326725.00	3.76E+08	\$ 1,878.77	119,254,625.00	1.37E+11	\$ 685,749.87
	7	326725.00	3.76E+08	\$ 1,878.77	119,254,625.00	1.37E+11	\$ 685,749.87
	8	326725.00	3.76E+08	\$ 1,878.77	119,254,625.00	1.37E+11	\$ 685,749.87
	9	326725.00	3.76E+08	\$ 1,878.77	119,254,625.00	1.37E+11	\$ 685,749.87
	10	326725.00	3.76E+08	\$ 1,878.77	119,254,625.00	1.37E+11	\$ 685,749.87

# Operating Cost Summary

Year	Annual Manufacturing Costs										Total				
	Raw Materials		Cartridges & Parts		Operator Labor	Direct Super. Clerical Shop	Utilities		Main & Rep.	Operating supplies		Lab. charges	Space costs	Waste Removal	
	Whney	Cleaning Supplies	Total				Electric	Steam	Total						
1	\$ 164,250	\$ 25,061	\$ 189,311	\$ 159,677	\$ 183,960	\$ 27,594	\$ 76,134	\$ 589,361	\$ 665,495	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 31,924	\$ 1,525,153
2	\$ 170,820	\$ 25,441	\$ 196,261	\$ 162,969	\$ 183,960	\$ 27,594	\$ 76,134	\$ 604,512	\$ 680,846	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 32,475	\$ 1,551,098
3	\$ 177,653	\$ 26,012	\$ 203,665	\$ 167,908	\$ 183,960	\$ 27,594	\$ 76,134	\$ 626,960	\$ 703,095	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 34,528	\$ 1,587,942
4	\$ 184,769	\$ 26,583	\$ 211,342	\$ 172,846	\$ 183,960	\$ 27,594	\$ 76,134	\$ 631,643	\$ 707,778	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 34,832	\$ 1,605,544
5	\$ 192,149	\$ 27,249	\$ 219,398	\$ 178,608	\$ 183,960	\$ 27,594	\$ 76,134	\$ 677,102	\$ 753,236	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 37,350	\$ 1,667,338
6	\$ 199,835	\$ 28,200	\$ 228,035	\$ 186,838	\$ 183,960	\$ 27,594	\$ 76,134	\$ 685,750	\$ 761,885	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 115,158	\$ 1,770,663
7	\$ 207,829	\$ 28,676	\$ 236,504	\$ 190,954	\$ 183,960	\$ 27,594	\$ 76,134	\$ 685,750	\$ 761,885	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 185,501	\$ 1,853,591
8	\$ 216,142	\$ 29,437	\$ 245,579	\$ 197,538	\$ 183,960	\$ 27,594	\$ 76,134	\$ 685,750	\$ 761,885	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 284,009	\$ 1,967,758
9	\$ 224,787	\$ 30,198	\$ 254,985	\$ 204,123	\$ 183,960	\$ 27,594	\$ 76,134	\$ 685,750	\$ 761,885	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 388,358	\$ 2,088,097
10	\$ 233,779	\$ 31,149	\$ 264,928	\$ 212,354	\$ 183,960	\$ 27,594	\$ 76,134	\$ 685,750	\$ 761,885	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 502,906	\$ 2,220,819

Annual general expenses		Operating Cost Summary		
Year	Selling Expenses	Year	Total	
1	\$ 168,683	\$ 506,080	\$ 210,866	\$ 885,639
2	\$ 175,441	\$ 526,323	\$ 219,301	\$ 921,065
3	\$ 182,459	\$ 547,378	\$ 228,073	\$ 957,907
4	\$ 189,757	\$ 569,271	\$ 237,196	\$ 996,224
5	\$ 197,347	\$ 592,042	\$ 246,684	\$ 1,036,073
6	\$ 205,241	\$ 615,723	\$ 256,551	\$ 1,077,516
7	\$ 213,451	\$ 640,352	\$ 266,813	\$ 1,120,616
8	\$ 221,989	\$ 665,866	\$ 277,486	\$ 1,165,441
9	\$ 230,868	\$ 692,605	\$ 288,585	\$ 1,212,058
10	\$ 240,103	\$ 720,309	\$ 300,129	\$ 1,260,541



# Equipment Information Summary

## Process Equipment

Process Equipment	Pump Number	Pump Size			Pressure (psi)	Recycle Flow Rate (gpm)	Temperature (°C)	No. of Cartridges	Pressure (psi)	
		Speed (RPM)	Impeller Dia (Inches)	Motor HP					Inter	Extr
Stage										
1	P-101	4410	8.25	15	12	32	645.5	30	15	5
2	P-102	4410	8.25	15	12	32	632.4	30	15	5
3	P-103	4410	8	15	12	32	619.5	30	15	5
4	P-104	4410	8	15	12	32	606.9	30	15	5
5	P-105	4410	8	15	12	32	594.6	30	15	5
6	P-106	4410	8	15	12	32	582.7	30	15	5
7	P-107	4410	8	15	12	32	571.2	30	15	5
8	P-108	4410	8	10	12	32	560.2	30	15	5
9	P-109	4410	8	10	12	32	548.8	30	15	5
10	P-110	4410	8	10	12	32	539.9	30	15	5
11	P-201	4410	7.75	10	12	32	282.3	30	15	5
12	P-202	4410	7.75	10	12	32	422.0	30	15	5
13	P-301	328	7	5	12	32	187.1	30	15	5
Pumps										
Feed Pump	P-100	328	7	5	5	20	139.5	30	-	-
D-1 Water Pump	P-202W	218	6.5	1.5	5	20	5.9	30	-	-
D-2 Water Pump	P-301W	218	6.5	1	5	20	2.0	30	-	-
Permeate Pump	P-111	328	6.75	3	5	25	96.1	30	-	-
Permeate Pump	P-203	328	6.75	2	5	25	13.2	30	-	-
Cleaning Pump	P-400	328	6.75	2	5	25	10.7	30	-	-
Dryer System	No data available other than evaporative capacity and steam requirement									
								Steam Requirement		Evaporative Capacity
								.35 lbs steam/lb water evaporated		933,500 lbs water/day
Tanks										
35% Holding	27829	316 SS	14.7	Ambient						
75% Holding	2289	316 SS	15.7	Ambient						
85% Holding	1069	316 SS	16.7	Ambient						
Permeate Storage	151497	316 SS	18.7	Ambient						
Deionized Water	13658	316 SS	17.7	Ambient						
Soft Water	2812	PE	23.7	Ambient						
CIP Acid	242	PE	24.7	Ambient						
Caustic	242	PE	25.7	Ambient						
Sodium Hypochlorite	45	PE	26.7	Ambient						
Mixing Tank	500	316 SS	27.7	Ambient						
Permeate Product	42141	316 SS	19.7	Ambient						
35% Product	175621	316 SS	20.7	Ambient						
75% Product	14611	316 SS	21.7	Ambient						
85% Product	5389	316 SS	22.7	Ambient						

## Capital Estimate

The capital requirement of the project is comprised of equipment costs, engineering costs, and installation costs. The equipment costs are itemized in Table 4 and the engineering costs in Table 5. The total capital cost is \$4,317,900 as shown in Table 6.

**Table 4: Equipment Cost Summary**

Tank	Use	Capacity (days)	Volume (gal)	Actual (gal)	Cost (1990)	Material Factor	Cost 316 SS (1990)	Cost (2000)
1	35% Holding	1%	22,263	27,829.1	\$ 40,000	3.5	\$ 140,000	\$ 169,502
2	75% Holding	1%	1,831	2,289.1	\$ 9,500	3.5	\$ 33,250	\$ 40,257
3	85% Holding	1%	855	1,068.8	\$ 6,000	3.5	\$ 21,000	\$ 25,425
4	DI H2O	1	10927	13,658.4	\$ 26,000	3.5	\$ 91,000	\$ 110,176
5	Permeate Storage**	1	121,198	151,496.9	\$ 60,000	3.5	\$ 210,000	\$ 254,253
6	Perm Product	1	33,713	42,140.8	\$ 50,000	3.5	\$ 175,000	\$ 211,878
7	35% Product**	60	140,657	175,820.9	\$ 60,000	3.5	\$ 210,000	\$ 254,253
8	75% Product	60	11,689	14,611.5	\$ 30,000	3.5	\$ 105,000	\$ 127,127
9	85% Product	60	4,311	5,389.2	\$ 18,000	3.5	\$ 63,000	\$ 76,276
10	Soft H2O	1	2250	2,811.9	Polyethylene, closed top, vertical, cylindrical, flat bottom, dome top (etanks) <sup>3</sup>			\$ 3,140
11	CIP Acid	60	193.47	241.8				\$ 331
12	Caustic	60	193.47	241.8				\$ 331
13	Sodium Hypochlorite	7	35	45.0				\$ 135
14	Mixing Tank***	1	400	500.0	\$ 8,000	3.5	\$ 28,000	\$ 33,900
<b>Total Cost</b>								\$ 1,306,985
<b>Marked up</b>								\$ 2,010,747

\* Cost for carbon steel tanks in January 1990

\*\* Cone roof tanks

\*\*\* Carbon steel tank with agitator

**Table 5: Engineering Cost Summary**

Item	Number	Cartridges	Cost per	Price
Cartridge Costs		258	\$ 1,200.00	\$ 309,600.00
Additional Stages	12		\$ 10,000.00	\$ 120,000.00
Automation per Stage	13		\$ 6,000.00	\$ 78,000.00
Central Control Panel			\$ 48,000.00	\$ 48,000.00
Cleaning System			\$ 58,000.00	\$ 55,000.00
<b>Total</b>				\$ 610,600.00
<b>Marked Up</b>				\$ 939,384.62

**Table 6: Total Capital Costs**

Item	Cost
New Equipment	\$ 2,010,747
Old Equipment (drying system)	\$ 300,000
Engineering Costs	\$ 939,385
Installation (50% of Equipment and Services)	\$ 1,067,773
Services (1 engineer for 1 year)	\$ 124,800
<b>Total</b>	<b>\$ 4,317,904.44</b>

## Economic Analysis

The rate of return profitability analysis on the whey protein production was based on discounted cash flow. To determine the cash flow per year, the following equation was used:

$$\text{Cash Flow} = \text{Income} - \text{Investment} - \text{Expense} - \text{Tax} \quad (1)$$

The income was determined by the sales of the protein products, as shown in Table 7.

**Table 7: Protein Products Sales Income**

Year	Pounds Product Sold Per Day			Income Per Year
	35%	75%	85%	
1	14000.0	1163.5	400.0	\$ 4,217,330
2	14560.0	1210.0	416.0	\$ 4,386,023
3	15142.4	1258.4	432.6	\$ 4,561,464
4	15748.1	1308.7	449.9	\$ 4,743,922
5	16378.0	1361.1	467.9	\$ 4,933,679
6	17033.1	1415.5	486.7	\$ 5,131,026
7	17714.5	1472.2	506.1	\$ 5,336,267
8	18423.0	1531.0	526.4	\$ 5,549,718
9	19160.0	1592.3	547.4	\$ 5,771,707
10	19926.4	1656.0	569.3	\$ 6,002,575

Depreciation was determined using the Modified Accelerated Cost Recovery System for 7 years<sup>2</sup>. Tax was determined using equations 2 and 3, with a federal tax of 34 percent and a state tax of 6 percent. The cash flow for each year is shown in Table 8.

The cash flow was determined using the work sheet on pages 306 and 307 in Peters and Timmerhaus, Table 2.

$$\text{Profit before income tax} = \text{Income} - \text{Expense} - \text{Depreciation} \quad (2)$$

$$\text{Tax} = \text{Rate} \times \text{Profit before income tax} \quad (3)$$

**Table 8: Cash Flow Table**

Year	Total Capital Investment	Total Product Cost	Annual Operating Income	Annual Depreciation	Income before Tax	Tax	Annual Cash Flow
0	\$ 4,317,904						\$ (4,317,904)
1		\$2,410,792	\$ 1,806,537	\$ 330,206	\$ 1,476,332	\$ 590,533	\$ 1,216,005
2		\$2,472,163	\$ 1,913,860	\$ 565,902	\$ 1,347,958	\$ 539,183	\$ 1,374,677
3		\$2,545,849	\$ 2,015,615	\$ 404,150	\$ 1,611,465	\$ 644,586	\$ 1,371,029
4		\$2,601,768	\$ 2,142,155	\$ 288,612	\$ 1,853,542	\$ 741,417	\$ 1,400,738
5		\$2,703,410	\$ 2,230,269	\$ 206,350	\$ 2,023,919	\$ 809,568	\$ 1,420,701
6		\$2,848,179	\$ 2,282,848	\$ 206,119	\$ 2,076,729	\$ 830,692	\$ 1,452,156
7		\$2,974,207	\$ 2,362,061	\$ 206,350	\$ 2,155,711	\$ 862,284	\$ 1,499,776
8		\$3,133,198	\$ 2,416,520	\$ 103,059	\$ 2,313,460	\$ 925,384	\$ 1,491,136
9		\$3,300,156	\$ 2,471,551	\$ -	\$ 2,471,551	\$ 988,620	\$ 1,482,931
10		\$3,481,360	\$ 2,521,216	\$ -	\$ 2,521,216	\$ 1,008,486	\$ 1,512,729

The discounted cash flow brings the cash flow from each year back to the value in the first year by using a discount factor as shown in equation 4<sup>2</sup>.

$$\text{discount factor} = \frac{1}{(1+i)^n} \quad (4)$$

where  $i$  = rate of return

$n$  = year of project life to which cash flow applies

The rate of return was adjusted until the ratio of the total present value was equivalent to the initial investment, as shown in Table 9.

**Table 9: Discounted Cash Flow**

Year	Annual Cash Flow	Rate of Return Discount Factor	Present Value	Payback Period
0	\$ (4,317,904)			
1	\$ 1,216,005	0.7741	\$ 941,361	\$ 1,216,005
2	\$ 1,374,677	0.5993	\$ 823,839	\$ 2,590,681
3	\$ 1,371,029	0.4639	\$ 636,076	\$ 3,961,710
4	\$ 1,400,738	0.3592	\$ 503,084	\$ 5,362,448
5	\$ 1,420,701	0.2780	\$ 395,009	\$ 6,783,149
6	\$ 1,452,156	0.2152	\$ 312,564	\$ 8,235,305
7	\$ 1,499,776	0.1666	\$ 249,904	\$ 9,735,081
8	\$ 1,491,136	0.1290	\$ 192,346	
9	\$ 1,482,931	0.0999	\$ 148,084	
10	\$ 1,512,729	0.0773	\$ 116,942	Years
		<b>ratio</b>	1.00	4.00

Table 9 shows that a rate of return of 29.2% was achieved, and that the payback period is four years.

The ten-year income statement is shown in Table 10.

**Table 10: Ten-Year Income Statement**

10 Year Income Statement	
<b>Income</b>	
Net Sales	\$ 50,633,712
<b>Deductions</b>	
Cost of goods sold	\$ 17,838,002
Selling and administrative expenses	\$ 8,101,394
Research expenses	\$ 2,531,686
Depreciation	\$ 2,310,747
Income before tax	\$ 19,851,884
Tax	\$ 7,940,754
<b>Net Income</b>	<b>\$ 14,221,877</b>

# Innovation and Optimization

## Process Optimization

In order to reduce the initial capital investment, optimization of the ultrafiltration system need to be performed. A continuous system was used because it has an advantage over batch in that the residence time was shorter, which is an important consideration. By using multiple stages, the membrane area required is decreased and the yield increases. Instead of building three systems for each product, the lines build off of the previous product (the 75 percent and 85 percent products run through the 35 percent system and the 85 percent product runs through the 75 percent system).

Analysis of one through eleven stages to achieve the 35 percent product showed that stages one through nine have velocities that exceed the maximum of 16 feet per second when the recycle and the feed are combined. Ten stages proved more cost effect than eleven stages, as shown in Figure 2.

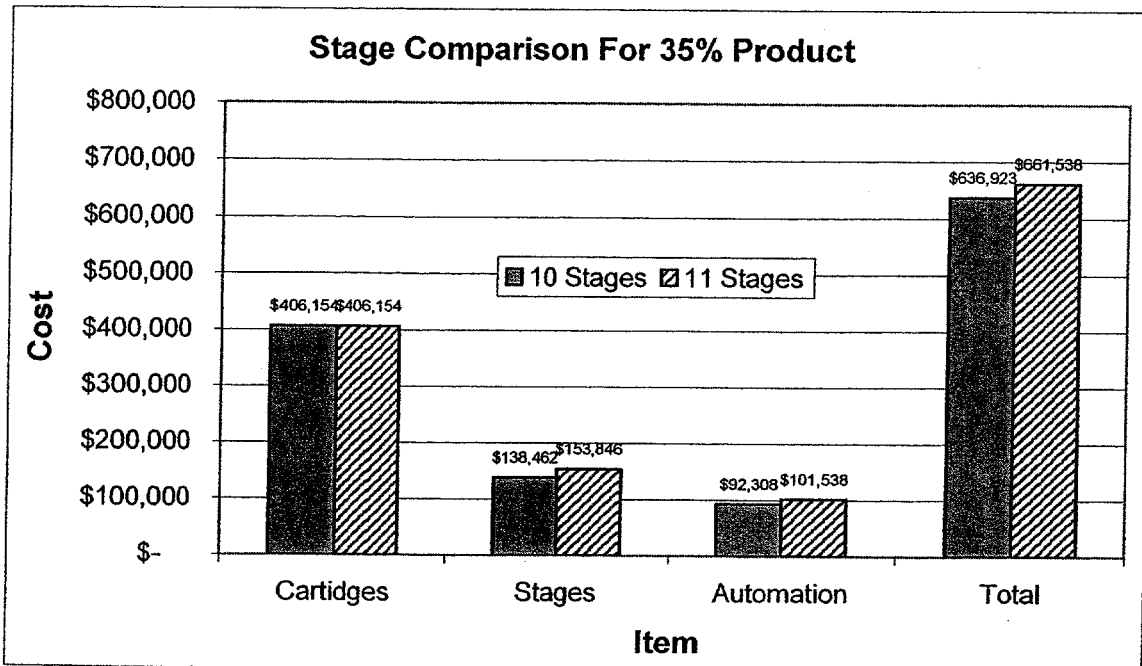
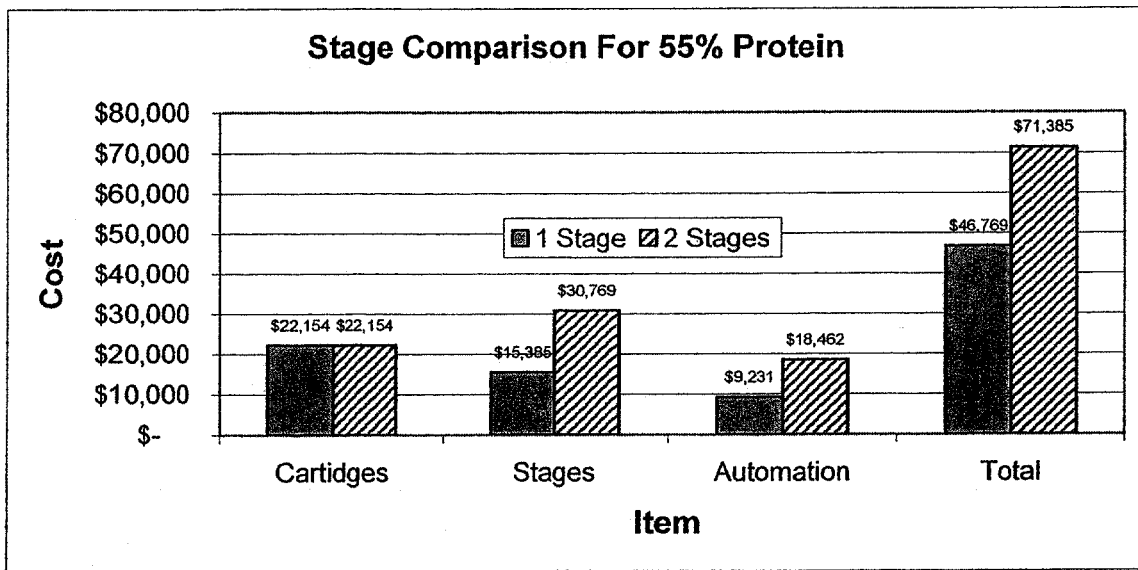
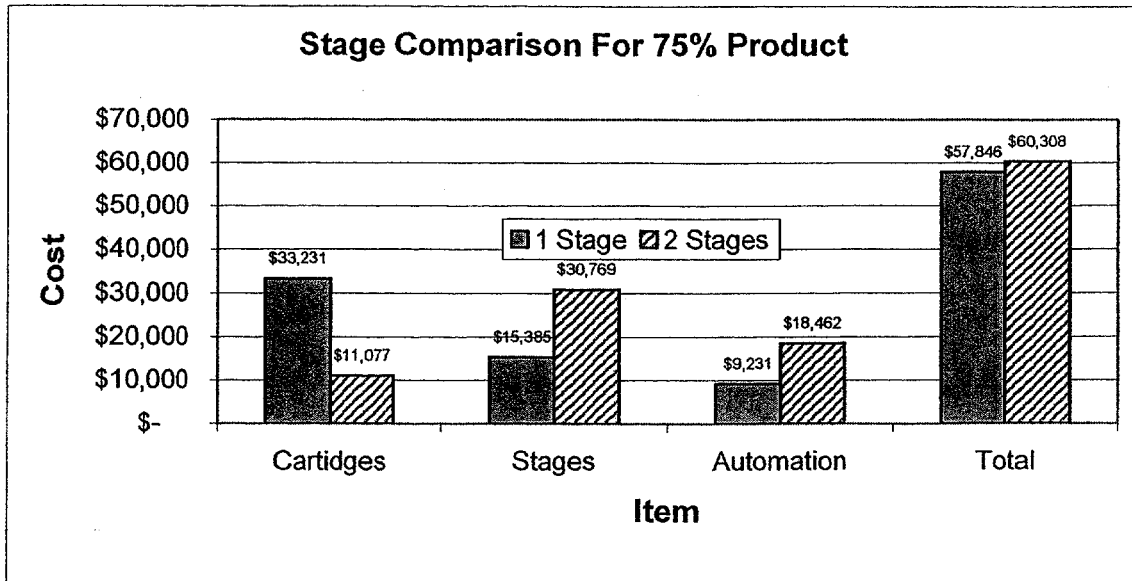


Figure 2: Cost Comparison for Ten versus Eleven Stages to Achieve 35% Product

Two methods were analyzed to achieve the 75 percent product. As the highest concentration achievable by ultrafiltration alone is 55 percent, one method consisted of using ultrafiltration to achieve 55 percent and then use diafiltration to increase the composition to 75 percent. This method tested several different stages to perform both the ultrafiltration and the diafiltration. Figure 3 shows that one stage of ultrafiltration is more cost effective than two stages to achieve a composition of about 55 percent protein, based on the 35 percent product from ten stages of ultrafiltration. Figure 4 shows that one stage of diafiltration is more cost effective than two stages to achieve a 75 percent product.

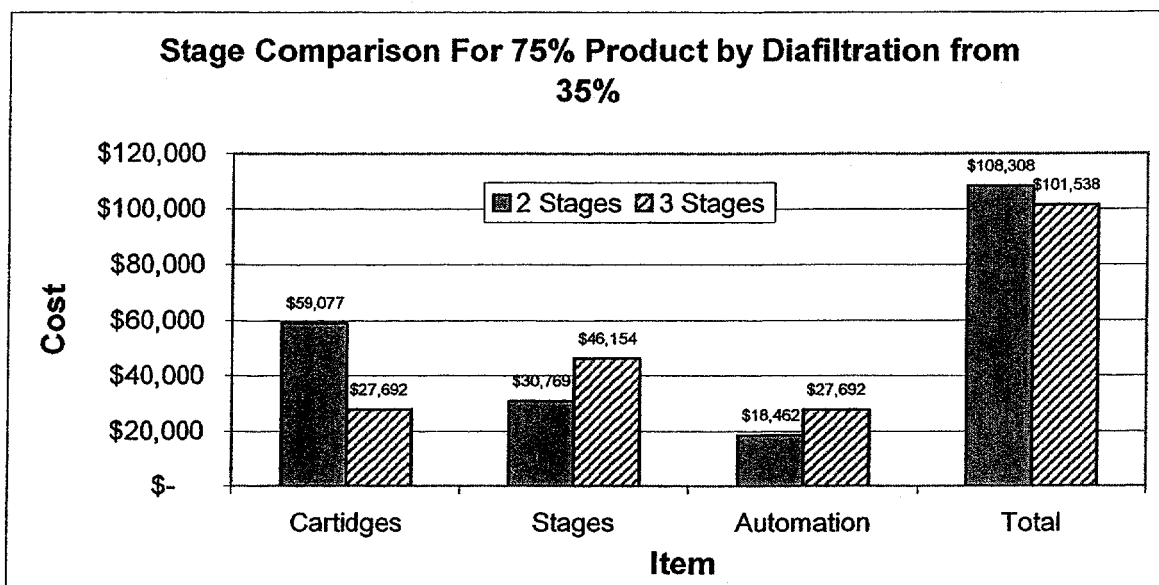


**Figure 3: Cost Comparison for One versus Two Stages to Achieve 55% Protein**



**Figure 4: Cost Comparison for One versus Two Stages to Achieve 75% Product**

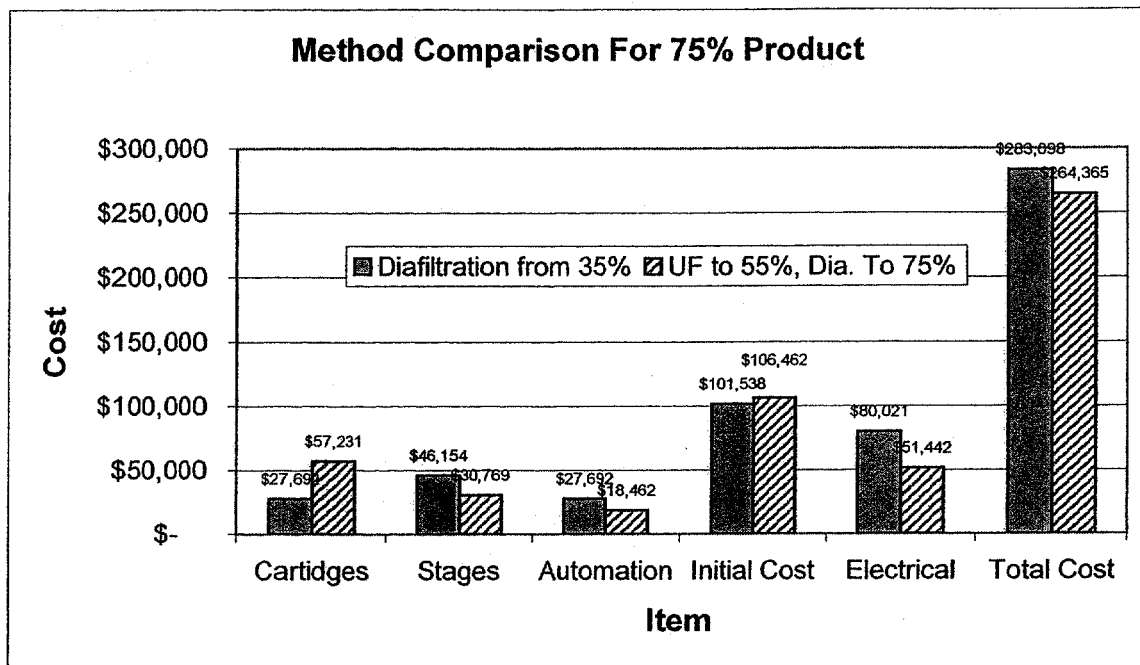
The other method of achieving the 75 percent product consisted of using diafiltration from the 35 percent product and increasing the composition to 75 percent. One stage of diafiltration exceeded the velocity requirement, and Figure 5 shows the cost comparison of two stages and three stages.



**Figure 5: Cost Comparison for Two versus Three Stages to Achieve 75% Product by Diafiltration from 35% Product**

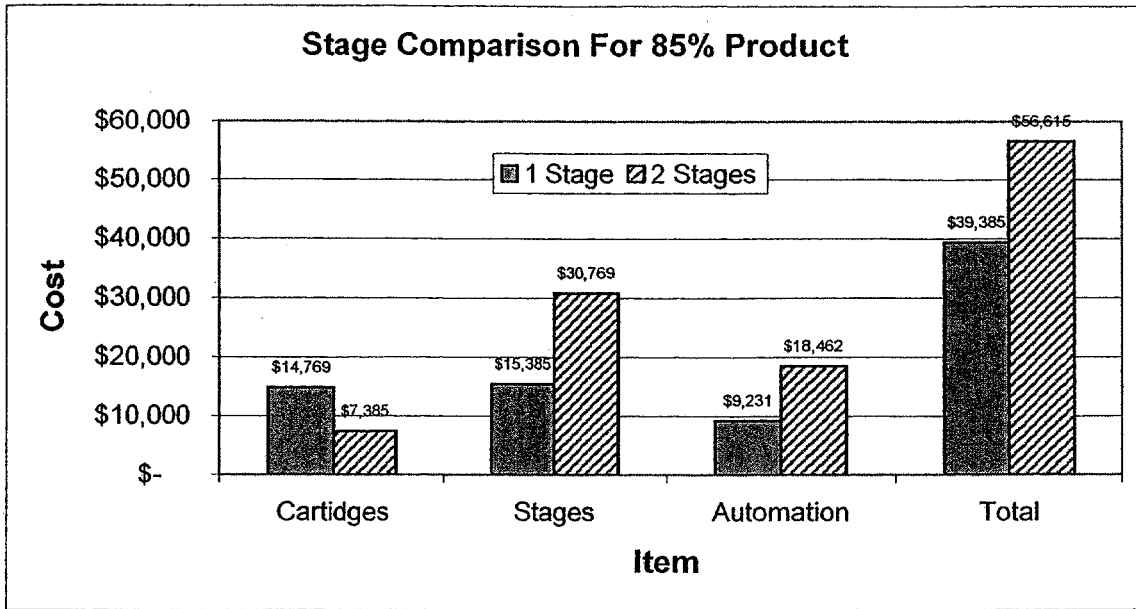


When the more cost effective of the two methods to achieve the 75 percent product are compared, the cost to install the second method is slightly less than the first. However, because more pumps are required, the electrical cost to run the second method is higher than the first. Over the ten-year project life, this difference in electrical costs offsets the initial installation savings, making the first option more economical as shown in Figure 6.



**Figure 6: Cost Comparison of Methods to Product 75% Product**

To achieve the 85% product, Figure 7 shows that it to be cheaper to use one stage rather than two.



**Figure 7: Cost Comparison for One versus Two Stages to Achieve 85% Product**

Table 11 shows the number of stages for each of the comparisons made to determine the best method of production.

**Table 11: Data for Cost Comparisons**

No. of Stages	No. of Cartridges per Stage
35% Comparison	
10	22
11	20
55%	
1	12
2	6
75%	
1	18
2	3
75% by Straight Diafiltration	
2	16
3	5
85%	
1	7
2	2

One of the process limitations was that the residence time could not exceed four hours. The residence time is equal to or less than the holdup volume over the bleed rate.

Table 12 summarizes the maximum residence time for each product. At no point is the residence time more than 1 hour.

**Table 12: System Residence Time**

Product	Total Residence Time (hours)
35%	0.078
75%	0.384
85%	0.621

**Cost Reduction**

Because there is an increase in capacity of the plant over the 10-year project life, the plant was built for maximum conditions. This posed complications due to the fact that area in each stage was based on the flow rates. In an effort to achieve the desired product concentrations in each year, as well as to reduce operating costs to minimum, though installed, not all the cartridges in each stage are utilized each year.

The number of cartridges per stage used each year is shown in Table 1. By reducing the number of cartridges used, there is less protein waste in the product. For example, if the same number of cartridges were used in the first ten stages to process the whey feed in the first year as the tenth year, instead of getting a 35 percent product, the exit would contain 74 percent protein, beyond the point where the solution becomes too viscous. The yield would also drop from 72 percent to 58 percent. More importantly, the product would still be sold for the same price, though it contains much more protein. It would also reduce the amount of protein available for conversion to the 75 percent and 85 percent product.

Another benefit of reducing the number of cartridges used per stage is the lower operation expenses. Since there is a cost of \$823 per cartridge and its parts (after markup), this is a savings per cartridge eliminated per year. Overall, the savings is

\$290,000 as shown in Table 13. There is also decreased volume for the system, requiring less of the cleaning solutions. This is a minor savings of about \$33,000 over the life of the project.

**Table 13: Cost of Cartridges and Parts**

Comparison	For Life of Project		
	Cost of Cartridges	Cost Of Parts	Total Cost
Reduced Cartridges	\$1,782,400.00	\$51,415.38	\$1,833,815.38
Full Cartridges	\$2,064,000.00	\$59,538.46	\$2,123,538.46
		Savings	\$289,723.08

**Product Optimization**

The determination of the optimum amount of product to be produced was calculated in Excel by taking into account the yields of each portion of the ultrafiltration process. With the known amount of protein going into the system, the flow rate of the 75 percent product was maximized with the 35 percent and 85 percent set at their maximum selling rates. The 35 and 85 percent were sold at maximum rates as the 75 percent has the lowest price per pound protein as shown in Table 14.

**Table 14: Product Comparison**

Product	Cost per Pound Protein
35%	\$1.86
75%	\$1.67
85%	\$2.94

**Water Usage**

To eliminate the need to purchase water for diafiltration and the cleaning system, water driven off in the drying of the products is recycled back into the system. This is pure water that has been heated, therefore is sanitary. This also eliminates additional waste from the system. Table 15 shows what the cost per year as well as what the overall

would be if water were not recycled back into the system. This does not take into account the increased hydraulic load cost to dispose of the additional waste.

**Table 15: Water Usage without Optimization**

Year	DI H <sub>2</sub> O	Soft Water	Total per Year
1	\$ 47,550	\$ 4,105	\$ 51,656
2	\$ 42,058	\$ 4,168	\$ 46,226
3	\$ 42,073	\$ 4,261	\$ 46,335
4	\$ 41,694	\$ 4,355	\$ 46,048
5	\$ 44,529	\$ 4,464	\$ 48,993
6	\$ 53,728	\$ 4,620	\$ 58,347
7	\$ 48,691	\$ 4,698	\$ 53,388
8	\$ 50,648	\$ 4,822	\$ 55,470
9	\$ 53,069	\$ 4,947	\$ 58,016
10	\$ 59,824	\$ 5,103	\$ 64,927
		<b>Total Cost</b>	\$ 529,406

### Permeate Disposal

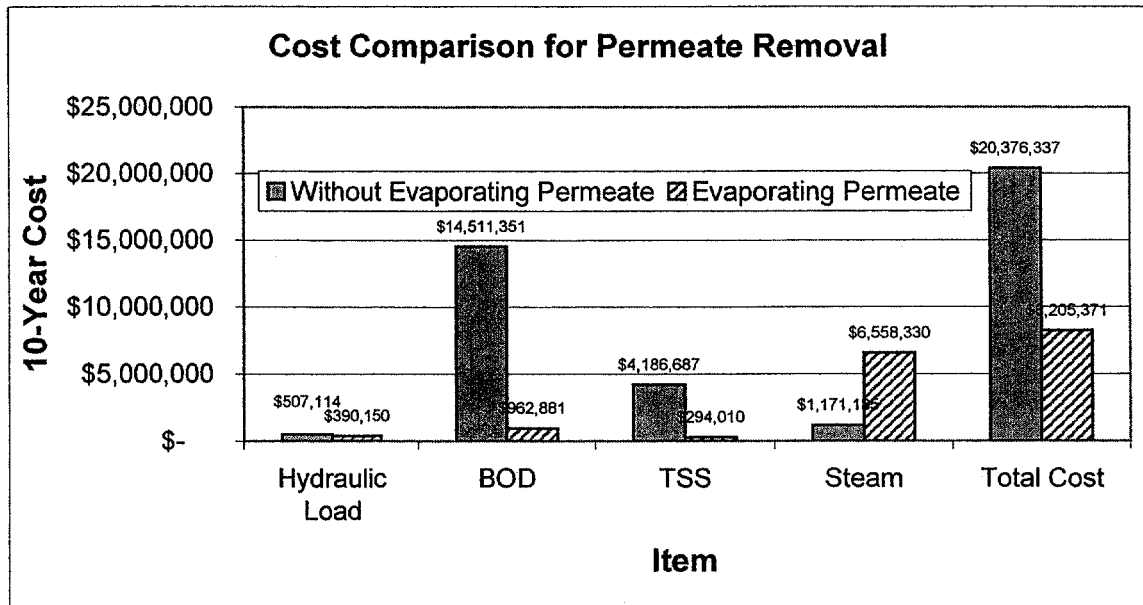
Because the amount of water being feed into the drying system once the ultrafiltration system has been brought online is much less than what the system handled when drying unfiltered whey, the system is not in full use. The system can then be used to help concentrate the permeate solution down to help eliminate it as a waste stream. Because no data was given on the individual unit's capacity for water removal, the permeate will be separated into two streams. One stream will be fully dried, where it is then combined with the unconcentrated stream to achieve an overall solid basis of 20 percent. As the production of protein products increases, the drying system will not be available for as long of period of time, requiring that some of the permeate be sent to wastewater treatment. This does not occur until the seventh year.

Comparison of cost of running the system by sending the permeate directly to waste versus concentrating the permeate can be found in Table 16.

**Table 16: Comparison of Cost Associated with Permeate Removal**

Year	Waste Flow gal/year	Hydraulic Load	BOD	TSS	Steam lb/year	Cost	Total Cost
<b>Without Evaporating Permeate</b>							
1	42,275,011	\$ 42,275	\$1,206,855	\$348,791	17,121,347	\$ 98,453	\$ 1,696,374
2	43,264,222	\$ 43,264	\$1,256,911	\$362,587	17,513,936	\$ 100,710	\$ 1,763,472
3	45,724,752	\$ 45,725	\$1,305,774	\$376,894	18,267,585	\$ 105,044	\$ 1,833,438
4	47,817,985	\$ 47,818	\$1,378,469	\$394,396	18,983,601	\$ 109,161	\$ 1,929,845
5	49,454,694	\$ 49,455	\$1,411,693	\$407,498	19,819,149	\$ 113,966	\$ 1,982,611
6	51,433,142	\$ 51,433	\$1,468,096	\$424,112	20,775,497	\$ 119,465	\$ 2,063,106
7	53,489,891	\$ 53,490	\$1,526,624	\$440,889	21,459,473	\$ 123,399	\$ 2,144,401
8	55,630,554	\$ 55,631	\$1,588,498	\$458,466	22,243,593	\$ 127,907	\$ 2,230,502
9	57,854,483	\$ 57,854	\$1,651,113	\$476,890	23,232,459	\$ 133,594	\$ 2,319,451
10	60,169,105	\$ 60,169	\$1,717,319	\$496,165	24,256,969	\$ 139,484	\$ 2,413,138
						<b>Total</b>	<b>\$ 20,376,337</b>
<b>Evaporating Permeate</b>							
1	31,923,791	\$ 31,924	\$ -	\$ -	102,492,102	\$ 589,361	\$ 621,285
2	32,475,198	\$ 32,475	\$ -	\$ -	105,126,872	\$ 604,512	\$ 636,987
3	34,527,756	\$ 34,528	\$ -	\$ -	109,030,825	\$ 626,960	\$ 661,488
4	34,831,948	\$ 34,832	\$ -	\$ -	109,845,186	\$ 631,643	\$ 666,475
5	37,349,604	\$ 37,350	\$ -	\$ -	117,750,582	\$ 677,102	\$ 714,451
6	39,452,843	\$ 39,453	\$ 56,240	\$ 19,466	119,254,625	\$ 685,750	\$ 800,909
7	41,488,992	\$ 41,489	\$ 109,233	\$ 34,780	119,254,625	\$ 685,750	\$ 871,252
8	43,775,979	\$ 43,776	\$ 183,942	\$ 56,292	119,254,625	\$ 685,750	\$ 969,760
9	46,177,101	\$ 46,177	\$ 263,035	\$ 79,146	119,254,625	\$ 685,750	\$ 1,074,108
10	48,147,221	\$ 48,147	\$ 350,432	\$104,327	119,254,625	\$ 685,750	\$ 1,188,656
						<b>Total</b>	<b>\$ 8,205,371</b>

Though there is increased steam costs associated with running the drying system for longer periods of time, the elimination of whey as a waste stream by utilizing existing and available equipment greatly out ways this. As can be seen in Table 16, dealing with the permeate in this manner has a total savings of \$12 million over the ten years. Figure 8 summarizes the overall differences between the two options.



**Figure 8: Summary of Permeate Removal Options**

A cash flow table can be found in Appendix B showing all the costs associated with the project if the permeate was not removed in the manner described above. An IRR of 8.9 percent is achieved, lower than the minimum IRR for the project to proceed. This indicates that in order for this project to be build, the permeate must be concentrated.

## Engineering Calculations

The calculations were conducted by using an assumption that the recirculation rate is high compared to the feed rate, the permeate rate, and the bleed rate, as well as that the membrane rejection is constant.

### Ultrafiltration

To determine the requirements for the ultrafiltration, designing using equal area per stage was used to minimized engineering design time and system assembly time. The final desired product composition was known. The following equations were used:

$$\overline{cf}_1 = \frac{F}{B_1} \quad (5)$$

where  $\overline{cf}_1$  = concentration factor for the stage

$F$  = Feed Rate

$B_1$  = Bleed Rate for stage one

$$C_{B1} = C_F \left[ \frac{\overline{cf}_1}{\overline{cf}_1(1-\sigma) + \sigma} \right] \quad (6)$$

where  $C_{B1}$  = Concentration of stage one bleed

$C_F$  = Concentration of feed

$\sigma$  = Membrane rejection rate

$$J = 27.9 - 5.3 \ln(CF_n) \quad (7)$$

where  $J$  = Flux rate (gsfd)

$CF_n$  = Concentration factor from feed up through stage n

$$A = \frac{P}{J} \quad (8)$$

where  $A$  = Area (ft<sup>2</sup>)

$P$  = Permeate flow rate

$$P_n = B_{n-1} - B_n \quad (9)$$

where n = stage number

$$B_n = \frac{B_{n-1}}{cf} \quad (10)$$

$$yeild = \frac{B_n \times C_{Bn}}{F \times C_F} \quad (11)$$

Goal seek was used to determine the flow rate out necessary to obtain the desired product composition. Goal seek was then used to determine the area necessary to achieve a calculated flow rate into the system as was actually being feed.

### **Diafiltration**



To determine the amount of water to be added to each stage, goal seek was used to achieve the desired product composition. The area required was then calculated. The following equations were used:

$$CF = \frac{W + F}{B} = \frac{W + F}{F} \quad (12)$$

$$C_B = C_F \left[ \frac{1}{\left( \frac{W + F}{F} \right) (1 - \sigma) + \sigma} \right]^n \quad (13)$$

### Wastewater Calculations

To determine the cost to remove waste to wastewater treatment, the biological oxygen demand (BOD) and thus the theoretical chemical oxygen demand (COD) needed to be calculated. The theoretical COD was calculated for the oxidation of lactose, as the waste stream consisted of mostly lactose. Lactose contains 12 carbons, therefore 12 oxygen's are required. The BOD is 60 percent of the theoretical COD. The cost for the BOD is \$0.12 per pound above 300 mg per liter. The actual requirement was determined, and the charge was applied to that above 300 mg per liter.

To determine the total suspended solids (TSS), it was assumed that all the lactose was oxidized, and therefore the only remaining solids in the waste stream were protein and ash. A charge of \$0.10 per pound of TSS was applied.

### Computer Programs

The following is descriptions for each of the Excel worksheets used to design the ultrafiltration system. The worksheets can be found in Appendix C and with the cell formulas in Appendix D.

<b>Worksheet Name</b>	<b>Description</b>
Given	Includes given data on feed rate (extended to ten years), feed composition, membrane rejections, and membrane operating conditions.
Equip.	Shows how equipment was sized and costed as well as pump information and energy requirements.
Costs	Costs gives the cost information on each item
10 years	Shows cartridge requirements, flow rates and compositions between stages for each of the ten years of production to achieve a final protein concentration of 35 percent dry weight.
10-55%	Shows cartridge requirements, flow rates and compositions between stages for each of the ten years of production by ultrafiltration to 55 percent protein concentration, with diafiltration to achieve 75 percent protein concentration. By accounting for the yields across the system, the cartridges per stage are determined to give as close to the desired concentration as possible. The portion that achieves 55 percent was designed so that the actual protein concentration was never great than 55 percent to insure the solution did not become too viscous.
10-85%	Shows cartridge requirements, flow rates and compositions between stages for each of the ten years of production by diafiltration to 85 percent protein concentration. By accounting for the yields across the system, the cartridges per stage are determined to give as close to the desired concentration as possible.
Full mass	Shows stream attributes for each year in gallons and pounds per minute.
1\$1opt.	Calculates the optimum product ratios to maximize income keeping in mind the maximum sales for each product. By using the yields for each product, and the amount of protein available, the amount of 75 percent is adjusted to make sure all protein available is used. This particular optimization page uses one stage of ultrafiltration to achieve 55 percent protein concentration.
Time	Calculates the residence time at maximum conditions to assure that the maximum four hours is not exceeded. Also determines the volume of the system and determines amount of cleaning solutions necessary for each year.
Max 35%	Determines the number of stages necessary at maximum conditions (tenth year). One through nine stages exceed the maximum velocity of 16-ft per second.
1Max 55%	Determines the number of ultrafiltration stages necessary to achieve 55 percent protein concentration based on ten stages to achieve 35 percent protein concentration. Also determines number of ultrafiltration stages to achieve 75 percent product. This sheet references the optimization page based on one stage of ultrafiltration to achieve 55 percent protein concentration.
2Max 55%	Determines the number of ultrafiltration stages necessary to achieve

	55 percent based on ten stages to achieve 35 percent protein concentration. Also determines number of ultrafiltration stages to achieve 75 percent product. This sheet references the optimization page based on two stages of ultrafiltration to achieve 55 percent protein concentration.
2\$1opt.	Product optimization based on two stages of ultrafiltration to achieve 55 percent protein concentration.
1max85%	Determines number of stage of diafiltration necessary for 85 percent protein concentration based on one stage of ultrafiltration to 55 percent.
2max85%	Determines number of stage of diafiltration necessary for 85 percent protein concentration based on two stages of ultrafiltration to 55 percent.
\$2opt.	Optimization based on converting the 35 percent product concentration by diafiltration to 75 percent product concentration.
Max75%	Determines the number of stages to achieve 75 percent concentration based on straight diafiltration from 35 percent concentration.
Fullday	Stream attributes for each stream for pounds and gallons per day.

## References

- 1) "Marshall and Swift Equipment Cost Index" *Chemical Engineering*, V 108 no 1, Jan 2001, pg. 140.
- 2) Peters, M. and Timmerhaus, K., *Plant Design and Economics for Chemical Engineers*, 4<sup>th</sup> edition, McGraw-Hill, 1991, pg. 200, 287, 303, 306-307.
- 3) Peabody Engineering – etanks, January 24, 2001, [www2.thomasregister.com/olc/Peabody/ovaltank.htm](http://www2.thomasregister.com/olc/Peabody/ovaltank.htm).
- 4) TriClover Manual, "Tri-Clover D/SP Series Pump Performance Curves".
- 5) Sandler, S. I., *Chemical And Engineering Thermodynamics*, 2<sup>nd</sup> Edition, John Wiley & Sons, Inc., 1989, pg. 259.

## Appendices



Appendix A

Year 2

Stream Description	Perm. Mix	Bleed 1	Perm. 8	Perm. Mix	Bleed 9	Perm. 9	Perm. Mix	Bleed 10	Perm. 10	Perm. Mix	35% Wet	65% Feed	65% Bleed	55% Perm.	Perm. Mix	Dia. 1 Feed	H2O Feed	Dia. 1 Bleed	
Stream Number	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	
<b>Component</b>																			
Ibs/min																			
True Protein	0.16	5.01	0.04	0.19	4.96	0.04	0.28	4.91	0.06	0.24	3.72	1.19	1.13	0.06	0.18	1.13	0.00	0.00	1.03
Non-Protein Nitrogen	1.26	1.15	0.19	1.45	0.97	0.19	0.55	0.76	0.20	0.37	0.58	0.18	0.09	0.10	0.16	0.09	0.00	0.00	0.03
Lactose	24.83	14.49	3.15	27.97	11.50	2.99	7.92	8.45	3.05	4.93	6.41	2.04	0.80	1.24	1.88	0.80	0.00	0.00	0.21
Ash	3.97	2.45	0.51	4.49	1.95	0.49	1.32	1.45	0.51	0.83	1.10	0.35	0.14	0.21	0.32	0.14	0.00	0.00	0.04
Butter Fat	0.00	0.43	0.00	0.00	0.43	0.00	0.00	0.43	0.00	0.00	0.33	0.10	0.10	0.00	0.00	0.10	0.00	0.00	0.10
Water	502.81	246.12	60.10	562.91	190.10	56.03	180.50	134.50	55.60	124.48	106.81	27.69	11.30	16.39	68.88	53.24	41.95	12.15	13.56
Total	533.03	299.66	63.98	597.01	209.91	59.74	195.37	150.49	59.42	155.63	114.15	36.35	13.56	22.79	76.21	55.51	41.95	13.56	13.56
Total Solids	30.22	23.53	3.88	34.10	19.82	3.72	10.07	16.00	3.82	6.36	12.13	3.86	2.26	1.60	2.54	2.26	0.00	0.00	1.41
gall/min																			
Total	62.71	31.72	7.93	70.24	24.70	7.03	23.10	17.71	6.99	16.07	13.43	4.28	1.60	2.88	9.08	6.62	5.03	1.60	1.60
<b>Mass %</b>																			
True Protein	0.03%	1.86%	0.06%	0.03%	2.37%	0.07%	0.14%	3.26%	0.10%	0.17%	3.26%	0.14%	8.32%	0.25%	0.23%	2.03%	0.00%	0.00%	7.60%
Non-Protein Nitrogen	0.24%	0.43%	0.29%	0.24%	0.46%	0.31%	0.28%	0.51%	0.34%	0.27%	0.51%	0.28%	0.63%	0.43%	0.21%	0.15%	0.00%	0.00%	0.20%
Lactose	4.66%	5.38%	4.92%	4.69%	5.48%	5.01%	4.06%	5.61%	5.14%	3.63%	5.61%	4.06%	5.93%	5.43%	2.46%	1.45%	0.00%	0.00%	1.53%
Ash	0.75%	0.91%	0.80%	0.75%	0.93%	0.82%	0.67%	0.96%	0.85%	0.61%	0.96%	0.67%	1.04%	0.92%	0.42%	0.25%	0.00%	0.00%	0.27%
Butter Fat	0.00%	0.16%	0.00%	0.00%	0.21%	0.00%	0.00%	0.29%	0.00%	0.00%	0.29%	0.00%	0.77%	0.00%	0.00%	0.19%	0.00%	0.00%	0.77%
Water	94.33%	91.27%	93.93%	94.29%	90.56%	93.78%	94.84%	89.37%	93.57%	95.31%	93.57%	94.84%	83.31%	92.98%	96.67%	95.92%	100%	89.62%	89.62%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
% Solids	5.7%	8.7%	6.1%	5.7%	9.4%	6.2%	5.2%	10.6%	6.4%	4.7%	10.6%	10.6%	16.7%	7.0%	3.3%	4.1%	0.0%	10.4%	10.4%
% Protein of Solids	4.7%	26.2%	5.7%	4.8%	29.9%	6.2%	8.3%	35.4%	6.9%	9.5%	35.4%	35.4%	53.6%	9.7%	13.4%	53.6%	0.0%	75.2%	75.2%
<b>Properties</b>																			
Temperature (°C)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Pressure (psi)	5	15	5	5	15	5	5	15	5	5	15	15	15	5	5	15	15	15	15

Appendix A

Year 2

Stream Description	Dia. 1 Perm.	Perm. Mix	75% Wet	Dia. 2	Dia. 2 Feed	H2O Feed	85% Wet	Dia. 2 Perm.	Total Perm.	35% Prod.	75% Prod.	85% Prod.	Evap. H2O	Evap. Perm.	Wet Perm.	Perm. Prod.
Stream Number	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
<b>Component</b>																
lbs/min																
True Protein	0.10	0.12	0.74	0.29	0.29	0.29	0.00	0.27	0.02	4,465.96	886.52	320.99	0.00	431.88	134.65	566.53
Non-Protein Nitrogen	0.06	0.06	0.02	0.01	0.01	0.00	0.00	0.00	0.01	693.16	23.49	3.02	0.00	1,828.82	570.51	2,400.33
Lactose	0.60	0.64	0.15	0.06	0.06	0.06	0.00	0.02	0.04	35.90	178.06	18.59	0.00	32,836.56	10,237.97	43,074.53
Ash	0.10	0.11	0.03	0.01	0.01	0.00	0.00	0.00	0.01	1,317.65	31.91	3.41	0.00	5,311.10	1,655.92	6,967.02
Butter Fat	0.00	0.00	0.08	0.03	0.03	0.00	0.00	0.03	0.00	394.41	90.02	35.57	0.00	0.00	0.00	0.00
Water	41.09	52.48	8.71	3.44	14.92	11.47	3.52	11.39	743.41	0.00	0.00	0.00	822,910.93	0.00	212,033.65	212,033.65
Total	41.95	53.42	9.72	3.84	15.31	11.47	3.84	11.47	787.59	14,560.00	1,210.00	381.59	822,910.93	40,409.36	224,632.71	265,042.07
Total Solids	0.86	0.94	1.01	0.40	0.40	0.00	0.32	0.08	44.17	14,560.00	1,210.00	381.59	0.00	40,409.36	12,599.06	53,008.41
gal/min																
Total	5.03	6.40	1.14	0.45	1.83	1.37	0.45	1.37	93.34	1,712.94	142.35	44.89	98,611.26	4,754.04	26,427.38	31,181.42
<b>Mass %</b>																
True Protein	0.23%	0.23%	7.60%	7.60%	1.91%	0.00%	6.97%	0.21%	0.06%	30.67%	73.27%	84.12%	0.00%	1.07%	0.06%	0.21%
Non-Protein Nitrogen	0.14%	0.12%	0.20%	0.20%	0.05%	0.00%	0.07%	0.05%	0.25%	4.76%	1.94%	0.79%	0.00%	4.53%	0.25%	0.91%
Lactose	1.42%	1.20%	1.53%	1.53%	0.38%	0.00%	0.40%	0.38%	4.56%	52.81%	14.72%	4.87%	0.00%	81.26%	4.56%	16.25%
Ash	0.25%	0.21%	0.27%	0.27%	0.07%	0.00%	0.07%	0.07%	0.74%	9.05%	2.64%	0.89%	0.00%	13.14%	0.74%	2.63%
Butter Fat	0.00%	0.00%	0.77%	0.77%	0.19%	0.00%	0.77%	0.00%	0.00%	2.71%	7.44%	9.32%	0.00%	0.00%	0.00%	0.00%
Water	97.96%	98.25%	89.62%	89.62%	97.40%	100%	91.72%	99.30%	94.39%	0.00%	0.00%	0.00%	100%	0.00%	94.38%	80.00%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
% Solids	2.0%	1.8%	10.4%	10.4%	2.6%	0.0%	8.3%	0.7%	5.6%	100.0%	100.0%	100.0%	0.0%	100.0%	5.6%	20.0%
% Protein of Solids	18.2%	19.8%	75.2%	75.2%	75.2%	0.0%	84.9%	36.8%	5.6%	35.4%	75.2%	84.9%	0.0%	5.6%	5.6%	5.6%
<b>Properties</b>																
Temperature (°C)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Pressure (psi)	5	5	15	15	15	15	15	15	5	5	15	15	5	5	5	5







Appendix A

Year 3

Stream Description	Perm. Mix	Bleed 8	Perm. 8	Perm. Mix	Bleed 9	Perm. 9	Perm. Mix	Bleed 10	Perm. 10	Perm. Mix	35% Wet	55% Feed	55% Bleed	55% Perm.	Perm. Mix	Dia. Feed	H2O Feed	Dia. Feed	
Stream Number	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	
Component																			
lbs/min																			
True Protein	0.17	5.20	0.04	0.21	5.15	0.05	0.28	5.11	0.04	0.24	3.84	1.27	1.20	0.07	0.19	1.20	0.00	1.11	
Non-Protein Nitrogen	1.35	1.16	0.20	1.55	0.96	0.20	0.53	0.80	0.16	0.33	0.60	0.20	0.09	0.11	0.18	0.09	0.00	0.00	
Lactose	26.42	14.41	3.34	29.76	11.25	3.16	7.54	8.91	2.34	4.38	6.89	2.21	0.83	1.39	2.04	0.83	0.00	0.23	
Ash	4.23	2.43	0.54	4.78	1.91	0.52	1.26	1.53	0.39	0.74	1.15	0.38	0.14	0.23	0.35	0.14	0.00	0.04	
Butter Fat	0.00	0.45	0.00	0.00	0.45	0.00	0.00	0.45	0.00	0.00	0.34	0.11	0.11	0.00	0.00	0.11	0.00	0.00	
Water	534.44	243.50	63.46	597.90	184.65	58.85	177.78	141.96	42.69	118.93	106.68	35.28	11.53	23.75	76.24	50.55	39.02	12.38	
Total	566.61	267.15	67.57	634.18	204.37	62.78	187.39	158.75	45.62	124.61	119.30	39.45	13.90	25.55	78.99	52.92	39.02	13.90	
Total Solids	32.17	23.65	4.12	36.29	19.72	3.93	9.62	16.79	2.93	5.69	12.62	4.17	2.37	1.80	2.76	2.37	0.00	1.52	
gal/min																			
Total	66.66	31.43	7.95	74.61	24.04	7.39	22.16	18.68	5.37	14.78	14.04	4.64	1.64	3.01	9.41	6.31	4.68	1.64	
Mass %																			
True Protein	0.24%	0.43%	0.29%	0.24%	0.47%	0.32%	0.28%	0.50%	0.34%	0.27%	0.50%	0.28%	0.64%	0.43%	0.22%	0.17%	0.00%	0.22%	
Non-Protein Nitrogen	4.66%	5.39%	4.94%	4.69%	5.50%	5.04%	4.02%	5.61%	5.13%	3.52%	5.61%	4.02%	5.94%	5.43%	2.58%	1.56%	0.00%	1.64%	
Lactose	0.75%	0.91%	0.81%	0.75%	0.94%	0.83%	0.67%	0.96%	0.85%	0.59%	0.96%	0.67%	1.04%	0.92%	0.44%	0.27%	0.00%	0.29%	
Ash	0.00%	0.17%	0.00%	0.00%	0.22%	0.00%	0.00%	0.28%	0.00%	0.00%	0.28%	0.00%	0.81%	0.00%	0.00%	0.21%	0.00%	0.81%	
Butter Fat	94.32%	91.15%	93.90%	94.28%	90.35%	93.74%	94.87%	89.42%	93.58%	95.44%	89.42%	94.87%	82.93%	92.96%	96.51%	95.52%	100%	89.07%	
Water	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Total	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
% Solids	5.7%	8.9%	6.1%	5.7%	9.7%	6.3%	5.1%	10.6%	6.4%	4.6%	10.6%	10.6%	17.1%	7.0%	3.5%	4.5%	0.0%	10.9%	
% Protein of Solids	4.7%	26.9%	5.8%	4.8%	31.0%	6.3%	8.5%	35.2%	6.8%	10.0%	35.2%	35.2%	54.4%	9.8%	13.4%	54.4%	0.0%	74.9%	
Properties																			
Temperature (°C)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	
Pressure (psi)	5	15	5	5	15	5	5	15	5	5	15	15	15	5	5	15	15	15	

Appendix A

Year 3

Stream/Description	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Stream Number	Dia. 1 Perm	Perm Mix	75% Wet	Dia. 2	Dia. 2 Feed	H2O Feed	35% Wet	Dia. 2 Perm	Total Perm	35% Prod.	75% Prod.	35% Prod.	Evap H2O	Evap Perm	Wet Perm	Perm. Prod.
Component	lbs/min	lbs/min	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day
True Protein	0.10	0.13	0.76	0.34	0.34	0.00	0.31	0.03	0.49	4,805.39	917.77	373.39	0.00	452.68	140.38	593.06
Non-Protein Nitrogen	0.06	0.06	0.02	0.01	0.01	0.00	0.00	0.01	2.08	722.71	24.91	3.36	0.00	1,903.51	590.31	2,493.82
Lactose	0.60	0.65	0.16	0.07	0.07	0.00	0.02	0.05	37.30	8,031.75	189.06	20.57	0.00	34,162.57	10,594.44	44,757.01
Ash	0.10	0.11	0.03	0.01	0.01	0.00	0.00	0.01	6.03	1,376.15	33.88	3.78	0.00	5,525.45	1,713.54	7,238.99
Butter Fat	0.00	0.00	0.08	0.03	0.03	0.00	0.03	0.00	0.00	406.40	92.79	41.61	0.00	0.00	0.00	0.00
Water	38.17	52.48	8.55	3.83	18.25	14.42	3.93	14.32	775.67	0.00	0.00	0.00	853,470.26	0.00	220,331.55	220,331.55
Total	39.02	53.44	9.60	4.30	18.72	14.42	4.30	14.42	821.57	15,142.40	1,258.40	442.71	853,470.26	42,044.20	233,370.24	275,414.44
Total Solids	0.85	0.96	1.05	0.47	0.47	0.00	0.37	0.10	45.90	15,142.40	1,258.40	442.71	0.00	42,044.20	13,038.68	55,082.89
gal/min										gal/day	gal/day	gal/day	gal/day	gal/day	gal/day	gal/day
Total	4.68	6.40	1.13	0.51	2.23	1.73	0.51	1.73	96.77	1,781.46	148.05	52.08	102,273.25	4,946.38	27,455.32	32,401.70
Mass %																
True Protein	0.15%	0.12%	0.22%	0.22%	0.05%	0.00%	0.07%	0.05%	0.25%	4.77%	1.96%	0.76%	0.00%	4.53%	0.25%	0.91%
Non-Protein Nitrogen	1.53%	1.22%	1.64%	1.64%	0.38%	0.00%	0.40%	0.37%	4.54%	53.04%	15.02%	4.65%	0.00%	81.25%	4.54%	16.25%
Lactose	0.27%	0.21%	0.29%	0.29%	0.07%	0.00%	0.07%	0.07%	0.73%	9.09%	2.69%	0.85%	0.00%	13.14%	0.73%	2.63%
Ash	0.00%	0.00%	0.81%	0.81%	0.19%	0.00%	0.81%	0.00%	0.00%	2.68%	7.37%	9.40%	0.00%	0.00%	0.00%	0.00%
Butter Fat	97.81%	98.21%	89.07%	89.07%	97.49%	100%	91.43%	99.30%	94.41%	0.00%	0.00%	0.00%	100%	0.00%	94.41%	80.00%
Water	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Total	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
% Solids	2.2%	1.8%	10.9%	10.9%	2.5%	0.0%	8.6%	0.7%	5.6%	100.0%	100.0%	100.0%	0.0%	100.0%	5.6%	20.0%
% Protein of Solids	18.0%	20.1%	74.9%	74.9%	74.9%	0.0%	85.1%	37.8%	5.6%	35.2%	74.9%	85.1%	0.0%	5.6%	5.6%	5.6%
Properties																
Temperature (°C)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Pressure (psi)	5	5	15	15	15	15	15	15	5	15	15	15	5	5	5	5





Appendix A

Year 4	Stream Description	Palm Mix	Bleed 8	Palm 8	Palm Mix	Bleed 9	Palm 9	Palm Mix	Bleed 10	Palm 10	Palm Mix	35% Wet	55% Feed	55% Bleed	55% Perm.	Palm Mix	Dia. Feed	H2O Feed	Dia. Bleed
Stream Number	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	
<b>Component</b>																			
lbs/min																			
True Protein	0.17	5.42	0.04	0.21	5.37	0.05	4.17	5.31	0.06	4.12	0.12	5.19	1.26	3.93	4.06	1.26	0.00	1.16	
Non-Protein Nitrogen	1.36	1.26	0.20	1.66	1.05	0.20	0.81	0.84	0.22	0.60	0.43	0.41	0.09	0.32	0.39	0.09	0.00	0.03	
Lactose	26.70	15.82	3.41	30.11	12.57	3.25	9.26	9.33	3.25	6.01	6.38	2.94	0.83	2.11	2.77	0.83	0.00	0.23	
Ash	4.27	2.67	0.56	4.83	2.14	0.53	1.58	1.60	0.54	1.05	1.06	0.54	0.14	0.39	0.51	0.14	0.00	0.04	
Butter Fat	0.00	0.47	0.00	0.00	0.47	0.00	0.35	0.47	0.00	0.35	0.00	0.47	0.12	0.35	0.35	0.12	0.00	0.12	
Water	540.95	268.97	65.12	606.08	208.13	60.84	192.86	148.88	59.25	132.12	116.51	32.37	11.50	20.87	72.87	49.96	38.46	12.35	
Total	573.45	294.61	69.33	642.78	229.74	64.87	209.13	166.42	63.31	144.26	124.50	41.92	13.94	27.99	80.94	52.40	38.46	13.94	
Total Solids	32.50	25.63	4.20	36.70	21.60	4.03	16.17	17.54	4.06	12.14	13.12	4.42	2.44	7.11	8.07	2.44	0.00	1.59	
gall/min																			
Total	67.46	34.66	8.16	75.62	27.03	7.63	24.72	19.58	7.45	17.09	14.65	4.93	1.64	3.29	9.64	6.25	4.61	1.64	
<b>Mass %</b>																			
True Protein	0.03%	1.84%	0.06%	0.03%	2.34%	0.07%	1.99%	3.19%	0.10%	2.86%	0.10%	1.99%	9.05%	14.04%	5.02%	2.41%	0.00%	8.35%	
Non-Protein Nitrogen	0.24%	0.43%	0.29%	0.24%	0.46%	0.31%	0.39%	0.50%	0.34%	0.42%	0.34%	0.39%	0.84%	1.15%	0.48%	0.17%	0.00%	0.22%	
Lactose	4.66%	5.37%	4.91%	4.68%	5.47%	5.01%	4.43%	5.60%	5.13%	4.17%	5.13%	4.43%	5.94%	7.56%	3.42%	1.58%	0.00%	1.66%	
Ash	0.75%	0.91%	0.80%	0.75%	0.93%	0.82%	0.76%	0.96%	0.85%	0.73%	0.85%	0.76%	1.04%	1.41%	0.63%	0.28%	0.00%	0.30%	
Butter Fat	0.00%	0.16%	0.00%	0.00%	0.20%	0.00%	0.17%	0.28%	0.00%	0.24%	0.00%	0.17%	0.85%	1.25%	0.43%	0.23%	0.00%	0.85%	
Water	94.33%	91.30%	93.94%	94.29%	90.60%	93.79%	92.27%	89.48%	93.58%	91.59%	93.58%	92.27%	82.48%	74.58%	90.03%	95.34%	100%	88.62%	
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
% Solids	5.7%	8.7%	6.1%	5.7%	9.4%	6.2%	7.7%	10.5%	6.4%	8.4%	10.5%	22.8%	17.5%	25.4%	10.0%	4.7%	0.0%	11.4%	
% Protein of Solids	4.7%	26.0%	5.7%	4.8%	29.7%	6.1%	30.8%	35.0%	6.8%	38.9%	6.8%	58.6%	55.3%	59.8%	55.1%	55.3%	0.0%	75.3%	
<b>Properties</b>																			
Temperature (°C)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Pressure (psi)	5	15	5	5	15	5	5	15	5	5	15	15	15	15	5	15	15	15	15

Appendix A

Year 4

Stream Description	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Stream Number	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Component	Perm. Mix	75% Wet	Dia. 2	H2O Feed	H2O Feed	85% Wet	Dia. 2	Total Perm.	35% Prod.	75% Prod.	85% Prod.	Evap. H2O	Evap. Perm.	Wet Perm.	Perm. Prod.	
	Perm. Mix	75% Wet	Dia. 2	H2O Feed	H2O Feed	85% Wet	Dia. 2	Total Perm.	35% Prod.	75% Prod.	85% Prod.	Evap. H2O	Evap. Perm.	Wet Perm.	Perm. Prod.	
lbs/min																
True Protein	0.10	0.13	0.80	0.36	0.36	0.00	0.33	0.03	4.37	143.05	960.42	395.89	0.00	3,860.42	1,389.40	5,249.82
Non-Protein Nitrogen	0.06	0.07	0.02	0.01	0.01	0.00	0.00	0.01	2.36	511.02	25.27	3.47	0.00	2,084.57	750.26	2,834.83
Lactose	0.60	0.65	0.16	0.07	0.07	0.00	0.02	0.05	39.37	7,661.71	191.32	21.16	0.00	34,740.66	12,503.46	47,244.13
Ash	0.10	0.11	0.03	0.01	0.01	0.00	0.00	0.01	6.41	1,269.26	34.29	3.89	0.00	5,655.87	2,036.60	7,691.47
Butter Fat	0.00	0.00	0.08	0.04	0.04	0.00	0.04	0.00	0.35	0.00	97.43	44.25	0.00	309.40	111.35	420.75
Water	37.61	52.00	8.49	3.86	18.35	14.49	3.96	14.39	799.04	0.00	0.00	0.00	859,844.90	0.00	253,765.21	253,765.21
Total	38.46	52.96	9.58	4.35	18.85	14.49	4.35	14.48	851.91	9,585.04	1,306.74	468.68	859,844.90	46,650.93	270,555.28	317,206.21
Total Solids	0.86	0.96	1.09	0.50	0.50	0.00	0.39	0.11	52.87	15,748.10	1,306.74	468.68	0.00	46,650.93	16,790.07	63,441.00
gal/min																
Total	4.61	6.35	1.13	0.51	2.25	1.74	0.51	1.74	100.34	1,127.65	153.97	55.14	103,037.14	5,486.34	31,830.03	37,318.38
Mass %																
True Protein	0.26%	0.25%	8.35%	0.35%	1.93%	0.00%	7.58%	0.23%	0.51%	1.49%	73.39%	84.47%	0.00%	8.28%	0.51%	1.66%
Non-Protein Nitrogen	0.15%	0.12%	0.22%	0.22%	0.05%	0.00%	0.07%	0.05%	0.28%	5.33%	1.93%	0.74%	0.00%	4.47%	0.28%	0.89%
Lactose	1.55%	1.28%	1.66%	1.66%	0.38%	0.00%	0.41%	0.38%	4.62%	79.93%	14.62%	4.52%	0.00%	74.47%	4.62%	14.89%
Ash	0.27%	0.21%	0.30%	0.30%	0.07%	0.00%	0.07%	0.07%	0.75%	13.24%	2.62%	0.83%	0.00%	12.12%	0.75%	2.42%
Butter Fat	0.00%	0.00%	0.85%	0.85%	0.20%	0.00%	0.85%	0.00%	0.04%	0.00%	7.44%	9.44%	0.00%	0.66%	0.04%	0.13%
Water	97.77%	98.19%	88.62%	88.62%	97.37%	100%	91.03%	99.28%	93.79%	0.00%	0.00%	0.00%	100%	0.00%	93.79%	80.00%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
% Solids	2.2%	1.8%	11.4%	11.4%	2.8%	0.0%	9.0%	0.7%	6.2%	100.0%	100.0%	100.0%	0.0%	100.0%	6.2%	20.0%
% Protein of Solids	18.3%	20.5%	75.3%	75.3%	75.3%	0.0%	85.2%	38.4%	12.7%	6.8%	75.3%	85.2%	0.0%	12.7%	12.7%	12.7%
Properties																
Temperature (°C)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Pressure (psi)	5	5	15	15	15	15	15	5	5	15	15	15	5	5	5	5







Appendix A

Year 5

Stream Description Stream Number	Perm. Mix 21	Bleed 8 22	Perm. 8 23	Perm. Mix 24	Bleed 9 25	Perm. 9 26	Perm. Mix 27	Bleed 10 28	Perm. 10 29	Perm. Mix 30	35% NaCl 31	55% Feed 32	55% Bleed 33	55% Perm. 34	Perm. Mix 35	Dia. 1 feed 36	H2O Feed 37	Dia. 1 Bleed 38
<b>Component</b>																		
lbs/min																		
True Protein	0.18	5.63	0.04	0.22	5.58	0.05	0.31	5.52	0.05	0.26	4.13	1.39	1.32	0.07	0.21	1.32	0.00	1.21
Non-Protein Nitrogen	1.44	1.27	0.21	1.66	1.05	0.22	0.59	0.87	0.18	0.37	0.65	0.22	0.10	0.12	0.19	0.10	0.00	0.03
Lactose	28.34	15.63	3.60	31.94	12.40	3.43	8.38	9.70	2.71	4.96	7.25	2.44	0.90	1.54	2.25	0.90	0.00	0.25
Ash	4.54	2.67	0.59	5.13	2.11	0.56	1.40	1.66	0.45	0.83	1.24	0.42	0.26	0.26	0.38	0.16	0.00	0.04
Butter Fat	0.00	0.49	0.00	0.00	0.49	0.00	0.00	0.49	0.00	0.00	0.36	0.12	0.12	0.00	0.00	0.12	0.00	0.12
Water	573.46	267.92	68.68	642.13	204.04	63.88	195.20	154.68	49.36	131.32	115.74	38.94	12.51	26.43	81.95	54.38	41.87	13.43
Total	607.95	293.80	73.13	661.08	226.67	68.14	205.88	172.92	52.75	137.74	129.39	43.53	15.10	28.43	84.98	56.97	41.87	15.10
Total Solids	34.50	25.88	4.45	38.95	21.63	4.26	10.88	18.24	3.39	6.42	13.65	4.59	2.59	2.00	3.04	2.59	0.00	1.66
gal/min																		
Total	71.52	34.57	8.60	80.13	26.55	8.02	24.34	20.34	6.21	16.33	15.22	5.12	1.78	3.34	10.12	6.79	5.02	1.78
<b>Mass %</b>																		
True Protein	0.03%	1.91%	0.06%	0.03%	2.47%	0.07%	0.15%	3.20%	0.10%	0.19%	3.20%	0.15%	8.72%	0.26%	0.25%	2.31%	0.00%	8.04%
Non-Protein Nitrogen	0.24%	0.43%	0.29%	0.24%	0.47%	0.32%	0.29%	0.50%	0.34%	0.27%	0.50%	0.29%	0.64%	0.43%	0.23%	0.17%	0.00%	0.22%
Lactose	4.66%	5.39%	4.93%	4.69%	5.50%	5.03%	4.07%	5.61%	5.13%	3.60%	5.61%	4.07%	5.94%	5.43%	2.65%	1.57%	0.00%	1.66%
Ash	0.75%	0.91%	0.81%	0.75%	0.93%	0.83%	0.68%	0.96%	0.85%	0.80%	0.96%	0.68%	1.04%	0.92%	0.45%	0.28%	0.00%	0.30%
Butter Fat	0.00%	0.17%	0.00%	0.00%	0.22%	0.00%	0.00%	0.28%	0.00%	0.00%	0.28%	0.00%	0.81%	0.00%	0.00%	0.22%	0.00%	0.81%
Water	94.33%	91.19%	93.91%	94.28%	90.42%	93.75%	94.81%	89.45%	93.58%	95.34%	89.45%	94.81%	82.86%	92.95%	96.43%	95.46%	100%	88.88%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
% Solids	5.7%	8.8%	6.1%	5.7%	9.6%	6.2%	5.2%	10.5%	6.4%	4.7%	10.5%	10.5%	17.1%	7.0%	3.6%	4.5%	0.0%	11.0%
% Protein of Solids	4.7%	26.6%	5.9%	4.8%	30.6%	6.3%	8.4%	35.1%	6.8%	9.9%	35.1%	35.1%	64.6%	9.9%	13.3%	54.6%	0.0%	74.9%
<b>Properties</b>																		
Temperature (°C)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Pressure (psi)	5	15	5	5	15	5	5	15	5	5	15	15	15	5	5	15	15	15

Appendix A

Year 5

Stream Description	Dia. 1 Perm	Perm. Mix	75% Wet	Dia. 2	Dia. 2 Feed	H2O Feed	85% Wet	Dia. 2 Perm	Total Perm	35% Prod.	75% Prod.	85% Prod.	Evap. H2O	Evap. Perm.	Wet Perm.	Perm. Prod
Stream Number	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Component																
lbs/min																
True Protein	0.10	0.14	0.83	0.39	0.39	0.00	0.35	0.03	0.53	4,960.87	992.62	424.14	0.00	489.43	152.08	641.51
Non-Protein Nitrogen	0.06	0.07	0.02	0.01	0.01	0.00	0.00	0.01	2.25	782.11	26.83	4.04	0.00	2,057.24	639.26	2,696.51
Lactose	0.65	0.71	0.17	0.08	0.08	0.00	0.02	0.06	40.32	8,705.99	204.53	24.83	0.00	36,916.37	11,471.34	48,387.71
Ash	0.11	0.12	0.03	0.01	0.01	0.00	0.00	0.01	6.52	1,491.37	36.65	4.56	0.00	5,970.91	1,855.39	7,826.30
Butter Fat	0.00	0.00	0.08	0.04	0.04	0.00	0.04	0.00	0.00	437.68	100.36	46.89	0.00	0.00	0.00	0.00
Water	40.95	55.53	9.16	4.28	18.97	14.69	4.39	14.58	837.33	0.00	0.00	0.00	921,726.67	0.00	238,208.12	238,208.12
Total	41.87	56.56	10.29	4.81	19.50	14.69	4.81	14.69	886.96	16,378.02	1,361.09	504.46	921,726.67	45,433.94	252,326.20	297,760.15
Total Solids	0.92	1.03	1.13	0.53	0.53	0.00	0.42	0.11	49.63	16,378.02	1,361.09	504.46	0.00	45,433.94	14,118.08	59,552.03
gal/min																
Total	5.02	6.78	1.21	0.57	2.33	1.76	0.57	1.76	104.47	1,926.83	160.13	59.35	110,452.57	5,345.17	29,685.44	35,030.61
Mass %																
True Protein	0.25%	0.24%	8.04%	8.04%	1.98%	0.00%	7.35%	0.22%	0.06%	30.29%	72.93%	84.08%	0.00%	1.08%	0.08%	0.22%
Non-Protein Nitrogen	0.15%	0.12%	0.22%	0.22%	0.05%	0.00%	0.07%	0.05%	0.25%	4.78%	1.98%	0.80%	0.00%	4.53%	0.25%	0.91%
Lactose	1.54%	1.25%	1.66%	1.66%	0.41%	0.00%	0.43%	0.40%	4.55%	53.16%	15.03%	4.92%	0.00%	81.25%	4.55%	16.25%
Ash	0.27%	0.22%	0.30%	0.30%	0.07%	0.00%	0.08%	0.07%	0.74%	9.11%	2.69%	0.90%	0.00%	13.14%	0.74%	2.63%
Butter Fat	0.00%	0.00%	0.81%	0.81%	0.20%	0.00%	0.81%	0.00%	0.00%	2.67%	7.37%	9.29%	0.00%	0.00%	0.00%	0.00%
Water	97.79%	98.17%	88.98%	88.98%	97.28%	100%	91.26%	98.25%	94.40%	0.00%	0.00%	0.00%	100%	0.00%	94.40%	80.00%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
% Solids	2.2%	1.8%	11.0%	11.0%	2.7%	0.0%	8.7%	0.7%	5.6%	100.0%	100.0%	100.0%	0.0%	100.0%	5.6%	20.0%
% Protein of Solids	18.0%	19.9%	74.9%	74.9%	74.9%	0.0%	84.9%	36.6%	5.6%	35.1%	74.9%	84.9%	0.0%	5.6%	5.6%	5.6%
Properties																
Temperature (°C)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Pressure (psi)	5	5	15	15	15	15	15	15	5	5	15	15	5	5	5	5





Appendix A

Year 6

Stream Description	Perm. Mix	Bleed 8	Perm. 8	Perm. Mix	Bleed 9	Perm. 9	Perm. Mix	Bleed 10	Perm. 10	Perm. Mix	35% Wet	55% Feed	55% Bleed	55% Perm.	Perm. Mix	De. 1 Feed	H2O Feed	De. 1 Bleed	
Stream Number	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	
Component																			
lbs/min																			
True Protein	0.19	5.84	0.05	0.24	5.79	0.06	0.32	5.75	0.04	0.27	4.29	1.45	1.38	0.07	0.23	1.38	0.00	0.00	1.26
Non-Protein Nitrogen	1.53	1.28	0.23	1.76	1.05	0.23	0.58	0.91	0.14	0.35	0.68	0.23	0.11	0.12	0.20	0.11	0.00	0.00	0.03
Lactose	29.99	15.88	3.81	33.80	12.28	3.61	8.14	10.11	2.17	4.53	7.55	2.56	0.99	1.57	2.36	0.99	0.00	0.00	0.26
Ash	4.80	2.68	0.62	5.43	2.09	0.69	1.36	1.73	0.36	0.76	1.29	0.44	0.17	0.27	0.40	0.17	0.00	0.00	0.05
Butter Fat	0.00	0.51	0.00	0.00	0.51	0.00	0.00	0.51	0.00	0.00	0.38	0.13	0.13	0.00	0.00	0.13	0.00	0.00	0.13
Water	606.40	267.77	72.28	678.68	200.81	66.96	200.49	161.29	39.52	133.53	120.48	40.81	13.88	26.94	94.02	65.07	51.19	14.93	14.93
Total	842.92	283.97	76.99	719.91	222.52	71.45	210.89	180.30	42.23	139.44	134.68	45.62	16.65	28.97	97.21	67.84	51.19	16.65	16.65
Total Solids	36.52	26.20	4.70	41.22	21.71	4.49	10.39	19.00	2.71	5.91	14.19	4.81	2.77	2.03	3.20	2.77	0.00	0.00	1.73
gal/min																			
Total	75.64	34.58	9.06	84.69	26.18	8.41	24.96	21.21	4.97	16.55	15.84	5.37	1.96	3.41	11.59	8.09	6.13	1.96	1.96
Mass %																			
True Protein	0.03%	1.99%	0.06%	0.03%	2.60%	0.08%	0.15%	3.19%	0.10%	0.19%	3.19%	0.15%	8.30%	0.25%	0.23%	2.04%	0.00%	0.00%	7.59%
Non-Protein Nitrogen	0.24%	0.44%	0.30%	0.24%	0.47%	0.32%	0.27%	0.50%	0.34%	0.25%	0.50%	0.27%	0.63%	0.43%	0.21%	0.16%	0.00%	0.00%	0.20%
Lactose	4.67%	5.40%	4.94%	4.69%	5.52%	5.05%	3.86%	5.61%	5.13%	3.25%	5.61%	3.88%	5.93%	5.42%	2.43%	1.45%	0.00%	0.00%	1.53%
Ash	0.75%	0.91%	0.81%	0.75%	0.94%	0.83%	0.64%	0.96%	0.85%	0.55%	0.96%	0.64%	1.04%	0.92%	0.41%	0.25%	0.00%	0.00%	0.27%
Butter Fat	0.00%	0.17%	0.00%	0.00%	0.23%	0.00%	0.00%	0.28%	0.00%	0.00%	0.28%	0.00%	0.77%	0.00%	0.00%	0.19%	0.00%	0.00%	0.77%
Water	94.32%	91.09%	93.89%	94.27%	90.24%	93.72%	95.07%	89.46%	93.58%	95.76%	89.46%	95.07%	83.34%	92.98%	96.71%	95.91%	100%	100%	89.63%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
% Solids	5.7%	8.9%	6.1%	5.7%	9.8%	6.3%	4.9%	10.8%	6.4%	4.2%	10.5%	10.5%	16.7%	7.0%	3.3%	4.1%	0.0%	0.0%	10.4%
% Protein of Solids	4.7%	27.2%	5.8%	4.9%	31.5%	6.4%	8.7%	35.0%	6.8%	10.4%	35.0%	35.0%	53.6%	9.7%	13.5%	53.6%	0.0%	0.0%	75.1%
Properties																			
Temperature (°C)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Pressure (psi)	5	15	5	5	15	5	5	15	5	5	15	15	15	5	5	15	15	15	15

Appendix A

Year 6

Stream Number	39	40	41	42	43	44	45	46	47	49	49	50	51	52	53	54
Component	Di. 1	Perm. Mix	75% Wet	Di. 2	Di. 2	H2O Feed	65% Wet	Di. 2	Total Perm.	35% Prod.	75% Prod.	85% Prod.	Evap H2O	Evap. Perm.	Wet Perm.	Perm. Prod.
Di. 1	Di. 2	Di. 2	Di. 2	Di. 2	Di. 2	Di. 2	Di. 2	Di. 2	Di. 2	Di. 2	Di. 2	Di. 2	Di. 2	Di. 2	Di. 2	Di. 2
lbs/min	0.12	0.15	0.86	0.40	0.40	0.40	0.36	0.04	0.56	5,151.27	1,035.90	436.92	0.00	483.82	151.56	645.38
True Protein	0.07	0.08	0.02	0.01	0.01	0.01	0.00	0.01	2.34	813.83	27.57	3.94	0.00	2,049.27	628.96	2,678.23
Non-Protein Nitrogen	0.73	0.79	0.17	0.08	0.08	0.08	0.02	0.06	41.93	9,061.42	209.36	24.18	0.00	36,768.49	11,285.04	48,053.53
Lactose	0.13	0.14	0.03	0.01	0.01	0.01	0.00	0.01	6.78	1,552.22	37.51	4.44	0.00	5,947.03	1,825.27	7,772.30
Ash	0.00	0.00	0.09	0.04	0.04	0.04	0.04	0.00	0.00	454.40	105.18	48.75	0.00	0.00	0.00	0.00
Butter Fat	50.14	67.08	10.20	4.73	21.78	17.05	4.84	16.94	879.18	0.00	0.00	0.00	933,500.00	0.00	236,597.77	236,597.77
Water	51.19	68.24	11.38	5.27	22.32	17.05	5.27	17.05	930.79	17,033.14	1,415.53	518.22	933,500.00	45,258.60	250,488.61	295,747.21
Total	1.05	1.16	1.18	0.55	0.55	0.55	0.43	0.12	51.62	17,033.14	1,415.53	518.22	0.00	45,258.60	13,890.84	59,149.44
Total Solids																
gal/min										gal/day	gal/day	gal/day	gal/day	gal/day	gal/day	gal/day
Total	6.13	8.18	1.34	0.62	0.62	2.66	2.04	2.04	109.65	2,003.90	166.53	60.97	111,863.39	5,324.54	29,469.25	34,793.79
Mass %																
True Protein	0.23%	0.23%	7.59%	7.59%	1.79%	0.00%	6.90%	0.21%	0.06%	30.24%	73.18%	84.31%	0.00%	1.09%	0.06%	0.22%
Non-Protein Nitrogen	0.14%	0.12%	0.20%	0.20%	0.05%	0.00%	0.06%	0.04%	0.25%	4.78%	1.95%	0.76%	0.00%	4.53%	0.25%	0.91%
Lactose	1.43%	1.16%	1.53%	1.53%	0.36%	0.00%	0.38%	0.36%	4.51%	53.20%	14.79%	4.67%	0.00%	81.24%	4.51%	16.25%
Ash	0.25%	0.20%	0.27%	0.27%	0.06%	0.00%	0.07%	0.06%	0.73%	9.11%	2.65%	0.86%	0.00%	13.14%	0.73%	2.63%
Butter Fat	0.00%	0.00%	0.77%	0.77%	0.18%	0.00%	0.77%	0.00%	0.00%	2.87%	7.43%	9.41%	0.00%	0.00%	0.00%	0.00%
Water	97.95%	98.30%	89.63%	89.63%	97.55%	100%	91.81%	99.33%	94.45%	0.00%	0.00%	0.00%	100%	0.00%	94.45%	80.00%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
% Solids	2.0%	1.7%	10.4%	10.4%	2.4%	0.0%	8.2%	0.7%	5.5%	100.0%	100.0%	100.0%	0.0%	100.0%	5.5%	20.0%
% Protein of Solids	18.1%	20.1%	75.1%	75.1%	75.1%	0.0%	85.1%	37.7%	5.6%	35.0%	75.1%	85.1%	0.0%	5.6%	5.6%	5.8%
Properties																
Temperature (°C)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Pressure (psi)	5	5	15	15	15	15	15	15	5	5	15	15	5	5	5	5







Appendix A

Year 7

Stream/Description Stream Number	Perm. Mix 21	Bleed % 22	Perm. % 23	Perm. Mix 24	Bleed % 25	Perm. % 26	Perm. Mix 27	Bleed % 28	Perm. % 29	Perm. Mix 30	35% Wet 31	55% Feed 32	55% Bleed 33	55% Perm. 34	Perm. Mix 35	Dp. 1 feed 36	H2O Feed 37	Dia. 1 Bleed 38
<b>Component</b>																		
lbs/min																		
True Protein	0.19	6.08	0.04	0.24	6.04	0.05	0.35	5.98	0.06	0.29	4.46	1.51	1.43	0.08	0.23	1.43	0.00	1.32
Non-Protein Nitrogen	1.94	1.39	0.23	1.77	1.16	0.23	0.66	0.84	0.22	0.43	0.70	0.24	0.10	0.14	0.21	0.10	0.00	0.04
Lactose	30.31	17.47	3.89	34.19	13.77	3.71	9.41	10.52	3.25	5.71	7.86	2.66	0.97	1.70	2.46	0.97	0.00	0.27
Ash	4.85	2.95	0.63	5.49	2.34	0.61	1.57	1.80	0.54	0.96	1.35	0.46	0.17	0.29	0.42	0.17	0.00	0.05
Butter Fat	0.00	0.53	0.00	0.00	0.53	0.00	0.00	0.53	0.00	0.00	0.39	0.13	0.13	0.00	0.00	0.13	0.00	0.13
Water	613.69	296.44	74.18	687.87	227.20	69.24	218.30	167.91	59.29	149.06	125.39	42.52	13.48	29.04	89.77	58.09	44.61	14.47
Total	650.58	324.88	78.97	729.56	251.03	73.84	230.29	187.67	63.36	156.45	140.15	47.52	16.28	31.24	93.09	60.90	44.61	16.28
Total Solids	36.89	28.43	4.80	41.69	23.63	4.60	11.99	19.77	4.06	7.39	14.76	5.01	2.80	2.20	3.32	2.80	0.00	1.81
gal/min																		
Total	76.54	38.22	9.29	85.83	29.53	8.69	27.23	22.08	7.45	18.54	16.49	5.59	1.92	3.68	11.09	7.26	5.35	1.92
<b>Mass %</b>																		
True Protein	0.03%	1.87%	0.06%	0.03%	2.40%	0.07%	0.15%	3.18%	0.10%	0.19%	3.18%	0.15%	8.79%	0.26%	0.25%	2.35%	0.00%	8.11%
Non-Protein Nitrogen	0.24%	0.43%	0.29%	0.24%	0.48%	0.31%	0.29%	0.50%	0.34%	0.27%	0.50%	0.29%	0.64%	0.43%	0.23%	0.17%	0.00%	0.22%
Lactose	4.66%	5.38%	4.92%	4.66%	5.48%	5.02%	4.09%	5.60%	5.13%	3.65%	5.60%	4.09%	5.94%	5.43%	2.64%	1.59%	0.00%	1.67%
Ash	0.75%	0.91%	0.80%	0.75%	0.93%	0.82%	0.68%	0.96%	0.85%	0.61%	0.96%	0.68%	1.04%	0.92%	0.45%	0.28%	0.00%	0.30%
Butter Fat	0.00%	0.16%	0.00%	0.00%	0.21%	0.00%	0.00%	0.28%	0.00%	0.00%	0.28%	0.09%	0.82%	0.00%	0.00%	0.22%	0.00%	0.82%
Water	94.33%	91.25%	93.93%	94.29%	90.51%	93.77%	94.80%	89.47%	93.58%	95.28%	89.47%	94.80%	82.78%	92.95%	96.43%	95.40%	100%	88.88%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
% Solids	5.7%	8.8%	6.1%	5.7%	9.5%	6.2%	5.2%	10.5%	6.4%	4.7%	10.5%	10.5%	17.2%	7.0%	3.6%	4.6%	0.0%	11.1%
% Protein of Solids	4.7%	26.3%	5.7%	4.8%	30.2%	6.2%	8.4%	35.0%	6.8%	9.8%	35.0%	35.0%	54.7%	9.9%	13.3%	54.7%	0.0%	74.9%
<b>Properties</b>																		
Temperature (°C)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Pressure (psi)	5	15	5	5	15	5	5	15	5	5	15	15	15	5	5	15	15	15

Appendix A

Year 7	Stream Description	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Stream Number	Dia. 1 Perm.	Farm Mix	75% Wet	Dia. 2	Dia. 2 Feed	H2O Feed	35% Wet	Dia. 2 Perm.	Total Perm.	35% Prod	75% Prod	35% Prod	Evap H2O	Evap Perm.	Wet Perm.	Perm. Prod.	
Component	lbs/min	lbs/min	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	gal/day	gal/day	gal/day	gal/day	gal/day	gal/day	gal/day	
True Protein	0.11	0.15	0.89	0.43	0.43	0.00	0.39	0.04	0.58	1,073.98	484.18	0.00	491.96	152.74	644.70		
Non-Protein Nitrogen	0.07	0.08	0.02	0.01	0.01	0.00	0.00	0.01	2.43	845.93	29.10	0.00	2,053.31	637.50	2,690.80		
Lactose	0.69	0.76	0.18	0.09	0.09	0.00	0.02	0.07	43.61	9,426.31	25.92	0.00	36,837.57	11,437.07	48,274.64		
Ash	0.12	0.13	0.03	0.02	0.02	0.00	0.00	0.01	7.05	1,614.53	39.63	0.00	5,958.27	1,849.88	7,808.15		
Butter Fat	0.00	0.00	0.00	0.04	0.04	0.00	0.04	0.00	0.00	472.45	108.56	0.00	0.00	0.00	0.00		
Water	43.62	60.73	9.81	4.66	21.90	17.23	4.78	17.11	906.17	0.00	0.00	0.00	933,500.00	0.00	237,673.30		
Total	44.61	61.85	11.03	5.25	22.48	17.23	5.25	17.23	959.85	17,714.47	1,472.15	550.73	933,500.00	45,341.10	251,750.49		
Total Solids	0.99	1.12	1.23	0.58	0.58	0.00	0.46	0.13	53.67	17,714.47	1,472.15	550.73	0.00	45,341.10	14,077.19		
gal/min																	
Total	5.35	7.41	1.30	0.62	2.68	2.06	0.62	2.06	113.06	2,084.05	173.19	64.79	111,863.39	5,334.25	29,617.71	34,951.95	
Mass %																	
True Protein	0.25%	0.24%	8.11%	8.11%	1.89%	0.00%	7.37%	0.23%	0.06%	30.23%	72.93%	0.00%	0.00%	1.03%	0.06%	0.22%	
Non-Protein Nitrogen	0.15%	0.12%	0.22%	0.22%	0.05%	0.00%	0.07%	0.05%	0.25%	4.78%	1.98%	0.00%	0.00%	4.53%	0.25%	0.91%	
Lactose	1.56%	1.23%	1.67%	1.67%	0.39%	0.00%	0.41%	0.38%	4.54%	53.21%	15.02%	0.00%	0.00%	81.25%	4.54%	16.25%	
Ash	0.27%	0.21%	0.30%	0.30%	0.07%	0.00%	0.08%	0.07%	0.73%	9.11%	2.69%	0.00%	0.00%	13.14%	0.73%	2.63%	
Butter Fat	0.00%	0.00%	0.82%	0.82%	0.19%	0.00%	0.82%	0.00%	0.00%	2.67%	7.37%	0.00%	0.00%	0.00%	0.00%	0.00%	
Water	97.77%	98.19%	88.88%	88.88%	97.40%	100%	91.26%	99.28%	94.41%	0.00%	0.00%	100%	100%	0.00%	94.41%	80.00%	
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
% Solids	2.2%	1.8%	11.1%	11.1%	2.6%	0.0%	8.7%	0.7%	5.6%	100.0%	100.0%	100.0%	0.0%	100.0%	5.6%	20.0%	
% Protein of Solids	18.0%	20.2%	74.9%	74.9%	74.9%	0.0%	85.1%	37.6%	5.6%	35.0%	74.9%	85.1%	0.0%	5.6%	5.6%	5.6%	
Properties																	
Temperature (°C)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	
Pressure (psi)	5	5	15	15	15	15	15	15	5	5	15	15	5	5	5	5	





Appendix A

Year 8

Stream Description Stream Number	Perm. Mix 21	Bleed 8 22	Perm. 8 23	Perm. Mix 24	Bleed 9 25	Perm. 9 26	Perm. Mix 27	Bleed 10 28	Perm. 10 29	Perm. Mix 30	35% Wat 31	55% Feed 32	55% Bleed 33	55% Perm. 34	Perm. Mix 35	Dia. 1 Feed 36	H2O Feed 37	Dia. 1 Bleed 38
Component																		
lbs/min																		
True Protein	0.21	6.33	0.05	0.25	6.27	0.06	0.35	6.21	0.05	0.29	4.67	1.55	1.47	0.08	0.23	1.47	0.00	1.35
Non-Protein Nitrogen	1.63	1.42	0.24	1.87	1.17	0.25	0.65	0.98	0.19	0.41	0.73	0.24	0.11	0.14	0.21	0.11	0.00	0.04
Lactose	32.00	17.63	4.10	36.10	13.73	3.90	9.27	10.85	2.88	5.37	8.15	2.70	1.01	1.70	2.49	1.01	0.00	0.28
Ash	5.13	2.98	0.87	5.79	2.34	0.84	1.54	1.86	0.48	0.90	1.40	0.46	0.18	0.29	0.42	0.18	0.00	0.05
Butter Fat	0.00	0.55	0.00	0.00	0.55	0.00	0.00	0.55	0.00	0.00	0.41	0.14	0.14	0.00	0.00	0.14	0.00	0.14
Water	647.55	298.13	78.00	725.56	225.56	72.57	217.36	172.99	52.57	144.79	129.88	43.11	14.05	29.05	92.22	61.47	47.42	15.09
Total	686.52	327.03	83.08	769.58	249.61	77.42	228.18	193.44	56.18	151.76	145.24	48.20	16.95	31.25	95.59	64.37	47.42	16.95
Total Solids	38.97	28.90	5.06	44.03	24.06	4.84	11.82	20.45	3.61	6.97	15.35	5.10	2.89	2.20	3.36	2.89	0.00	1.85
gall/min																		
Total	80.77	38.47	9.77	90.54	29.37	9.11	27.10	22.76	6.61	17.99	17.09	5.67	1.99	3.68	11.39	7.68	5.68	1.99
Mass %																		
True Protein	0.03%	1.93%	0.06%	0.03%	2.51%	0.08%	0.15%	3.21%	0.10%	0.19%	3.21%	0.15%	8.66%	0.26%	0.25%	2.28%	0.00%	7.98%
Non-Protein Nitrogen	0.24%	0.43%	0.29%	0.24%	0.47%	0.32%	0.29%	0.50%	0.34%	0.27%	0.50%	0.29%	0.64%	0.43%	0.22%	0.17%	0.00%	0.22%
Lactose	4.66%	5.39%	4.93%	4.69%	5.50%	5.03%	4.05%	5.61%	5.13%	3.54%	5.61%	4.05%	5.94%	5.43%	2.61%	1.56%	0.00%	1.65%
Ash	0.75%	0.91%	0.81%	0.75%	0.94%	0.83%	0.67%	0.96%	0.85%	0.59%	0.96%	0.67%	1.04%	0.92%	0.44%	0.27%	0.00%	0.29%
Butter Fat	0.00%	0.17%	0.00%	0.00%	0.22%	0.00%	0.00%	0.28%	0.00%	0.00%	0.28%	0.00%	0.81%	0.00%	0.00%	0.21%	0.00%	0.81%
Water	94.32%	91.16%	93.91%	94.28%	90.36%	93.74%	94.84%	89.43%	93.58%	95.41%	89.43%	94.84%	82.92%	92.96%	96.48%	95.50%	100%	89.06%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
% Solids	5.7%	8.8%	6.1%	5.7%	9.6%	6.3%	5.2%	10.6%	6.4%	4.6%	10.6%	10.6%	17.1%	7.0%	3.5%	4.5%	0.0%	10.9%
% Protein of Solids	4.7%	26.8%	5.8%	4.8%	30.9%	6.3%	8.5%	35.2%	6.8%	10.0%	35.2%	35.2%	54.4%	9.8%	13.3%	54.4%	0.0%	74.9%
Properties																		
Temperature (°C)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Pressure (psi)	5	15	5	5	15	5	5	15	5	5	15	15	15	5	5	15	15	15

Appendix A

Stream Description	Dia. 1 Perm.	Perm. Mix	75% Wat	Dia. 2	Dia. 2 Feed	H2O Feed	35% Wat	Dia. 2 Perm.	Total Perm.	35% Prod.	75% Prod.	35% Prod.	Evap. Perm.	Wat Perm.	Perm. Prod.	
Stream Number	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Component																
lbs/min										lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day
True Protein	0.12	0.15	0.93	0.42	0.42	0.00	0.38	0.04	0.60	5,598.35	1,116.29	460.52	0.00	483.49	150.08	633.58
Non-Protein Nitrogen	0.07	0.08	0.03	0.01	0.01	0.00	0.00	0.01	2.53	879.31	30.33	4.27	0.00	2,036.13	632.05	2,668.17
Lactose	0.73	0.79	0.19	0.09	0.09	0.00	0.02	0.07	45.37	9,776.39	230.31	26.18	0.00	36,541.40	11,343.03	47,884.43
Ash	0.13	0.14	0.03	0.02	0.02	0.00	0.00	0.01	7.34	1,674.98	41.27	4.81	0.00	5,910.22	1,834.63	7,744.85
Butter Fat	0.00	0.00	0.09	0.04	0.04	0.00	0.04	0.00	0.00	494.01	112.84	51.11	0.00	0.00	0.00	0.00
Water	46.38	63.17	10.39	4.70	21.62	16.91	4.93	16.79	942.92	0.00	0.00	0.00	933,500.00	0.00	285,724.23	235,724.23
Total	47.42	64.33	11.66	5.28	22.19	16.91	5.28	16.91	998.76	18,423.04	1,531.04	546.90	933,500.00	44,971.24	249,684.02	294,655.26
Total Solids	1.04	1.16	1.28	0.58	0.58	0.00	0.46	0.12	55.84	18,423.04	1,531.04	546.90	0.00	44,971.24	13,959.79	58,931.02
gal/min										gal/day	gal/day	gal/day	gal/day	gal/day	gal/day	gal/day
Total	5.68	7.71	1.37	0.62	2.65	2.03	0.62	2.03	117.64	2,167.42	180.12	64.34	111,863.39	5,280.73	29,374.59	34,665.32
Mass %																
True Protein	0.24%	0.24%	7.98%	7.98%	1.90%	0.00%	7.26%	0.22%	0.06%	30.38%	72.91%	84.21%	0.00%	1.06%	0.06%	0.22%
Non-Protein Nitrogen	0.15%	0.12%	0.22%	0.22%	0.05%	0.00%	0.07%	0.06%	0.25%	4.77%	1.98%	0.78%	0.00%	4.53%	0.25%	0.91%
Lactose	1.53%	1.23%	1.65%	1.65%	0.39%	0.00%	0.41%	0.38%	4.54%	53.07%	15.04%	4.79%	0.00%	81.26%	4.54%	16.25%
Ash	0.27%	0.21%	0.29%	0.29%	0.07%	0.00%	0.08%	0.07%	0.73%	9.09%	2.70%	0.88%	0.00%	13.14%	0.73%	2.63%
Butter Fat	0.00%	0.00%	0.81%	0.81%	0.19%	0.00%	0.81%	0.00%	0.00%	2.68%	7.37%	9.35%	0.00%	0.00%	0.00%	0.00%
Water	97.81%	98.19%	89.06%	89.06%	97.40%	100%	91.37%	99.28%	94.41%	0.00%	0.00%	0.00%	100%	0.00%	94.41%	80.00%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
% Solids	2.2%	1.8%	10.9%	10.9%	2.6%	0.0%	8.6%	0.7%	5.6%	100.0%	100.0%	100.0%	0.0%	100.0%	5.6%	20.0%
% Protein of Solids	18.0%	20.0%	74.9%	74.9%	74.9%	0.0%	85.0%	37.2%	5.6%	35.2%	74.9%	85.0%	0.0%	5.6%	5.6%	5.6%
Properties																
Temperature (°C)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Pressure (psi)	5	5	15	15	15	15	15	15	5	5	15	15	5	5	5	5







Appendix A

Year 9

Stream Description Stream Number	Perm. Mix 21	Bleed 0 22	Perm. 8 23	Perm. Mix 24	Bleed 9 25	Perm. 9 26	Perm. Mix 27	Bleed 10 28	Perm. 10 29	Perm. Mix 30	15% Wet 31	55% Feed 32	55% Bleed 33	35% Perm. 34	Perm. Mix 35	Dia. Feed 36	H2O Feed 37	Dia. Bleed 38
Component																		
lbs/min																		
True Protein	0.22	6.57	0.05	0.27	6.51	0.06	0.36	6.46	0.05	0.30	4.82	1.64	1.55	0.09	0.25	1.55	0.00	1.43
Non-Protein Nitrogen	1.71	1.45	0.26	1.97	1.19	0.26	0.66	1.02	0.17	0.40	0.76	0.26	0.11	0.15	0.23	0.11	0.00	0.04
Lactose	33.53	18.04	4.32	37.85	13.93	4.10	9.31	11.40	2.53	5.21	8.50	2.90	1.85	2.68	1.05	0.00	0.29	0.29
Ash	5.37	3.05	0.71	6.08	2.37	0.68	1.55	1.95	0.42	0.88	1.46	0.50	0.18	0.31	0.46	0.18	0.00	0.05
Butter Fat	0.00	0.57	0.00	0.00	0.57	0.00	0.00	0.57	0.00	0.00	0.43	0.15	0.15	0.00	0.00	0.15	0.00	0.15
Water	678.06	304.42	82.15	760.21	228.15	76.27	220.28	182.01	46.14	144.01	135.71	46.30	14.62	31.68	97.86	64.81	50.19	15.71
Total	718.89	334.10	87.49	806.37	252.73	81.38	232.17	203.42	49.31	150.79	151.67	51.75	17.67	34.08	101.49	67.85	50.19	17.67
Total Solids	40.82	29.68	5.34	46.16	24.58	5.10	11.89	21.41	3.16	6.79	15.97	5.45	3.04	2.40	3.62	3.04	0.00	1.95
gal/min																		
Total	84.57	39.31	10.29	94.87	29.73	9.57	27.46	29.93	5.80	17.89	17.84	6.09	2.08	4.01	12.09	8.09	6.01	2.08
Mass %																		
True Protein	0.03%	1.97%	0.06%	0.03%	2.58%	0.08%	0.16%	3.18%	0.10%	0.20%	3.18%	0.16%	8.80%	0.26%	0.25%	2.29%	0.00%	8.10%
Non-Protein Nitrogen	0.24%	0.43%	0.30%	0.24%	0.47%	0.32%	0.28%	0.50%	0.34%	0.26%	0.50%	0.28%	0.64%	0.43%	0.23%	0.17%	0.00%	0.21%
Lactose	4.66%	5.40%	4.94%	4.69%	5.51%	5.04%	4.01%	5.61%	5.13%	3.46%	5.61%	4.01%	5.94%	5.43%	2.64%	1.55%	0.00%	1.63%
Ash	0.75%	0.91%	0.81%	0.75%	0.94%	0.83%	0.67%	0.96%	0.85%	0.58%	0.96%	0.67%	1.04%	0.92%	0.45%	0.27%	0.00%	0.29%
Butter Fat	0.00%	0.17%	0.00%	0.00%	0.23%	0.00%	0.00%	0.28%	0.00%	0.00%	0.28%	0.00%	0.82%	0.00%	0.00%	0.21%	0.00%	0.82%
Water	94.32%	91.12%	93.90%	94.28%	90.28%	93.73%	94.88%	89.47%	93.58%	95.50%	89.47%	94.88%	82.77%	92.95%	96.43%	95.51%	100%	88.95%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
% Solids	5.7%	8.9%	6.1%	5.7%	9.7%	6.3%	5.1%	10.5%	6.4%	4.5%	10.5%	10.5%	17.2%	7.0%	3.6%	4.5%	0.0%	11.1%
% Protein of Solids	4.7%	27.0%	5.8%	4.8%	31.3%	6.3%	8.6%	35.0%	6.8%	10.3%	35.0%	35.0%	54.8%	9.9%	13.4%	54.8%	0.0%	75.2%
Properties																		
Temperature (°C)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Pressure (psi)	5	15	5	5	15	5	5	15	5	5	15	15	15	5	5	15	15	15

Appendix A

Year 9		39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Stream Description	Dia. 1 Perm.	Perm. Mix	75% Wet	Dia. 2	H2O Feed	35% Wet	Dia. 2 Perm.	Total Perm.	35% Prod	75% Prod	85% Prod	Evap H2O	Evap Perm.	Wet Perm.	Perm. Prod.		
Stream Number	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	
Component																	
lbs/min																	
True Protein	0.12	0.16	0.97	0.46	0.46	0.00	0.42	0.04	0.63	5,784.48	1,166.48	503.22	0.00	483.75	150.11	633.87	
Non-Protein Nitrogen	0.07	0.08	0.03	0.01	0.01	0.00	0.00	0.01	2.63	915.59	30.94	4.70	0.00	2,015.18	625.32	2,640.50	
Lactose	0.76	0.83	0.20	0.09	0.08	0.00	0.02	0.07	47.16	10,202.23	234.53	28.83	0.00	36,154.19	11,218.86	47,373.05	
Ash	0.13	0.14	0.04	0.02	0.02	0.00	0.00	0.01	7.63	1,747.47	42.03	5.30	0.00	5,847.71	1,814.58	7,662.28	
Butter Fat	0.00	0.00	0.10	0.05	0.05	0.00	0.05	0.00	0.00	510.22	118.29	55.78	0.00	0.00	0.00	0.00	
Water	49.09	66.19	10.68	5.04	22.26	17.22	5.16	17.09	980.49	0.00	0.00	0.00	933,500.00	0.00	233,238.79	233,238.79	
Total	50.19	67.41	12.01	5.66	22.88	17.22	5.66	17.22	1,038.54	19,159.97	1,592.28	597.82	933,500.00	44,500.82	247,047.66	291,548.48	
Total Solids	1.09	1.22	1.33	0.63	0.63	0.00	0.50	0.13	58.05	19,159.97	1,592.28	597.82	0.00	44,500.82	13,808.87	58,309.70	
gal/min																	
Total	6.01	8.08	1.41	0.67	2.73	2.06	0.67	2.06	122.33	2,254.11	187.33	70.33	111,863.39	5,235.39	29,064.43	34,299.82	
Mass %																	
True Protein	0.25%	0.24%	8.10%	8.10%	2.00%	0.00%	7.41%	0.23%	0.06%	30.19%	73.26%	84.18%	0.00%	1.09%	0.06%	0.22%	
Non-Protein Nitrogen	0.15%	0.12%	0.21%	0.21%	0.05%	0.00%	0.07%	0.05%	0.25%	4.78%	1.94%	0.79%	0.00%	4.53%	0.25%	0.91%	
Lactose	1.52%	1.23%	1.63%	1.63%	0.40%	0.00%	0.42%	0.40%	4.54%	53.25%	14.73%	4.82%	0.00%	81.24%	4.54%	16.25%	
Ash	0.26%	0.21%	0.29%	0.29%	0.07%	0.00%	0.08%	0.07%	0.73%	9.12%	2.64%	0.89%	0.00%	13.14%	0.73%	2.63%	
Butter Fat	0.00%	0.00%	0.82%	0.82%	0.20%	0.00%	0.82%	0.00%	0.00%	2.68%	7.43%	9.33%	0.00%	0.00%	0.00%	0.00%	
Water	97.82%	98.19%	88.95%	88.95%	97.27%	100%	91.20%	99.26%	94.41%	0.00%	0.00%	0.00%	100%	0.00%	94.41%	80.00%	
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
% Solids	2.2%	1.8%	11.1%	11.1%	2.7%	0.0%	8.8%	0.7%	5.6%	100.0%	100.0%	100.0%	0.0%	100.0%	5.6%	20.0%	
% Protein of Solids	18.2%	20.2%	75.2%	75.2%	75.2%	0.0%	85.0%	37.1%	5.6%	35.0%	75.2%	85.0%	0.0%	5.6%	5.6%	5.6%	
Properties																	
Temperature (°C)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	
Pressure (psi)	5	5	15	15	15	15	15	15	5	15	15	15	5	5	5	5	





Appendix A

Year 10

Stream Description Stream Number	Perm. Mix 21	Bleed 3 22	Perm. 3 23	Perm. Mix 24	Bleed 9 25	Perm. 9 26	Perm. Mix 27	Bleed 10 28	Perm. 10 29	Perm. Mix 30	35% Wet 31	55% Feed 32	55% Bleed 33	55% Perm. 34	Perm. Mix 35	Dia. Feed 36	H2O Feed 37	Dia. Bleed 38
Component lbs/min																		
True Protein	0.21	6.85	0.05	0.26	6.79	0.06	0.40	6.72	0.07	0.33	5.02	1.70	1.62	0.09	0.26	1.62	0.00	1.48
Non-Protein Nitrogen	1.72	1.58	0.26	1.98	1.31	0.26	0.75	1.06	0.25	0.49	0.79	0.27	0.12	0.15	0.24	0.12	0.00	0.04
Lactose	33.87	19.84	4.41	36.28	15.63	4.21	10.78	11.84	3.79	6.56	8.84	3.00	1.13	1.87	2.77	1.13	0.00	0.30
Ash	5.42	3.35	0.72	6.14	2.66	0.69	1.79	2.03	0.63	1.10	1.51	0.51	0.20	0.32	0.47	0.20	0.00	0.05
Butter Fat	0.00	0.59	0.00	0.00	0.59	0.00	0.00	0.59	0.00	0.00	0.44	0.15	0.15	0.00	0.00	0.15	0.00	0.15
Water	686.04	336.95	84.23	770.27	258.16	78.79	254.71	188.98	69.19	175.92	141.09	47.88	15.82	32.07	106.73	72.25	56.44	17.00
Total	727.26	369.16	89.67	816.93	285.15	84.02	268.42	211.22	73.93	184.41	157.70	53.52	19.03	34.49	110.48	75.47	56.44	19.03
Total Solids	41.22	32.21	5.44	46.66	26.98	5.23	13.72	22.24	4.74	8.49	16.61	5.64	3.21	2.42	3.75	3.21	0.00	2.02
gal/min																		
Total	85.56	43.43	10.55	96.11	33.55	9.88	31.75	24.85	8.70	21.86	18.55	6.30	2.24	4.06	13.16	9.00	6.76	2.24
Mass %																		
True Protein	0.03%	1.86%	0.06%	0.03%	2.36%	0.07%	0.15%	3.18%	0.10%	0.18%	3.18%	0.15%	8.49%	0.25%	0.24%	2.14%	0.00%	7.78%
Non-Protein Nitrogen	0.24%	0.43%	0.29%	0.24%	0.46%	0.31%	0.28%	0.50%	0.34%	0.27%	0.50%	0.28%	0.63%	0.43%	0.22%	0.16%	0.00%	0.21%
Lactose	4.66%	5.37%	4.92%	4.69%	5.48%	5.01%	4.01%	5.60%	5.13%	3.56%	5.60%	4.01%	5.93%	5.42%	2.51%	1.49%	0.00%	1.57%
Ash	0.75%	0.91%	0.80%	0.75%	0.93%	0.82%	0.67%	0.96%	0.85%	0.60%	0.96%	0.67%	1.04%	0.92%	0.43%	0.26%	0.00%	0.28%
Butter Fat	0.00%	0.16%	0.00%	0.00%	0.21%	0.00%	0.00%	0.28%	0.00%	0.00%	0.28%	0.00%	0.79%	0.00%	0.00%	0.20%	0.00%	0.79%
Water	94.33%	91.27%	93.93%	94.29%	90.54%	93.78%	94.89%	89.47%	93.59%	95.40%	89.47%	94.89%	83.12%	92.97%	96.61%	95.74%	100%	89.36%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
% Solids	5.7%	8.7%	6.1%	5.7%	9.5%	6.2%	5.1%	10.5%	6.4%	4.6%	10.5%	10.5%	16.9%	7.0%	3.4%	4.3%	0.0%	10.6%
% Protein of Solids	4.7%	26.2%	5.7%	4.8%	30.0%	6.2%	8.4%	35.0%	6.8%	9.7%	35.0%	35.0%	54.1%	9.8%	13.4%	54.1%	0.0%	75.1%
Properties																		
Temperature (°C)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Pressure (psi)	5	15	5	5	15	5	5	15	5	5	15	15	15	5	5	15	15	15







**Cash Flow For Project without Permeate Evaporation**

Year	Initial Investments			Total Capital Investment	Sales	Annual Manufacturing Costs											
	Equipment Cost	Engineering Expenses	Installation			Fixed Capital Investment	Working Capital	Raw Materials	Cartridges & Parts	Operator Labor	Direct super. & clerical labor	Utilities	Main & Rep.	Operating supplies	Lab charges	Space costs	Waste Removal
0	\$ 2,310,747	\$ 939,385	\$ 1,067,773	\$ 3,454,324	\$ 863,581	\$ 4,317,904											
1						\$ 4,217,330	\$ 189,311	\$ 159,677	\$ 183,960	\$ 27,594	\$ 174,587	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 1,597,921	\$ 2,600,242
2						\$ 4,386,023	\$ 196,261	\$ 162,969	\$ 183,960	\$ 27,594	\$ 176,845	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 1,662,762	\$ 2,677,584
3						\$ 4,561,464	\$ 203,665	\$ 167,908	\$ 183,960	\$ 27,594	\$ 181,178	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 1,728,393	\$ 2,759,891
4						\$ 4,743,922	\$ 211,342	\$ 172,846	\$ 183,960	\$ 27,594	\$ 185,286	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 1,820,683	\$ 2,863,914
5						\$ 4,933,679	\$ 219,398	\$ 178,608	\$ 183,960	\$ 27,594	\$ 190,100	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 1,868,645	\$ 2,935,497
6						\$ 5,131,026	\$ 228,035	\$ 186,838	\$ 183,960	\$ 27,594	\$ 195,600	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 1,943,640	\$ 3,032,860
7						\$ 5,336,287	\$ 236,504	\$ 190,954	\$ 183,960	\$ 27,594	\$ 199,533	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 2,021,002	\$ 3,126,740
8						\$ 5,549,718	\$ 245,579	\$ 197,538	\$ 183,960	\$ 27,594	\$ 204,042	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 2,102,594	\$ 3,228,500
9						\$ 5,771,707	\$ 254,985	\$ 204,123	\$ 183,960	\$ 27,594	\$ 209,728	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 2,185,857	\$ 3,333,440
10						\$ 6,002,575	\$ 264,928	\$ 212,354	\$ 183,960	\$ 27,594	\$ 215,619	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 2,273,653	\$ 3,445,301

Whey and Cleaning Materials

Steam and Electric

Year	Annual general expenses		Total Product Cost	Annual Operating Income	Annual Depreciation	Income before Tax	Tax	Annual Cash Flow	Rate of Return Discount Factor	8.9% Present Value	Payback Period
	Admin.	Selling Expenses									
0	\$ 168,693	\$ 506,080	\$ 210,966	\$ 885,639	\$ 3,485,882	\$ 731,448	\$ 885,639	\$ 210,966	0.9184	\$ 610,956.70	\$ 665,230
1	\$ 175,441	\$ 528,323	\$ 219,301	\$ 921,065	\$ 3,598,648	\$ 787,374	\$ 921,065	\$ 219,301	0.8435	\$ 534,841.28	\$ 1,289,314
2	\$ 182,459	\$ 547,376	\$ 228,073	\$ 957,907	\$ 3,717,796	\$ 843,666	\$ 957,907	\$ 228,073	0.7747	\$ 481,569.05	\$ 1,920,958
3	\$ 189,757	\$ 569,271	\$ 237,198	\$ 996,224	\$ 3,865,137	\$ 878,785	\$ 996,224	\$ 237,198	0.7115	\$ 433,861.13	\$ 2,530,769
4	\$ 197,347	\$ 592,042	\$ 246,684	\$ 1,036,073	\$ 3,971,570	\$ 962,109	\$ 1,036,073	\$ 246,684	0.6534	\$ 431,071.60	\$ 3,190,482
5	\$ 205,241	\$ 615,723	\$ 256,551	\$ 1,077,518	\$ 4,110,376	\$ 1,020,651	\$ 1,077,518	\$ 256,551	0.6001	\$ 417,036.92	\$ 3,885,412
6	\$ 213,451	\$ 640,352	\$ 266,813	\$ 1,120,616	\$ 4,247,356	\$ 1,088,911	\$ 1,120,616	\$ 266,813	0.5512	\$ 382,814.69	\$ 4,579,983
7	\$ 221,989	\$ 665,966	\$ 277,486	\$ 1,165,441	\$ 4,393,940	\$ 1,155,778	\$ 1,165,441	\$ 277,486	0.5082	\$ 351,023.90	
8	\$ 230,968	\$ 692,605	\$ 288,585	\$ 1,212,058	\$ 4,545,498	\$ 1,226,208	\$ 1,212,058	\$ 288,585	0.4649	\$ 342,031.05	
9	\$ 240,103	\$ 720,309	\$ 300,129	\$ 1,260,541	\$ 4,705,842	\$ 1,296,734	\$ 1,260,541	\$ 300,129	0.4270	\$ 332,193.31	Years
10									ratio	1.000	FALSE

Appendix C

<b>Composition Feed</b>	<b>Percentage</b>	<b>Flow Rate</b>	<b>Membrane Rejections</b>
		lbs/day	σ
Protein	0.90%	9,000	
	0.60%	6,000	0.97
	0.30%	3,000	0.32
Lactose	4.90%	49,000	0.085
Ash	0.80%	8,000	0.115
Butter Fat	0.05%	500	1.0
Water	93.35%	933,500	0
		1,000,000	
Density		8.5 lbs/gal	
<b>Membrane Conditions</b>			
Cartridge inlet pressure	30 psig		
Crossflow pressure drop	15 psig		
Permeate pressure	5 psig		
Recirculation Rate/Cartridge	23 gpm		

Year	Whey Feed		Increase
	lbs/day	gal/day	
1	1,000,000	117647.1	40,000
2	1,040,000	122352.9	41,600
3	1,081,600	127247.1	43,264
4	1,124,864	132336.9	44,995
5	1,169,859	137630.4	46,794
6	1,216,653	143135.6	48,666
7	1,265,319	148861.1	50,613
8	1,315,932	154815.5	52,637
9	1,368,569	161008.1	54,743
10	1,423,312	167448.4	56,932

Appendix C

Jan. 1990 Marshall and Swift Cost Inde

904 Jan. 2001

1094.5

Storage Tanks

Tank	Use	Capacity (days)	Volume (gal)	Actual (gal)	Cost* (1990) <sup>2</sup>	Material Factor	Cost 316 SS (1990)	Cost (2000)
1	35% Holding	1%	22,263	27,829.1	\$ 40,000	3.5	\$ 140,000	\$ 169,502
2	75% Holding	1%	1,831	2,289.1	\$ 9,500	3.5	\$ 33,250	\$ 40,257
3	85% Holding	1%	855	1,068.8	\$ 6,000	3.5	\$ 21,000	\$ 25,425
4	DI H2O	1	10927	13,658.4	\$ 26,000	3.5	\$ 91,000	\$ 110,176
5	Permeate Storage	1	121,198	151,496.9	\$ 60,000	3.5	\$ 210,000	\$ 254,253
6	Perm Product	1	33,713	42,140.8	\$ 50,000	3.5	\$ 175,000	\$ 211,878
7	35% Product	60	140,657	175,820.9	\$ 60,000	3.5	\$ 210,000	\$ 254,253
8	75% Product	60	11,689	14,611.5	\$ 30,000	3.5	\$ 105,000	\$ 127,127
9	85% Product	60	4,311	5,389.2	\$ 18,000	3.5	\$ 63,000	\$ 76,276
10	Soft H2O	1	2250	2,811.9				\$ 3,140
11	CIP Acid	60	193.47	241.8				\$ 331
12	Caustic	60	193.47	241.8				\$ 331
13	Sodium Hypochlorite	7	35	45.0				\$ 135
14	Mixing Tank	1	400	500.0	\$ 8,000	3.5	\$ 28,000	\$ 33,900

Cone roof tank

Cone roof tank

Carbon steel with agitator

Total Cost \$ 1,306,985

Marked up \$ 2,010,747

\* Jan. 1990 for CS

1990

2001

pg 539

\*\* 60 days, all other 1 day

\*\*\* 1 week supply, rest can be stored in original containers from Walmart

Pumps

35%							
Number	Stage	Flow Rate (gpm)	Pump	speed	diameter (in)	HP	Energy (kw-hr)
P-100	Feed	139.54	328	1750	7	5	89.48
P-101	A-1	645.5	4410	1750	8.25	15	268.45
P-102	A-2	632.4	4410	1750	8.25	15	268.45
P-103	A-3	619.5	4410	1750	8	15	268.45
P-104	A-4	606.9	4410	1750	8	15	268.45
P-105	A-5	594.6	4410	1750	8	15	268.45
P-106	A-6	582.7	4410	1750	8	15	268.45
P-107	A-7	571.2	4410	1750	8	15	268.45
P-108	A-8	560.2	4410	1750	8	10	178.97
P-109	A-9	549.8	4410	1750	8	10	178.97
P-110	A-10	539.9	4410	1750	8	10	178.97
75%							
P-201	B-1	282.3	218	1750	6.75	2	35.79
P-202V	W-1	5.9	218	1750	6.5	1.5	26.85
P-202	D-1	422.0	4410	1750	7.75	10	178.97
85%							
P-301V	W-2	2.0	218	1750	6.5	1	17.90
P-301	D-2	187.1	328	1750	7	5	89.48
Permeate							
35% Stream 24							
P-111	P-1	96.1	328	1750	6.75	3	53.69
75% Stream 35							
P-203	P-2	13.2	328	1750	6.75	2	35.79
Cleaning							
P-400	cleaning	10.75	328	1750	6.75	2	35.79

Appendix C

Operating Costs

Year	Cost to pay for Why Feed		Per year	Margin-75%		Margin-35%		Cleaning sol/day		
	lbs Protein Feed	Cost		Cartridges	Cart. Cost	Gasket Cost	Acid	Caustic	Na. Hypo	Cost
1	9,000.0	\$450.00	194	\$155,200.00	\$	4,476.92	3.22	3.22	1.23	\$ 68.66
2	9,360.0	\$468.00	198	\$158,400.00	\$	4,569.23	3.27	3.27	1.25	\$ 69.70
3	9,734.4	\$486.72	204	\$163,200.00	\$	4,707.69	3.35	3.35	1.28	\$ 71.27
4	10,123.8	\$506.19	210	\$168,000.00	\$	4,846.15	3.42	3.42	1.30	\$ 72.83
5	10,528.7	\$526.44	217	\$173,600.00	\$	5,007.69	3.51	3.51	1.34	\$ 74.65
6	10,949.9	\$547.49	227	\$181,600.00	\$	5,238.46	3.63	3.63	1.38	\$ 77.26
7	11,387.9	\$569.39	232	\$185,600.00	\$	5,353.85	3.69	3.69	1.41	\$ 78.56
8	11,843.4	\$592.17	240	\$192,000.00	\$	5,538.46	3.79	3.79	1.44	\$ 80.65
9	12,317.1	\$615.86	248	\$198,400.00	\$	5,723.08	3.89	3.89	1.48	\$ 82.73
10	12,809.8	\$640.49	258	\$206,400.00	\$	5,953.85	4.01	4.01	1.53	\$ 85.34

per year

Item	Cost	Margin
Cartridges	\$ 200.00	75%
Gaskets	\$ 15.00	35%

**New Equipment**  
 \$ 2,010,746.55  
**Old Equipment**  
 \$ 300,000.00

Inst. Cost	Equipment	Services
\$ 1,067,773.28	\$ 2,010,746.55	\$ 124,800.00

for 1 eng. For 1 year

Engineering Costs

Item	Number	Cartridges	Cost	Price
Stage 1	13	258	\$ 1,200.00	\$ 309,600.00
Add. Stages	12		\$ 10,000.00	\$ 120,000.00
Automation	13		\$ 6,000.00	\$ 78,000.00
Computer			\$ 48,000.00	\$ 48,000.00
Cleaning			\$ 55,000.00	\$ 55,000.00

Total \$ 610,600.00  
 Marked Up \$ 939,384.62

Utilities	Amount/day	Cost	Total
Electrical	2,979.8	\$ 0.07	\$ 208.59
Steam		\$ 5.00	

\$ 76,134.32





Appendix C

1150.06 BTU/lb steam  
\$5/mil BTU

Waste Flow	Costs		BOD	TSS	Steam	
	Hydraulic				Amount/day	Cost
87,462.4	\$ 87.46	\$ -	-	-	280,800.3	\$ 1,614.69
88,973.1	\$ 88.97	\$ -	-	-	288,018.8	\$ 1,656.20
94,596.6	\$ 94.60	\$ -	-	-	298,714.6	\$ 1,717.70
95,430.0	\$ 95.43	\$ -	-	-	300,945.7	\$ 1,730.53
102,327.7	\$ 102.33	\$ -	-	-	322,604.3	\$ 1,855.07
108,090.0	\$ 108.09	\$ 154.08	53.33	53.33	326,725.0	\$ 1,878.77
113,668.5	\$ 113.67	\$ 298.27	95.29	95.29	326,725.0	\$ 1,878.77
119,934.2	\$ 119.93	\$ 503.95	154.22	154.22	326,725.0	\$ 1,878.77
126,512.6	\$ 126.51	\$ 720.64	216.84	216.84	326,725.0	\$ 1,878.77
131,910.2	\$ 131.91	\$ 960.09	285.83	285.83	326,725.0	\$ 1,878.77

\* with evap permeate

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Allocations	Of Sales
Admin Costs	4%
Selling Expense	12%
R&D	5%
Space	\$ 1,250.00 per year

kW-hr

Operation Lab.	\$21/hr	\$ 183,960.00
Dir. Super & Clerical	15% oper labor	\$ 27,594.00
Main. & Repairs	6% capital invest	\$ 138,644.79
Oper. Supplies	15% m&r	\$ 20,796.72
Lab. Charges	15% oper labor	\$ 27,594.00



Year	Initial Investments				Annual Manufacturing Costs											
	Equipment Cost	Engineering Expenses	Installation	Fixed Capital Investment	Sales	Raw Materials	Cartridges & Parts	Operator Labor	Direct super. & clerical labor	Utilities	Main & Rep.	Operating supplies	Lab charges	Space costs	Waste Removal	Total
0	\$ 2,310,747	\$ 939,384.62	\$ 1,067,773.28	\$ 3,454,324	\$ 4,317,904	\$ 189,311	\$ 159,677	\$ 183,960	\$ 27,594	\$ 663,495	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 31,924	\$ 1,525,153
1					\$ 4,217,330	\$ 196,261	\$ 182,989	\$ 183,960	\$ 27,594	\$ 680,646	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 32,475	\$ 1,551,098
2					\$ 4,386,023	\$ 203,665	\$ 167,908	\$ 183,960	\$ 27,594	\$ 703,095	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 34,528	\$ 1,587,942
3					\$ 4,561,464	\$ 211,342	\$ 172,846	\$ 183,960	\$ 27,594	\$ 707,778	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 34,832	\$ 1,605,544
4					\$ 4,743,922	\$ 219,388	\$ 178,608	\$ 183,960	\$ 27,594	\$ 753,236	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 37,350	\$ 1,687,338
5					\$ 4,933,679	\$ 228,035	\$ 186,838	\$ 183,960	\$ 27,594	\$ 761,885	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 115,168	\$ 1,770,663
6					\$ 5,131,026	\$ 236,504	\$ 190,954	\$ 183,960	\$ 27,594	\$ 761,885	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 185,501	\$ 1,863,691
7					\$ 5,336,267	\$ 245,579	\$ 197,538	\$ 183,960	\$ 27,594	\$ 761,885	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 284,009	\$ 1,967,768
8					\$ 5,549,718	\$ 254,985	\$ 204,123	\$ 183,960	\$ 27,594	\$ 761,885	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 388,358	\$ 2,088,097
9					\$ 5,771,707	\$ 264,928	\$ 212,354	\$ 183,960	\$ 27,594	\$ 761,885	\$ 207,259	\$ 31,089	\$ 27,594	\$ 1,250	\$ 502,908	\$ 2,220,819
10					\$ 6,002,573											

Whye and Cleaning Materials  
Steam and Electric

Year	Annual general expenses			Total Product Cost	Annual Operating Income	Annual Depreciation	Income before Tax	Tax	Annual Cash Flow	Rate of Return Discount Factor	28.2% Payback Period	
	Admin.	Selling Expenses	R&D								Present Value	Years
0												
1	\$ 169,693	\$ 506,080	\$ 210,866	\$ 2,410,792	\$ 1,806,537	\$ 330,206	\$ 1,476,332	\$ 590,533	\$ 1,216,005	0.7741	\$ 941,360.81	\$ 1,216,005
2	\$ 175,441	\$ 526,323	\$ 219,301	\$ 2,472,153	\$ 1,913,860	\$ 565,902	\$ 1,347,958	\$ 539,183	\$ 1,374,877	0.5993	\$ 823,838.95	\$ 2,590,681
3	\$ 182,459	\$ 547,376	\$ 228,073	\$ 2,545,849	\$ 2,015,615	\$ 404,150	\$ 1,611,465	\$ 644,586	\$ 1,371,029	0.4639	\$ 636,076.21	\$ 3,961,710
4	\$ 189,757	\$ 569,271	\$ 237,196	\$ 2,601,768	\$ 2,142,155	\$ 288,612	\$ 1,853,542	\$ 741,417	\$ 1,400,738	0.3592	\$ 503,083.76	\$ 5,362,448
5	\$ 197,347	\$ 592,042	\$ 246,894	\$ 2,703,410	\$ 2,230,269	\$ 206,350	\$ 2,023,919	\$ 809,568	\$ 1,420,701	0.2780	\$ 395,009.07	\$ 6,783,149
6	\$ 205,241	\$ 615,723	\$ 256,551	\$ 2,848,179	\$ 2,282,848	\$ 206,119	\$ 2,076,729	\$ 830,692	\$ 1,452,156	0.2152	\$ 312,563.67	\$ 8,235,305
7	\$ 213,451	\$ 640,352	\$ 266,813	\$ 2,974,207	\$ 2,362,061	\$ 205,350	\$ 2,155,711	\$ 862,284	\$ 1,499,776	0.1666	\$ 249,903.61	\$ 9,735,081
8	\$ 221,989	\$ 665,966	\$ 277,488	\$ 3,103,198	\$ 2,471,551	\$ 103,059	\$ 2,371,551	\$ 988,620	\$ 1,482,931	0.0999	\$ 148,084.17	
9	\$ 230,868	\$ 692,605	\$ 288,585	\$ 3,300,156	\$ 2,471,551		\$ 2,471,551	\$ 1,008,486	\$ 1,512,729	0.0773	\$ 116,941.83	
10	\$ 240,103	\$ 720,309	\$ 300,129	\$ 3,481,360	\$ 2,521,216		\$ 2,521,216	\$ 1,008,486	\$ 1,512,729	ratio	1.000	4

Appendix C

	Year										Unit
10 Stages	1	2	3	4	5	6	7	8	9	10	22(1-9),20(10)
No. of Cart./Stage	17	17	18	18	19	20	20	21	22	22	ft <sup>2</sup>
Area	450.5	450.5	477.0	477.0	503.5	530.0	530.0	556.5	583.0	583.0	
F actual	117,647	122,353	127,247	132,337	137,630	143,136	148,861	154,816	161,008	167,448	gal/day
F calc	117,647	122,353	127,247	132,337	137,630	143,136	148,861	154,816	161,008	167,448	gal/day
CF <sub>1</sub>	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	
J <sub>1</sub>	27.3	27.3	27.3	27.3	27.3	27.3	27.4	27.4	27.4	27.4	gsfd
P <sub>1</sub>	12305.2	12315.6	13035.1	13045.9	13766.4	14487.3	14499.1	15221.1	15233.2	15244.8	gal/day
									556.5	556.5	21
CF <sub>2</sub>	1.8	1.7	1.6	1.6	1.5	1.5	1.4	1.3	1.3	1.2	
J <sub>2</sub>	24.8	25.1	25.3	25.5	25.7	25.9	26.2	26.3	26.6	26.8	gsfd
P <sub>2</sub>	11194.1	11307.6	12058.9	12178.7	12948.5	13729.6	13862.7	14662.4	15490.3	15635.8	gal/day
B <sub>1</sub>	105341.9	110037.3	114212.0	119291.0	123864.0	128648.4	134361.9	139594.4	145774.9	152203.6	gal/day
CF <sub>3</sub>	2.0	1.9	1.9	1.8	1.7	1.6	1.6	1.5	1.5	1.4	
J <sub>3</sub>	24.2	24.5	24.6	24.9	25.1	25.2	25.5	25.7	25.9	26.2	gsfd
P <sub>3</sub>	10900.3	11024.9	11750.0	11881.5	12626.0	13381.8	13528.2	14303.8	15109.4	15269.4	gal/day
B <sub>2</sub>	94147.8	98729.7	102153.1	107112.3	110915.5	114918.8	120499.2	124932.0	130284.6	136567.8	gal/day
CF <sub>4</sub>	2.3	2.2	2.1	2.0	1.9	1.9	1.8	1.7	1.7	1.6	
J <sub>4</sub>	23.5	23.8	23.9	24.2	24.4	24.5	24.8	25.0	25.2	25.5	gsfd
P <sub>4</sub>	10575.9	10713.8	11408.9	11554.5	12270.1	12997.0	13159.5	13907.5	14687.9	14865.5	gal/day
B <sub>3</sub>	83247.5	87704.9	90403.1	95230.8	98289.6	101537.0	106970.9	110628.2	115175.2	121298.4	gal/day
CF <sub>5</sub>	2.7	2.5	2.5	2.3	2.3	2.2	2.1	2.0	1.9	1.8	
J <sub>5</sub>	22.7	23.0	23.1	23.5	23.6	23.7	24.1	24.2	24.4	24.7	gsfd
P <sub>5</sub>	10214.3	10368.4	11028.8	11191.5	11873.7	12567.1	12749.2	13465.4	14216.5	14415.8	gal/day
B <sub>4</sub>	72671.5	76991.1	78994.2	83676.3	86019.5	88540.0	93811.4	96720.6	100487.4	106432.9	gal/day
CF <sub>6</sub>	3.2	3.0	2.9	2.7	2.7	2.6	2.4	2.4	2.3	2.1	
J <sub>6</sub>	21.8	22.2	22.2	22.6	22.7	22.8	23.2	23.3	23.5	23.9	gsfd
P <sub>6</sub>	9806.5	9980.9	10600.1	10784.3	11427.1	12080.6	12287.4	12966.1	13682.9	13909.4	gal/day
B <sub>5</sub>	62457.3	66622.7	67965.4	72484.7	74145.7	75972.9	81062.2	83255.2	86270.9	92017.1	gal/day
CF <sub>7</sub>	3.9	3.6	3.5	3.3	3.2	3.2	2.9	2.9	2.8	2.6	
J <sub>7</sub>	20.7	21.2	21.2	21.6	21.7	21.7	22.2	22.3	22.4	22.9	gsfd
P <sub>7</sub>	9340.2	9540.5	10110.0	10321.5	10916.8	11522.0	11760.7	12393.9	13069.5	13331.1	gal/day
B <sub>6</sub>	52650.8	56641.8	57365.3	61700.4	62718.6	63892.3	68774.8	70289.2	72587.9	78107.7	gal/day
CF <sub>8</sub>	4.9	4.4	4.4	4.0	4.0	4.0	3.7	3.6	3.6	3.2	
J <sub>8</sub>	19.5	20.0	20.0	20.5	20.5	20.5	21.0	21.1	21.2	21.7	gsfd
P <sub>8</sub>	8798.0	9032.2	9539.9	9787.2	10323.7	10868.6	11149.4	11726.4	12350.9	12659.2	gal/day
B <sub>7</sub>	43310.6	47101.2	47255.3	51379.0	51801.9	52370.3	57014.2	57895.3	59518.4	64776.6	gal/day
CF <sub>9</sub>	6.4	5.7	5.8	5.2	5.3	5.3	4.7	4.8	4.7	4.2	
J <sub>9</sub>	18.1	18.7	18.6	19.2	19.1	19.0	19.7	19.6	19.7	20.3	gsfd
P <sub>9</sub>	8154.4	8434.2	8862.7	9158.4	9619.5	10086.5	10425.1	10929.6	11488.4	11861.3	gal/day
B <sub>8</sub>	34512.6	38069.1	37715.4	41591.7	41478.2	41501.7	45864.7	46168.9	47167.5	52117.4	gal/day
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
n=	1	2	3	4	5	6	7	8	9	10	
CF <sub>n</sub>	5.6	5.8	5.7	5.6	5.6	5.6	5.6	5.7	5.6	5.6	CF total
J <sub>n</sub>	18.7	18.6	18.7	18.7	18.7	18.7	18.8	18.7	18.8	18.8	gsfd
B <sub>n</sub>	20895.3	21246.1	22411.8	23495.0	24412.0	25453.6	26495.0	27308.7	28718.0	29819.1	gal/day
P <sub>n</sub>	5462.9	8388.8	6440.9	8938.3	7446.6	5961.6	8944.7	7930.6	6961.1	10437.0	gal/day
B <sub>n-1</sub>	26,358.2	29,634.9	28,852.7	32,433.3	31,858.6	31,415.3	35,439.7	35,239.3	35,679.1	40,256.1	gal/day
	11	17	13	18	15	12	18	16	14	21	Cartridges
	164	170	175	180	186	192	198	205	212	219	
Area/Stage	450.5	450.5	477.0	477.0	503.5	530.0	530.0	556.5	583.0	583.0	ft <sup>2</sup>
No. of Cart./Stage	17.00	17.00	18.00	18.00	19.00	20.00	20.00	21.00	22.00	21.00	26.5 ft <sup>2</sup> /cartridge
Total Rec.	391.00	391.00	414.00	414.00	437.00	460.00	460.00	483.00	506.00	483.00	gal/min
Max Flow	489.04	492.96	520.04	524.28	551.69	579.28	584.05	612.01	640.17	609.84	gal/min
										15.4	
Final Stream											
C <sub>B,NPN</sub>	3.19%	3.26%	3.22%	3.19%	3.20%	3.19%	3.18%	3.21%	3.18%	3.18%	
C <sub>B,TP</sub>	0.50%	0.51%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	
C <sub>B,Lactose</sub>	5.61%	5.61%	5.61%	5.60%	5.61%	5.61%	5.60%	5.61%	5.61%	5.60%	
C <sub>B,Ash</sub>	0.96%	0.96%	0.96%	0.96%	0.96%	0.96%	0.96%	0.96%	0.96%	0.96%	
C <sub>B,Butter Fat</sub>	0.28%	0.29%	0.28%	0.28%	0.28%	0.28%	0.28%	0.28%	0.28%	0.28%	
% Protein	35%	35.4%	35%	35%	35%	35%	35%	35%	35%	35%	
% of Solids	10.54%	10.63%	10.58%	10.54%	10.55%	10.54%	10.53%	10.57%	10.53%	10.53%	
Yield	72.92%	72.67%	72.84%	72.88%	72.90%	72.93%	72.92%	72.85%	72.95%	72.92%	

Appendix C

Year 1	1	2	3	4	5	6	7	8	9	10		
$f_n$	1.117	1.119	1.131	1.146	1.164	1.186	1.216	1.255	1.309	1.261	Final Protein Concentration	3.70%
$C_{B,Protein}$	0.98%	1.07%	1.17%	1.30%	1.47%	1.69%	1.98%	2.40%	3.02%	3.70%	Yield	72.92%
$C_{B,NPN}$	0.6677%	0.74%	0.84%	0.96%	1.11%	1.31%	1.58%	1.97%	2.55%	3.19%	Final Protein % (dry weight)	35.04%
$C_{B,TP}$	0.3104%	0.32%	0.33%	0.35%	0.36%	0.38%	0.41%	0.43%	0.47%	0.50%	Total Area	450.5
$C_{B,Lactose}$	4.9440%	4.99%	5.04%	5.09%	5.16%	5.22%	5.30%	5.40%	5.51%	5.61%	Total Permeate	5462.9 gal/day
$C_{B,Ash}$	0.8097%	0.82%	0.83%	0.84%	0.86%	0.87%	0.89%	0.91%	0.94%	0.96%		
$C_{B,Butter Fat}$	0.0558%	0.06%	0.07%	0.08%	0.09%	0.11%	0.14%	0.17%	0.22%	0.28%		

Year 2	1	2	3	4	5	6	7	8	9	10		
$f_n$	1.112	1.115	1.126	1.139	1.156	1.176	1.203	1.237	1.285	1.395	Final Protein Concentration	3.77%
$C_{B,Protein}$	0.97%	1.06%	1.16%	1.29%	1.44%	1.64%	1.91%	2.28%	2.83%	3.77%	Yield	72.67%
$C_{B,NPN}$	0.6649%	0.7385%	0.83%	0.94%	1.08%	1.26%	1.51%	1.86%	2.37%	3.26%	Final Protein % (dry weight)	35%
$C_{B,TP}$	0.3100%	0.3205%	0.33%	0.35%	0.36%	0.38%	0.40%	0.43%	0.46%	0.51%	Total Area	901.0
$C_{B,Lactose}$	4.94%	4.99%	5.03%	5.09%	5.15%	5.21%	5.29%	5.38%	5.48%	5.61%	Total Permeate	20704.4 gal/day
$C_{B,Ash}$	0.81%	0.82%	0.83%	0.84%	0.85%	0.87%	0.89%	0.91%	0.93%	0.96%		
$C_{B,Butter Fat}$	0.06%	0.06%	0.07%	0.08%	0.09%	0.11%	0.13%	0.16%	0.21%	0.29%		

Year 3	1	2	3	4	5	6	7	8	9	10		
$f_n$	1.114	1.118	1.130	1.144	1.162	1.185	1.214	1.253	1.307	1.287	Final Protein Concentration	3.72%
$C_{B,Protein}$	0.98%	1.06%	1.17%	1.30%	1.46%	1.68%	1.97%	2.38%	2.99%	3.72%	Yield	72.84%
$C_{B,NPN}$	0.67%	0.74%	0.84%	0.95%	1.10%	1.30%	1.56%	1.95%	2.52%	3.22%	Final Protein % (dry weight)	35%
$C_{B,TP}$	0.31%	0.32%	0.33%	0.35%	0.36%	0.38%	0.41%	0.43%	0.47%	0.50%	Total Area	1431.0
$C_{B,Lactose}$	4.94%	4.99%	5.04%	5.09%	5.15%	5.22%	5.30%	5.39%	5.50%	5.61%	Total Permeate	31534.9 gal/day
$C_{B,Ash}$	0.81%	0.82%	0.83%	0.84%	0.86%	0.87%	0.89%	0.91%	0.94%	0.96%		
$C_{B,Butter Fat}$	0.06%	0.06%	0.07%	0.08%	0.09%	0.11%	0.13%	0.17%	0.22%	0.28%		

Year 4	1	2	3	4	5	6	7	8	9	10		
$f_n$	1.109	1.114	1.125	1.138	1.154	1.175	1.201	1.235	1.282	1.380	Final Protein Concentration	3.69%
$C_{B,Protein}$	0.97%	1.06%	1.16%	1.28%	1.44%	1.63%	1.90%	2.27%	2.80%	3.69%	Yield	72.88%
$C_{B,NPN}$	0.66%	0.74%	0.83%	0.94%	1.07%	1.26%	1.50%	1.84%	2.34%	3.19%	Final Protein % (dry weight)	35.0%
$C_{B,TP}$	0.31%	0.32%	0.33%	0.35%	0.36%	0.38%	0.40%	0.43%	0.46%	0.50%	Total Area	1908.0
$C_{B,Lactose}$	4.94%	4.98%	5.03%	5.08%	5.14%	5.21%	5.28%	5.37%	5.47%	5.60%	Total Permeate	46044.5 gal/day
$C_{B,Ash}$	0.81%	0.82%	0.83%	0.84%	0.85%	0.87%	0.89%	0.91%	0.93%	0.96%		
$C_{B,Butter Fat}$	0.06%	0.06%	0.07%	0.08%	0.09%	0.11%	0.13%	0.16%	0.20%	0.28%		

Year 5	1	2	3	4	5	6	7	8	9	10		
$f_n$	1.111	1.117	1.128	1.143	1.160	1.182	1.211	1.249	1.302	1.305	Final Protein Concentration	3.70%
$C_{B,Protein}$	0.97%	1.06%	1.16%	1.29%	1.45%	1.67%	1.95%	2.35%	2.94%	3.70%	Yield	72.90%
$C_{B,NPN}$	0.66%	0.74%	0.83%	0.95%	1.09%	1.28%	1.54%	1.91%	2.47%	3.20%	Final Protein % (dry weight)	35.1%
$C_{B,TP}$	0.31%	0.32%	0.33%	0.35%	0.36%	0.38%	0.40%	0.43%	0.47%	0.50%	Total Area	2517.5
$C_{B,Lactose}$	4.94%	4.99%	5.04%	5.09%	5.15%	5.22%	5.30%	5.39%	5.50%	5.61%	Total Permeate	59057.6 gal/day
$C_{B,Ash}$	0.81%	0.82%	0.83%	0.84%	0.86%	0.87%	0.89%	0.91%	0.93%	0.96%		
$C_{B,Butter Fat}$	0.06%	0.06%	0.07%	0.08%	0.09%	0.11%	0.13%	0.17%	0.22%	0.28%		

Appendix C

Year 6	1	2	3	4	5	6	7	8	9	10		
$g_f^n$	1.113	1.119	1.132	1.147	1.165	1.189	1.220	1.262	1.321	1.234	Final Protein Concentration	3.69%
$C_{B,Protein}$	0.98%	1.06%	1.17%	1.30%	1.47%	1.69%	1.99%	2.42%	3.07%	3.69%	Yield	72.93%
$C_{B,NPN}$	0.67%	0.74%	0.84%	0.96%	1.11%	1.31%	1.59%	1.99%	2.60%	3.19%	Final Protein % (dry weight)	35%
$C_{B,TP}$	0.31%	0.32%	0.33%	0.35%	0.36%	0.38%	0.41%	0.44%	0.47%	0.50%	Total Area	3180.0
$C_{B,Lactose}$	4.94%	4.99%	5.04%	5.09%	5.16%	5.23%	5.31%	5.40%	5.52%	5.61%	Total Permeate	73124.3 gal/day
$C_{B,Ash}$	0.81%	0.82%	0.83%	0.84%	0.86%	0.87%	0.89%	0.91%	0.94%	0.96%		
$C_{B,Butter Fat}$	0.06%	0.06%	0.07%	0.08%	0.09%	0.11%	0.14%	0.17%	0.23%	0.28%		

Year 7	1	2	3	4	5	6	7	8	9	10		
$g_f^n$	1.108	1.115	1.126	1.140	1.157	1.179	1.206	1.243	1.294	1.338	Final Protein Concentration	3.69%
$C_{B,Protein}$	0.97%	1.06%	1.16%	1.28%	1.44%	1.65%	1.92%	2.30%	2.87%	3.69%	Yield	72.92%
$C_{B,NPN}$	0.66%	0.74%	0.83%	0.94%	1.08%	1.27%	1.52%	1.87%	2.40%	3.18%	Final Protein % (dry weight)	35.0%
$C_{B,TP}$	0.31%	0.32%	0.33%	0.35%	0.36%	0.38%	0.40%	0.43%	0.46%	0.50%	Total Area	3710.0
$C_{B,Lactose}$	4.94%	4.98%	5.03%	5.09%	5.15%	5.21%	5.29%	5.38%	5.48%	5.60%	Total Permeate	89030.9 gal/day
$C_{B,Ash}$	0.81%	0.82%	0.83%	0.84%	0.85%	0.87%	0.89%	0.91%	0.93%	0.96%		
$C_{B,Butter Fat}$	0.06%	0.06%	0.07%	0.08%	0.09%	0.11%	0.13%	0.16%	0.21%	0.28%		

Year 8	1	2	3	4	5	6	7	8	9	10		
$g_f^n$	1.109	1.117	1.129	1.144	1.162	1.184	1.214	1.254	1.310	1.290	Final Protein Concentration	3.72%
$C_{B,Protein}$	0.97%	1.06%	1.16%	1.29%	1.46%	1.67%	1.96%	2.37%	2.98%	3.72%	Yield	72.85%
$C_{B,NPN}$	0.66%	0.74%	0.83%	0.95%	1.09%	1.29%	1.55%	1.93%	2.51%	3.21%	Final Protein % (dry weight)	35.2%
$C_{B,TP}$	0.31%	0.32%	0.33%	0.35%	0.36%	0.38%	0.40%	0.43%	0.47%	0.50%	Total Area	4452.0
$C_{B,Lactose}$	4.94%	4.99%	5.03%	5.09%	5.15%	5.22%	5.30%	5.39%	5.50%	5.61%	Total Permeate	104850.9 gal/day
$C_{B,Ash}$	0.81%	0.82%	0.83%	0.84%	0.86%	0.87%	0.89%	0.91%	0.94%	0.96%		
$C_{B,Butter Fat}$	0.06%	0.06%	0.07%	0.08%	0.09%	0.11%	0.13%	0.17%	0.22%	0.28%		

Year 9	1	2	3	4	5	6	7	8	9	10		
$g_f^n$	1.104	1.119	1.131	1.146	1.165	1.189	1.220	1.262	1.322	1.242	Final Protein Concentration	3.68%
$C_{B,Protein}$	0.97%	1.06%	1.16%	1.29%	1.46%	1.68%	1.98%	2.40%	3.05%	3.68%	Yield	72.95%
$C_{B,NPN}$	0.66%	0.74%	0.83%	0.95%	1.10%	1.30%	1.57%	1.97%	2.58%	3.18%	Final Protein % (dry weight)	35.0%
$C_{B,TP}$	0.31%	0.32%	0.33%	0.35%	0.36%	0.38%	0.41%	0.43%	0.47%	0.50%	Total Area	5247.0
$C_{B,Lactose}$	4.94%	4.98%	5.03%	5.09%	5.15%	5.22%	5.30%	5.40%	5.51%	5.61%	Total Permeate	120801.8 gal/day
$C_{B,Ash}$	0.81%	0.82%	0.83%	0.84%	0.86%	0.87%	0.89%	0.91%	0.94%	0.96%		
$C_{B,Butter Fat}$	0.06%	0.06%	0.07%	0.08%	0.09%	0.11%	0.14%	0.17%	0.23%	0.28%		

Year 10	1	2	3	4	5	6	7	8	9	10		
$g_f^n$	1.100	1.114	1.126	1.140	1.157	1.178	1.206	1.243	1.295	1.350	Final Protein Concentration	3.69%
$C_{B,Protein}$	0.97%	1.05%	1.15%	1.28%	1.43%	1.63%	1.91%	2.28%	2.84%	3.69%	Yield	72.92%
$C_{B,NPN}$	0.66%	0.73%	0.82%	0.93%	1.07%	1.26%	1.50%	1.86%	2.38%	3.18%	Final Protein % (dry weight)	35.0%
$C_{B,TP}$	0.31%	0.32%	0.33%	0.34%	0.36%	0.38%	0.40%	0.43%	0.46%	0.50%	Total Area	5830.0
$C_{B,Lactose}$	4.94%	4.98%	5.03%	5.08%	5.14%	5.21%	5.29%	5.37%	5.48%	5.60%	Total Permeate	137629.4 gal/day
$C_{B,Ash}$	0.81%	0.82%	0.83%	0.84%	0.85%	0.87%	0.89%	0.91%	0.93%	0.96%		
$C_{B,Butter Fat}$	0.06%	0.06%	0.07%	0.08%	0.09%	0.11%	0.13%	0.16%	0.21%	0.28%		

Based on 35%, 10 stages		Total Soln into 35% (gal/day)									
Amount in 35%	20380.60	21121.84	21857.88	22828.81	23644.09	24705.72	25575.06	26589.85	27758.51	28879.04	
Amount in 35%	20380.60	21121.85	21857.88	22828.82	23644.10	24705.73	25575.07	26589.86	27758.52	28879.05	
Year	1	2	3	4	5	6	7	8	9	10	
# of Cartridges	8.0	8.0	9.0	10.0	10.0	10.0	11.0	11.0	12.0	12.0	
Area	212.0	212.0	238.5	265.0	265.0	265.0	291.5	291.5	318.0	318.0	ft <sup>2</sup>
F actual	5,275.5	5,131.1	5,569.7	5,918.5	6,145.5	6,440.6	6,709.2	6,804.7	7,305.2	7,555.8	gal/day
F calc	5,276	5,131	5,570	5,918	6,145	6,441	6,709	6,805	7,305	7,556	gal/day
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
n=	1	2	3	4	5	6	7	8	9	10	
CF <sub>n</sub>	10.3	11.0	11.1	11.6	11.1	10.5	11.1	11.1	11.1	10.8	CF total
J <sub>n</sub>	15.5	15.2	15.1	14.9	15.1	15.4	15.1	15.1	15.1	15.3	gsfd
B <sub>n</sub>	1980.2	1914.1	1962.4	1967.7	2131.6	2350.8	2298.6	2392.4	2494.1	2686.3	gal/day
P <sub>n</sub>	3295.3	3217.0	3607.3	3950.8	4013.9	4089.7	4410.6	4412.3	4811.1	4869.5	gal/day
B <sub>n-1</sub>	5,275.5	5,131.1	5,569.7	5,918.5	6,145.5	6,440.5	6,709.2	6,804.7	7,305.2	7,555.8	gal/day

	Year										
	1	2	3	4	5	6	7	8	9	10	
Area/Stage	212.0	212.0	238.5	265.0	265.0	265.0	291.5	291.5	318.0	318.0	ft <sup>2</sup>
No. of Cartridges/Stage	8.00	8.00	9.00	10.00	10.00	10.00	11.00	11.00	12.00	12.00	26.5 ft <sup>2</sup> /cartridge
Total Recirculation	184.00	184.00	207.00	230.00	230.00	230.00	253.00	253.00	276.00	276.00	gal/min
Max Flow	188.40	188.28	211.64	234.93	235.12	235.37	258.59	258.67	282.09	282.30	gal/min
											7.1
Final Stream											
C <sub>B,NPN</sub>	8.10%	8.32%	8.65%	9.05%	8.72%	8.30%	8.79%	8.66%	8.80%	8.49%	
C <sub>B,TP</sub>	0.63%	0.63%	0.64%	0.64%	0.64%	0.63%	0.64%	0.64%	0.64%	0.63%	
C <sub>B,Lactose</sub>	5.92%	5.93%	5.94%	5.94%	5.94%	5.93%	5.94%	5.94%	5.94%	5.93%	
C <sub>B,Ash</sub>	1.03%	1.04%	1.04%	1.04%	1.04%	1.04%	1.04%	1.04%	1.04%	1.04%	
C <sub>B,Butter Fat</sub>	0.75%	0.77%	0.81%	0.85%	0.81%	0.77%	0.82%	0.81%	0.82%	0.79%	
% Protein	53.10%	53.64%	54.42%	55.02%	54.57%	53.60%	54.73%	54.43%	54.76%	54.05%	
% of Solids	16.43%	16.69%	17.07%	17.52%	17.14%	16.66%	17.22%	17.08%	17.23%	16.88%	
Yield this part	88.66%	88.68%	87.95%	87.23%	87.73%	88.32%	87.58%	87.92%	87.52%	88.01%	

Diafiltration										
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
1 Diafiltration	1.0									
Soln Feed (gpd)	1,980.2	1,914.1	1,962.4	1,967.7	2,131.6	2,350.8	2,298.6	2,392.4	2,494.1	2,686.3
Water Added (gpd)	6,590.6	6,031.9	5,611.4	5,531.2	6,020.9	7,361.5	6,415.4	6,819.0	7,216.6	8,115.8
Total Feed (gpd)	8,570.8	7,946.0	7,573.8	7,498.8	8,152.5	9,712.3	8,714.0	9,211.4	9,710.7	10,802.1
CF, D1	4.3	4.2	3.9	3.8	3.8	4.1	3.8	3.9	3.9	4.0
Concentrations										
True Protein	7.362%	7.602%	7.970%	8.350%	8.038%	7.587%	8.109%	7.975%	8.097%	7.784%
Non-Protein Nitrogen	0.193%	0.201%	0.216%	0.220%	0.218%	0.202%	0.220%	0.217%	0.215%	0.207%
Lactose	1.464%	1.527%	1.642%	1.663%	1.656%	1.533%	1.671%	1.645%	1.628%	1.575%
Ash	0.262%	0.274%	0.294%	0.298%	0.297%	0.275%	0.299%	0.295%	0.292%	0.282%
Butter Fat	0.750%	0.772%	0.806%	0.847%	0.813%	0.770%	0.820%	0.806%	0.821%	0.790%
Total Protein (dry weight)	75.3%	75.2%	74.9%	75.3%	74.9%	75.1%	74.9%	74.9%	75.2%	75.12%
Yield this part	86.57%	87.15%	88.11%	88.40%	88.24%	87.21%	88.37%	88.14%	88.07%	87.60%
CF overall	10.3	11.0	11.1	11.6	11.1	10.5	11.1	11.1	11.1	10.8
Area/stage	424	397.5	371	371	397.5	477	424	450.5	477	530
Cartridges/stage	16.00	15.00	14.00	14.00	15.00	18.00	16.00	17.00	18.00	20.00
Max Flow Rate (gpm)	375.14	351.62	328.31	328.25	351.79	422.09	375.26	398.68	422.09	469.00
Overall Yield 55%-75%	76.75%	77.29%	77.49%	77.12%	77.42%	77.02%	77.39%	77.49%	77.09%	77.10%
% Solids	10.0%	10.4%	10.9%	11.4%	11.0%	10.4%	11.1%	10.9%	11.1%	10.6%

Appendix C

Year	1	2	3	4	5	6	7	8	9	10
$\sigma_n$	2.664	2.681	2.838	3.008	2.883	2.740	2.919	2.844	2.929	2.813
$C_{B,NPN}$	8.0976%	8.3204%	8.6533%	9.0544%	8.7192%	8.2995%	8.7883%	8.6574%	8.7984%	8.4895%
$C_{B,TP}$	0.6296%	0.6330%	0.6368%	0.6397%	0.6368%	0.6320%	0.6370%	0.6366%	0.6374%	0.6334%
$C_{B,Protein}$	8.73%	8.95%	9.29%	9.69%	9.36%	8.93%	9.43%	9.29%	9.44%	9.12%
$C_{B,Lactose}$	5.9220%	5.9292%	5.9373%	5.9419%	5.9368%	5.9268%	5.9366%	5.9367%	5.9377%	5.9288%
$C_{B,Ash}$	1.0350%	1.0367%	1.0386%	1.0398%	1.0385%	1.0361%	1.0385%	1.0385%	1.0388%	1.0366%
$C_{B,Butter Fat}$	0.7500%	0.7719%	0.8057%	0.8471%	0.8127%	0.7703%	0.8200%	0.8062%	0.8211%	0.7897%
Concentration	8.73%	8.95%	9.29%	9.69%	9.36%	8.93%	9.43%	9.29%	9.44%	9.12%
Yield	88.66%	88.68%	87.95%	87.23%	87.73%	88.32%	87.58%	87.92%	87.52%	88.01%
% (dry weight)										
Total Area	212.0	212.0	238.5	265.0	265.0	265.0	291.5	291.5	318.0	318.0
Total Permea	3295.3	3217.0	3607.3	3950.8	4013.9	4089.7	4410.6	4412.3	4811.1	4869.5









Appendix C

Table with columns for Feed 1, Bleed 1, Perm. 1, Bleed 2, Perm. 2, Perm. 3, Perm. 4, Bleed 5, Perm. 5, Perm. 6, Bleed 6, Perm. 6, Perm. 7, Bleed 7, Perm. 7, Perm. 8, Bleed 8, Perm. 8. Rows include Butter Fat, Water, Total, gal/min, Mass %, True Protein, Non-Protein Nitrogen, Lactose, Ash, Butter Fat, Water, Total, % Solids, % Protein of Solids, Properties, Temperature (°C), Pressure (psi).

Year 8

Table with columns for Feed 1, Bleed 1, Perm. 1, Bleed 2, Perm. 2, Perm. 3, Perm. 4, Bleed 5, Perm. 5, Perm. 6, Bleed 6, Perm. 6, Perm. 7, Bleed 7, Perm. 7, Perm. 8, Bleed 8, Perm. 8. Rows include Component, lbs/min, True Protein, Non-Protein Nitrogen, Lactose, Ash, Butter Fat, Water, Total, % Solids, % Protein of Solids, Properties, Temperature (°C), Pressure (psi).

Year 9

Table with columns for Feed 1, Bleed 1, Perm. 1, Bleed 2, Perm. 2, Perm. 3, Perm. 4, Bleed 5, Perm. 5, Perm. 6, Bleed 6, Perm. 6, Perm. 7, Bleed 7, Perm. 7, Perm. 8, Bleed 8, Perm. 8. Rows include Component, lbs/min, True Protein, Non-Protein Nitrogen, Lactose, Ash, Butter Fat, Water, Total, % Solids, % Protein of Solids, Properties, Temperature (°C), Pressure (psi).









Appendix C

Perm. Mix	Bleed 3%	Perm. 9	Perm. 10	Perm. 10	Perm. Mix	Bleed 10	Perm. 10	Perm. Mix	55% Wet	55% Feed	55% Feed	Dia. 1 Feed	Dia. 1 Feed	H2O Feed	H2O Feed	Dia. 1 Perm.	Perm. Mix	75% Wet	75% Feed	75% Feed	Dia. 2 Feed	H2O Feed	35% Wet
46.16	24.58	5.10	11.89	21.41	3.16	6.79	15.97	5.45	3.04	2.40	3.62	3.04	0.00	1.95	1.09	1.22	1.33	0.63	0.63	0.00	0.63	0.00	0.50
94.87	29.73	9.57	27.46	23.93	5.80	17.89	17.84	6.09	2.08	4.01	12.09	8.09	6.01	2.08	6.01	8.08	1.41	0.87	2.73			2.06	0.67
0.03%	2.58%	0.08%	0.16%	3.18%	0.10%	0.20%	3.18%	0.16%	8.80%	0.26%	0.25%	2.28%	0.00%	8.10%	0.25%	0.24%	8.10%	8.10%	2.00%	2.00%	0.00%	0.00%	7.41%
0.24%	0.47%	0.32%	0.28%	0.50%	0.34%	0.26%	0.50%	0.28%	0.64%	0.43%	0.23%	0.17%	0.00%	0.21%	0.15%	0.21%	0.21%	0.21%	0.05%	0.05%	0.00%	0.00%	0.07%
4.69%	5.51%	5.04%	4.01%	5.61%	5.13%	3.46%	5.61%	4.01%	5.94%	5.43%	2.64%	1.55%	0.00%	1.63%	1.52%	1.23%	1.63%	1.63%	0.40%	0.40%	0.00%	0.00%	0.42%
0.75%	0.94%	0.85%	0.67%	0.96%	0.85%	0.58%	0.96%	0.67%	1.04%	0.92%	0.45%	0.27%	0.00%	0.29%	0.26%	0.21%	0.29%	0.29%	0.07%	0.07%	0.00%	0.00%	0.08%
0.00%	0.23%	0.00%	0.00%	0.28%	0.00%	0.00%	0.28%	0.00%	0.82%	0.00%	0.00%	0.21%	0.00%	0.82%	0.00%	0.00%	0.82%	0.82%	0.20%	0.20%	0.00%	0.00%	0.82%
94.28%	90.28%	93.73%	94.88%	89.47%	93.58%	95.50%	89.47%	94.88%	82.77%	92.95%	96.43%	95.51%	100%	88.95%	97.82%	98.19%	88.95%	88.95%	97.27%	100%	100%	91.20%	
100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
5.7%	9.7%	6.9%	5.1%	10.5%	6.4%	4.8%	10.5%	6.4%	17.2%	7.0%	3.6%	4.8%	0.0%	11.1%	2.2%	1.8%	11.1%	11.1%	2.7%	2.7%	0.0%	0.0%	8.8%
4.8%	31.3%	6.3%	8.6%	35.0%	6.8%	10.3%	35.0%	6.8%	54.8%	9.9%	13.4%	54.8%	0.0%	75.2%	18.2%	20.2%	75.2%	75.2%	75.2%	75.2%	0.0%	0.0%	85.0%
30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
5	15	5	5	15	5	5	15	15	15	5	5	15	15	15	5	5	15	15	15	15	15	15	15
5	15	5	5	15	5	5	15	15	15	5	5	15	15	15	5	5	15	15	15	15	15	15	15

Perm. Mix	Bleed 3%	Perm. 9	Perm. 10	Perm. Mix	Bleed 10	Perm. 10	Perm. Mix	55% Wet	55% Feed	55% Feed	Dia. 1 Feed	Dia. 1 Feed	H2O Feed	H2O Feed	Dia. 1 Perm.	Perm. Mix	75% Wet	75% Feed	75% Feed	Dia. 2 Feed	H2O Feed	35% Wet	
																							24
0.26	6.79	0.06	0.40	6.72	0.07	0.33	5.02	1.70	1.62	0.09	0.26	1.62	0.00	1.48	0.13	0.18	1.01	0.47	0.47	0.00	0.00	0.43	
1.98	1.31	0.26	0.75	1.06	0.25	0.49	0.79	0.27	0.12	0.15	0.24	0.12	0.00	0.04	0.08	0.09	0.03	0.01	0.01	0.00	0.00	0.00	
38.28	15.63	4.21	10.78	11.84	3.79	6.56	8.84	3.00	1.13	1.87	2.77	1.13	0.00	0.30	0.83	0.90	0.20	0.10	0.10	0.00	0.00	0.02	
6.14	2.66	0.69	1.79	2.03	0.63	1.10	1.61	0.51	0.20	0.32	0.47	0.20	0.00	0.05	0.14	0.16	0.04	0.02	0.02	0.00	0.00	0.00	
0.00	0.59	0.00	0.00	0.59	0.00	0.00	0.44	0.15	0.15	0.00	0.00	0.15	0.00	0.15	0.00	0.00	0.10	0.05	0.05	0.00	0.00	0.00	
770.27	258.16	78.79	254.71	188.98	69.19	175.92	141.09	47.88	15.82	32.07	106.73	72.25	56.44	17.00	55.25	74.66	11.59	5.41	24.96	19.55	5.55	6.06	
616.93	285.15	84.02	268.42	211.22	73.93	184.41	157.70	53.52	19.03	34.49	110.48	75.47	56.44	19.03	56.44	75.99	12.97	6.05	25.80	18.55	6.06	6.06	
46.88	28.98	5.23	13.72	22.24	4.74	8.49	16.61	5.64	3.21	2.42	3.75	3.21	0.00	2.02	1.19	1.32	1.38	0.64	0.64	0.00	0.00	0.51	
96.11	33.55	9.88	31.75	24.85	8.70	21.86	18.55	6.30	2.24	4.06	13.16	9.00	6.76	2.24	6.76	9.11	1.53	0.71	3.05	2.34	0.71	0.71	
0.03%	2.38%	0.07%	0.15%	3.18%	0.10%	0.18%	3.18%	0.15%	8.49%	0.25%	0.24%	2.14%	0.00%	7.78%	0.24%	0.23%	7.78%	7.78%	1.84%	0.00%	0.00%	7.09%	
0.24%	0.46%	0.31%	0.28%	0.50%	0.34%	0.27%	0.50%	0.28%	0.63%	0.43%	0.22%	0.16%	0.00%	0.21%	0.14%	0.12%	0.21%	0.21%	0.05%	0.05%	0.00%	0.06%	
4.69%	5.48%	5.01%	4.01%	5.60%	5.13%	3.56%	5.60%	4.01%	5.93%	5.42%	2.51%	1.49%	0.00%	1.57%	1.47%	1.18%	1.57%	1.57%	0.37%	0.37%	0.00%	0.39%	
0.75%	0.93%	0.82%	0.67%	0.95%	0.85%	0.60%	0.96%	0.67%	1.04%	0.92%	0.43%	0.26%	0.00%	0.28%	0.25%	0.21%	0.28%	0.28%	0.07%	0.07%	0.00%	0.07%	
0.00%	0.21%	0.00%	0.00%	0.28%	0.00%	0.00%	0.28%	0.00%	0.79%	0.00%	0.00%	0.20%	0.00%	0.79%	0.00%	0.00%	0.79%	0.79%	0.19%	0.19%	0.00%	0.19%	
94.29%	90.54%	93.76%	94.89%	89.47%	93.59%	95.40%	89.47%	94.89%	83.12%	92.97%	96.61%	95.74%	100%	89.36%	97.90%	98.26%	89.36%	89.36%	97.48%	100%	100%	91.60%	
100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
5.7%	9.5%	6.2%	5.1%	10.5%	6.4%	4.6%	10.5%	6.4%	16.9%	7.0%	3.4%	4.3%	0.0%	10.6%	2.1%	1.7%	10.6%	10.6%	2.5%	2.5%	0.0%	8.4%	
4.8%	30.0%	6.2%	8.4%	35.0%	6.8%	9.7%	35.0%	6.8%	54.1%	9.8%	13.4%	54.1%	0.0%	75.1%	18.1%	20.1%	75.1%	75.1%	75.1%	75.1%	0.0%	85.1%	
30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
5	15	5	5	15	5	5	15	15	15	5	5	15	15	15	5	5	15	15	15	15	15	15	15
5	15	5	5	15	5	5	15	15	15	5	5	15	15	15	5	5	15	15	15	15	15	15	15











Appendix C

	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64		
	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day		
0.13	58.05	19,159.97	1,592.28	597.82	0.00	44,500.82	13,808.87	58,309.70	44,500.82	48.59	9.46	58,309.70	0.00	0.00	0.00	0.00	0.00	11,349.08	0.00	0.00
	gal/day	2,254.11	187.33	70.33	111,863.39	5,235.39	29,064.43	34,299.82	93,663.77	102.27	19.91	122,728.20	9,693.00	2,710.61	99,459.79	123,349.03	2,719.86			
0.23%	0.06%	30.19%	75.26%	84.18%	0.00%	1.09%	0.06%	0.22%	0.06%	0.06%	0.06%	0.06%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	0.01%	0.01%
0.05%	0.25%	4.78%	1.94%	0.79%	0.00%	4.53%	0.25%	0.91%	0.25%	0.25%	0.25%	0.25%	0.00%	0.00%	0.00%	0.00%	0.05%	0.00%	0.05%	0.05%
0.40%	4.54%	53.25%	14.73%	4.82%	0.00%	81.24%	4.54%	16.25%	4.54%	4.54%	4.54%	4.54%	0.00%	0.00%	0.00%	0.00%	0.86%	0.00%	0.86%	0.87%
0.07%	0.73%	9.12%	2.64%	0.89%	0.00%	13.14%	0.73%	2.63%	0.73%	0.73%	0.73%	0.73%	0.00%	0.00%	0.00%	0.00%	0.14%	0.00%	0.14%	0.14%
0.00%	0.00%	2.86%	7.43%	9.33%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
99.26%	94.41%	0.00%	0.00%	0.00%	100%	0.00%	94.41%	80.00%	94.41%	94.41%	94.41%	94.41%	100%	100%	100%	100%	99%	100%	99%	99%
100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
0.7%	5.6%	100.0%	100.0%	100.0%	0.0%	100.0%	5.6%	20.0%	5.6%	5.6%	5.6%	5.6%	0.0%	0.0%	0.0%	0.0%	1.1%	0.0%	1.1%	1.1%
37.1%	5.6%	35.0%	75.2%	85.0%	0.0%	5.6%	5.6%	5.6%	5.6%	5.6%	5.6%	5.6%	0.0%	0.0%	0.0%	0.0%	5.6%	0.0%	5.6%	5.6%
30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
5	5	15	15	15	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	
	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	
0.04	0.66	6,022.35	1,211.67	514.92	0.00	478.18	147.42	625.60	478.18	0.52	0.14	625.60	0.00	0.00	0.00	0.00	0.00	165.33	0.00	165.33
0.01	2.73	951.38	32.28	4.66	0.00	1,984.03	611.64	2,595.67	1,984.03	2.16	0.57	2,595.67	0.00	0.00	0.00	0.00	0.00	685.96	0.00	685.96
0.07	49.05	10,804.89	245.17	28.56	0.00	35,588.13	10,971.21	46,569.34	35,588.13	38.80	10.25	46,569.34	0.00	0.00	0.00	0.00	0.00	12,304.23	0.00	12,304.23
0.01	7.93	1,816.32	43.92	5.25	0.00	5,756.27	1,774.56	7,530.83	5,756.27	6.28	1.66	7,530.83	0.00	0.00	0.00	0.00	0.00	1,990.17	0.00	1,990.17
0.00	0.00	531.33	122.83	57.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19.41	1,024.97	0.00	0.00	0.00	933,500.00	0.00	229,245.75	229,245.75	743,621.58	810.72	214.25	972,867.33	91,183.71	842,316.29	23,332.59	818,983.71	1,076,083.24	23,412.22	1,089,495.46	23,412.22
19.55	1,085.35	19,826.37	1,655.97	610.78	933,500.00	43,806.61	242,750.58	286,557.19	787,428.19	858.48	226.87	911,833.71	842,316.29	23,332.59	818,983.71	1,081,238.93	23,412.22	1,114,641.15	23,412.22	1,114,641.15
0.14	60.38	19,926.37	1,655.97	610.78	0.00	43,806.61	13,504.83	57,311.44	43,806.61	47.76	12.62	57,311.44	0.00	0.00	0.00	0.00	0.00	15,144.69	0.00	15,144.69
2.34	127.85	2,344.28	194.82	71.86	111,863.39	5,153.72	28,558.89	33,712.61	92,638.61	101.00	26.69	121,197.50	10,926.75	100,936.64	2,796.00	98,140.65	130,169.50	2,805.54	131,910.20	2,805.54
0.22%	0.06%	30.22%	73.17%	84.31%	0.00%	1.09%	0.06%	0.22%	0.06%	0.06%	0.06%	0.06%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%	0.02%	0.01%
0.04%	0.25%	4.77%	1.85%	0.76%	0.00%	4.53%	0.25%	0.91%	0.25%	0.25%	0.25%	0.25%	0.00%	0.00%	0.00%	0.00%	0.06%	0.00%	0.06%	0.06%
0.37%	4.52%	53.22%	14.80%	4.68%	0.00%	81.24%	4.52%	16.25%	4.52%	4.52%	4.52%	4.52%	0.00%	0.00%	0.00%	0.00%	1.13%	0.00%	1.13%	1.10%
0.07%	0.73%	9.12%	2.65%	0.86%	0.00%	13.14%	0.73%	2.63%	0.73%	0.73%	0.73%	0.73%	0.00%	0.00%	0.00%	0.00%	0.18%	0.00%	0.18%	0.18%
0.00%	0.00%	2.67%	7.42%	9.40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
99.31%	94.44%	0.00%	0.00%	0.00%	100%	0.00%	94.44%	80.00%	94.44%	94.44%	94.44%	94.44%	100%	100%	100%	100%	99%	100%	99%	99%
100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
0.7%	5.6%	100.0%	100.0%	100.0%	0.0%	100.0%	5.6%	20.0%	5.6%	5.6%	5.6%	5.6%	0.0%	0.0%	0.0%	0.0%	1.4%	0.0%	1.4%	1.4%
37.7%	5.6%	35.0%	75.1%	85.1%	0.0%	5.6%	5.6%	5.6%	5.6%	5.6%	5.6%	5.6%	0.0%	0.0%	0.0%	0.0%	5.6%	0.0%	5.6%	5.6%
30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
5	5	15	15	15	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Year1	COD	0.0 mg/liter soIn	300
	BOD	0.0 mg/liter soIn	0.00250
		0.00000 lb/gal	
Year2	COD	0.0 mg/liter soIn	300
	BOD	0.0 mg/liter soIn	0.00250
		0.00000 lb/gal	
Year3	COD	0.0 mg/liter soIn	300
	BOD	0.0 mg/liter soIn	0.00250
		0.00000 lb/gal	
Year4	COD	0.0 mg/liter soIn	300
	BOD	0.0 mg/liter soIn	0.00250
		0.00000 lb/gal	
Year5	COD	0.0 mg/liter soIn	300
	BOD	0.0 mg/liter soIn	0.00250
		0.00000 lb/gal	
Year6	COD	2,872.6 mg/liter soIn	300
	BOD	1,723.6 mg/liter soIn	0.00250
		0.01438 lb/gal	
Year7	COD	4,882.1 mg/liter soIn	300
	BOD	2,929.3 mg/liter soIn	0.00250
		0.02444 lb/gal	
Year8	COD	7,493.7 mg/liter soIn	300
	BOD	4,496.2 mg/liter soIn	0.00250
		0.03762 lb/gal	
Year9	COD	9,981.0 mg/liter soIn	300
	BOD	5,988.6 mg/liter soIn	0.00250
		0.04987 lb/gal	
Year10	COD	12,614.3 mg/liter soIn	300
	BOD	7,568.6 mg/liter soIn	0.00250
		0.06316 lb/gal	

Appendix C

Yield (ind.)

Year	Actual	Calc	Diff.	A	B	C	\$	a	b	c	35%	75%	85%
1	9000.0	9000.0	0.00	14000.0	1163.5	400.0	\$ 11,554.33	4900.0	872.6	340.0	72.92%	76.75%	80.11%
2	9360.0	9360.0	0.00	14560.0	1210.0	416.0	\$ 12,016.50	5096.0	907.5	353.6	72.67%	77.29%	82.31%
3	9734.4	9734.4	0.00	15142.4	1258.4	432.6	\$ 12,497.16	5299.8	943.8	367.7	72.84%	77.49%	84.91%
4	10123.8	10123.8	0.00	15748.1	1308.7	449.9	\$ 12,997.05	5511.8	981.6	382.5	72.88%	77.12%	88.82%
5	10528.7	10528.7	0.00	16378.0	1361.1	467.9	\$ 13,516.93	5732.3	1020.8	397.8	72.90%	77.42%	86.12%
6	10949.9	10949.9	0.00	17033.1	1415.5	486.7	\$ 14,057.61	5961.6	1061.6	413.7	72.93%	77.02%	81.00%
7	11387.9	11387.9	0.00	17714.5	1472.2	506.1	\$ 14,619.91	6200.1	1104.1	430.2	72.92%	77.39%	86.51%
8	11843.4	11843.4	0.00	18423.0	1531.0	526.4	\$ 15,204.71	6448.1	1148.3	447.4	72.85%	77.49%	85.27%
9	12317.1	12317.1	0.00	19160.0	1592.3	547.4	\$ 15,812.90	6706.0	1194.2	465.3	72.95%	77.09%	86.93%
10	12809.8	12809.8	0.00	19926.4	1656.0	569.3	\$ 16,445.41	6974.2	1242.0	483.9	72.92%	77.1%	89.10%

Total Protein available

max

lbs/day product (dry weight)

Total Soln In

lbs/day protein

Year 1	lb/day	746634.4	173235.1	84262.7		6719.71	1559.115671	758.36
	gal/day	87839.35	20380.6	9913.26				
Year 2	lb/day	779178.8	179535.6	84984.4		7012.61	1615.820802	764.86
	gal/day	91668.1	21121.8	9998.16				
Year 3	lb/day	808493.7	185791.9	85261.2		7276.44	1672.127483	767.35
	gal/day	95116.91	21857.9	10030.7				
Year 4	lb/day	840306.6	194044.9	85127.4		7562.76	1746.404328	766.15
	gal/day	98859.6	22828.8	10015				
Year 5	lb/day	873729.7	200974.8	90927.5		7863.57	1808.773075	818.35
	gal/day	102791.7	23644.1	10697.4				
Year 6	lb/day	908269.5	209998.6	101021		8174.43	1889.987564	909.18
	gal/day	106855.2	24705.7	11884.8				
Year 7	lb/day	944737.9	217388.0	97911.6		8502.64	1956.492125	881.2
	gal/day	111145.6	25575.1	11519				
Year 8	lb/day	983514.7	226013.7	103280		8851.63	2034.123557	929.52
	gal/day	115707.6	26589.9	12150.6				
Year 9	lb/day	1021340	235947.3	105763		9192.06	2123.525982	951.87
	gal/day	120157.6	27758.5	12442.7				
Year 10	lb/day	1062738	245471.8	115102		9564.64	2209.246338	1035.9
	gal/day	125028	28879.0	13541.5				

Appendix C

Area	1 Stage	2 Stages	3 Stages	4 Stages	5 Stages	6 Stages	7 Stages	8 Stages	9 Stages	10 Stages	11 Stages	Unit
F actual	167,448	167,448	167,448	167,448	167,448	167,448	167,448	167,448	167,448	167,448	167,448	gal/day
F calc	167,448	167,448	167,448	167,448	167,448	167,448	167,448	167,448	167,448	167,448	167,448	gal/day
CF <sub>1</sub>		1.9	1.5	1.3	1.2	1.2	1.2	1.1	1.1	1.1	1.1	
J <sub>1</sub>		24.6	25.9	26.5	26.8	27.0	27.1	27.2	27.3	27.4	27.4	gsfd
P <sub>1</sub>		76042.1	52609.8	39539.3	31646.5	26373.6	22582.0	19757.2	17590.1	15802.4	14364.3	gal/day
CF <sub>2</sub>			2.6	1.8	1.6	1.4	1.4	1.3	1.3	1.2	1.2	
J <sub>2</sub>			23.1	24.7	25.5	25.9	26.3	26.5	26.7	26.8	26.9	gsfd
P <sub>2</sub>			46950.8	36849.4	30079.0	25347.9	21860.4	19221.2	17146.1	15473.1	14096.1	gal/day
B <sub>1</sub>			114838.2	127908.7	135801.5	141074.4	144866.0	147690.8	149887.9	151645.6	153083.7	gal/day
CF <sub>3</sub>				2.9	2.2	1.8	1.6	1.5	1.4	1.4	1.3	
J <sub>3</sub>				22.3	23.8	24.7	25.3	25.7	26.0	26.2	26.4	gsfd
P <sub>3</sub>				33252.3	28141.3	24136.6	21033.2	18619.2	16698.3	15113.2	13805.7	gal/day
B <sub>2</sub>				91059.3	105722.5	115726.5	123005.5	129469.6	132741.8	136172.5	138987.6	gal/day
CF <sub>4</sub>					3.2	2.4	2.0	1.8	1.7	1.6	1.5	
J <sub>4</sub>					21.7	23.2	24.1	24.7	25.2	25.5	25.8	gsfd
P <sub>4</sub>					25630.5	22684.3	20066.6	17933.9	16176.8	14716.6	13489.2	gal/day
B <sub>3</sub>					77581.3	91589.9	101972.3	109850.4	116053.5	121059.3	125181.9	gal/day
CF <sub>5</sub>						3.5	2.7	2.2	2.0	1.8	1.7	
J <sub>5</sub>						21.3	22.7	23.6	24.3	24.7	25.1	gsfd
P <sub>5</sub>						20803.7	18908.7	17140.3	15598.2	14275.6	13141.7	gal/day
B <sub>4</sub>						68925.6	81905.7	91916.6	99876.7	106342.6	111692.7	gal/day
CF <sub>6</sub>							3.7	2.9	2.4	2.1	2.0	
J <sub>6</sub>							21.0	22.3	23.2	23.9	24.4	gsfd
P <sub>6</sub>							17475.5	16201.4	14933.6	13779.6	12756.9	gal/day
B <sub>5</sub>							62997.0	74776.3	84278.6	92067.0	98551.0	gal/day
CF <sub>7</sub>								3.8	3.0	2.6	2.3	
J <sub>7</sub>								20.8	22.0	22.9	23.5	gsfd
P <sub>7</sub>								15058.8	14155.6	13214.0	12326.3	gal/day
B <sub>6</sub>								56574.8	69345.0	78287.5	85794.1	gal/day
CF <sub>8</sub>									4.0	3.2	2.7	
J <sub>8</sub>									20.6	21.8	22.6	gsfd
P <sub>8</sub>									13222.3	12558.0	11838.5	gal/day
B <sub>7</sub>									55189.4	65073.5	73467.8	gal/day
CF <sub>9</sub>										4.1	3.3	
J <sub>9</sub>										20.4	21.5	gsfd
P <sub>9</sub>										11780.8	11277.5	gal/day
B <sub>8</sub>										52515.5	61629.3	gal/day

CF <sub>10</sub>											4.2	
J <sub>10</sub>											20.3	gsfd
P <sub>10</sub>											10619.9	gal/day
B <sub>9</sub>											50351.7	gal/day

n=	1	2	3	4	5	6	7	8	9	10	11	
CF <sub>n</sub>	5.85	5.6	5.619	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	CF total
J <sub>n</sub>	18.5	18.7	18.8	18.8	18.8	18.8	18.8	18.8	18.8	18.8	18.8	gsfd
B <sub>n</sub>	28600.0	29700.0	29800.0	29800.0	29800.0	29800.0	29900.0	29900.0	29900.0	29900.0	29901.0	gal/day
P <sub>n</sub>	139848.0	59519.8	38087.3	28007.1	22150.8	18321.9	15621.4	13616.0	12067.1	10834.7	9830.8	gal/day
B <sub>n-1</sub>	167,448.0	89,219.8	67,887.3	57,807.1	51,850.8	48,121.9	45,521.4	43,516.0	41,967.1	40,734.7	39,731.8	gal/day

	No. of Stages											Unit
	1	2	3	4	5	6	7	8	9	10	11	
Area/Stage	7491.7	3177.2	2031.2	1493.6	1181.3	977.1	832.3	725.4	642.9	577.3	523.8	ft <sup>2</sup>
No. of Cart./Stage	282.71	119.89	76.65	56.36	44.58	36.87	31.41	27.36	24.26	21.78	19.77	26.5 ft <sup>2</sup> /cartridge
Total Rec.	6502.27	2767.55	1762.91	1296.34	1025.27	848.05	722.37	629.63	558.01	501.02	454.60	gal/min
Max Flow	6641.81	2897.10	1902.45	1435.88	1164.81	987.59	861.91	769.17	697.55	640.56	594.14	gal/min
Final Stream										16.1	15.0	
C <sub>B,NPN</sub>	3.07%	3.11%	3.14%	3.16%	3.17%	3.17%	3.17%	3.17%	3.17%	3.17%	4.17%	
C <sub>B,TP</sub>	0.41%	0.45%	0.47%	0.48%	0.49%	0.49%	0.50%	0.50%	0.50%	0.50%	0.54%	
C <sub>B,Lactose</sub>	5.27%	5.41%	5.46%	5.52%	5.54%	5.56%	5.68%	5.69%	5.69%	5.60%	5.71%	
C <sub>B,Ash</sub>	0.88%	0.92%	0.93%	0.94%	0.95%	0.95%	0.95%	0.96%	0.96%	0.96%	0.98%	
C <sub>B,Butter Fat</sub>	0.29%	0.28%	0.28%	0.28%	0.28%	0.28%	0.28%	0.28%	0.28%	0.28%	0.37%	

Appendix C

Yield	65.94%	70.11%	71.30%	71.87%	72.21%	72.44%	72.64%	72.77%	72.86%	72.94%	72.71%
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**Flow Rates: Feed + Recycle**

Flow Rates (gpm)	1	2	3	4	5	6	7	8	9	10
Car/Stage	283	120	77	57	45	37	32	28	25	22
1	6648.5	2699.5	1910.5	1450.5	1174.5	990.5	875.5	783.5	714.5	645.5
2		2760.0	1866.7	1417.6	1148.2	966.6	856.7	767.1	699.9	632.4
3			1771.0	1386.9	1123.1	947.4	838.5	751.1	685.6	619.5
4				1311.0	1099.7	927.3	821.0	736.5	671.7	606.9
5					1035.0	908.4	804.3	720.6	658.2	594.6
6						851.0	788.5	706.3	645.2	582.7
7							736.0	692.8	632.8	571.2
8								644.0	621.0	560.2
9									575.0	549.8
10										539.9



1 Stage	1	Total Out		
$f_n$	5.855	gal/day	Final Protein Concentration	3.47%
$C_{B,NPN}$	3.0663%	877.0	Yield	65.94%
$C_{B,TP}$	0.4084%	116.8	Final Protein % (dry weight)	
$C_{B,Protein}$	3.47%	993.8	Total Area	7491.7
$C_{B,Lactose}$	5.2715%	1507.7	Total Permeate	138848.0 gal/day
$C_{B,Ash}$	0.8843%	252.9		
$C_{B,Butter Fat}$	0.2927%	83.7		

2 Stages	1	2	Total Out		
$f_n$	1.877	3.004	gal/day	Final Protein Concentration	3.56%
$C_{B,NPN}$	1.0972%	3.1092%	923.4	Yield	70.11%
$C_{B,TP}$	0.3527%	0.4485%	133.2	Final Protein % (dry weight)	
$C_{B,Protein}$	1.45%	3.56%	1056.6	Total Area	6354.4
$C_{B,Lactose}$	5.10%	5.41%	1606.6	Total Permeate	137561.9 gal/day
$C_{B,Ash}$	0.85%	0.92%	272.0		
$C_{B,Butter Fat}$	0.09%	0.28%	83.7		

3 Stages	1	2	3	Total Out		
$f_n$	1.458	1.692	2.278	gal/day	Final Protein Concentration	3.61%
$C_{B,NPN}$	0.86%	1.43%	3.14%	935.1	Yield	71.30%
$C_{B,TP}$	0.33%	0.38%	0.47%	139.4	Final Protein % (dry weight)	
$C_{B,Protein}$	1.20%	1.81%	3.61%	1074.4	Total Area	6093.5
$C_{B,Lactose}$	5.03%	5.22%	5.48%	1632.1	Total Permeate	137648.0 gal/day
$C_{B,Ash}$	0.83%	0.87%	0.93%	277.4		
$C_{B,Butter Fat}$	0.07%	0.12%	0.28%	83.7		

4 Stages	1	2	3	4	Total Out		
$f_n$	1.309	1.405	1.575	1.940	gal/day	Final Protein Concentration	3.63%
$C_{B,NPN}$	0.78%	1.08%	1.67%	3.16%	940.3	Yield	71.87%
$C_{B,TP}$	0.32%	0.36%	0.40%	0.48%	142.8	Final Protein % (dry weight)	
$C_{B,Protein}$	1.10%	1.44%	2.08%	3.63%	1083.1	Total Area	5974.4
$C_{B,Lactose}$	5.00%	5.13%	5.29%	5.52%	1644.2	Total Permeate	137648.0 gal/day
$C_{B,Ash}$	0.82%	0.85%	0.89%	0.94%	280.2		
$C_{B,Butter Fat}$	0.07%	0.09%	0.14%	0.28%	83.7		

5 Stages	1	2	3	4	5	Total Out		
$f_n$	1.233	1.285	1.363	1.493	1.743	gal/day	Final Protein Concentration	3.65%
$C_{B,NPN}$	0.73%	0.94%	1.26%	1.86%	3.17%	943.3	Yield	72.21%
$C_{B,TP}$	0.32%	0.34%	0.38%	0.42%	0.49%	145.0	Final Protein % (dry weight)	
$C_{B,Protein}$	1.05%	1.28%	1.64%	2.28%	3.65%	1088.3	Total Area	5906.5
$C_{B,Lactose}$	4.98%	5.08%	5.19%	5.34%	5.54%	1652.1	Total Permeate	137648.0 gal/day
$C_{B,Ash}$	0.82%	0.84%	0.87%	0.90%	0.95%	282.0		
$C_{B,Butter Fat}$	0.06%	0.08%	0.11%	0.16%	0.28%	83.7		

6 Stages	1	2	3	4	5	6	Total Out		
$f_n$	1.187	1.219	1.264	1.329	1.432	1.615	gal/day	Final Protein Concentration	3.66%
$C_{B,NPN}$	0.71%	0.86%	1.08%	1.41%	2.00%	3.17%	945.2	Yield	72.44%
$C_{B,TP}$	0.32%	0.34%	0.36%	0.39%	0.43%	0.49%	146.5	Final Protein % (dry weight)	
$C_{B,Protein}$	1.02%	1.19%	1.43%	1.80%	2.43%	3.66%	1091.8	Total Area	5862.6
$C_{B,Lactose}$	4.97%	5.04%	5.13%	5.24%	5.38%	5.56%	1657.8	Total Permeate	137648.0 gal/day
$C_{B,Ash}$	0.81%	0.83%	0.85%	0.88%	0.91%	0.95%	283.3		
$C_{B,Butter Fat}$	0.06%	0.07%	0.09%	0.12%	0.17%	0.28%	83.7		

7 Stages	1	2	3	4	5	6	7	Total Out		
$f_n$	1.156	1.178	1.206	1.245	1.300	1.384	1.522	gal/day	Final Protein Concentration	3.66%
$C_{B,NPN}$	0.69%	0.81%	0.97%	1.20%	1.54%	2.11%	3.17%	946.7	Yield	72.64%
$C_{B,TP}$	0.31%	0.33%	0.35%	0.37%	0.40%	0.44%	0.50%	148.0	Final Protein % (dry weight)	
$C_{B,Protein}$	1.00%	1.14%	1.32%	1.57%	1.95%	2.55%	3.66%	1094.7	Total Area	5826.1
$C_{B,Lactose}$	4.96%	5.02%	5.10%	5.18%	5.29%	5.41%	5.58%	1667.2	Total Permeate	137548.0 gal/day
$C_{B,Ash}$	0.81%	0.83%	0.84%	0.86%	0.89%	0.92%	0.95%	285.1		
$C_{B,Butter Fat}$	0.06%	0.07%	0.08%	0.10%	0.13%	0.18%	0.28%	83.7		

8 Stages	1	2	3	4	5	6	7	8	Total Out		
$f_n$	1.134	1.150	1.169	1.195	1.229	1.277	1.346	1.455	gal/day	Final Protein Concentration	3.67%
$C_{B,NPN}$	0.68%	0.78%	0.90%	1.07%	1.31%	1.66%	2.21%	3.17%	947.7	Yield	72.77%
$C_{B,TP}$	0.31%	0.33%	0.34%	0.36%	0.38%	0.41%	0.45%	0.50%	148.9	Final Protein % (dry weight)	
$C_{B,Protein}$	0.99%	1.10%	1.24%	1.43%	1.69%	2.07%	2.66%	3.67%	1096.6	Total Area	5803.6
$C_{B,Lactose}$	4.95%	5.01%	5.07%	5.14%	5.22%	5.32%	5.44%	5.59%	1670.5	Total Permeate	137548.0 gal/day
$C_{B,Ash}$	0.81%	0.82%	0.84%	0.85%	0.87%	0.92%	0.96%	0.96%	285.8		
$C_{B,Butter Fat}$	0.06%	0.07%	0.08%	0.09%	0.11%	0.14%	0.19%	0.28%	83.7		

Appendix C

9 Stages	1	2	3	4	5	6	7	8	9	Total Out		
$\sigma_n$	1.117	1.129	1.144	1.162	1.185	1.215	1.256	1.315	1.404	gal/day	Protein	3.67%
$C_{B,NPN}$	0.67%	0.75%	0.86%	0.99%	1.17%	1.41%	1.76%	2.29%	3.17%	948.4	Concentrati	
$C_{B,TP}$	0.31%	0.32%	0.34%	0.35%	0.37%	0.39%	0.42%	0.45%	0.50%	149.6	Yield	72.86%
$C_{B,Protein}$	0.98%	1.07%	1.19%	1.34%	1.54%	1.80%	2.18%	2.74%	3.67%	1098.1	Final	
$C_{B,Lactose}$	4.94%	4.99%	5.05%	5.11%	5.18%	5.25%	5.35%	5.46%	5.60%	1673.1	Protein % (dry weight)	
$C_{B,Ash}$	0.81%	0.82%	0.83%	0.85%	0.86%	0.88%	0.90%	0.93%	0.96%	286.4	Total Area	5786.3
$C_{B,Butter Fat}$	0.06%	0.06%	0.07%	0.08%	0.10%	0.12%	0.15%	0.20%	0.28%	83.7	Total Permea	137548.0

10 Stages	1	2	3	4	5	6	7	8	9	10	Total Out		
$\sigma_n$	1.104	1.114	1.125	1.138	1.155	1.176	1.203	1.239	1.289	1.362	gal/day	Protein	
$C_{B,NPN}$	0.66%	0.73%	0.82%	0.93%	1.07%	1.25%	1.50%	1.84%	2.36%	3.17%	949.0	Concentrati	
$C_{B,TP}$	0.31%	0.32%	0.33%	0.34%	0.36%	0.38%	0.40%	0.43%	0.46%	0.50%	150.2	Yield	
$C_{B,Protein}$	0.97%	1.05%	1.15%	1.28%	1.43%	1.63%	1.90%	2.27%	2.81%	3.68%	1099.2	Final	
$C_{B,Lactose}$	4.94%	4.98%	5.03%	5.08%	5.14%	5.21%	5.28%	5.37%	5.48%	5.60%	1675.2	Protein % (dry weight)	
$C_{B,Ash}$	0.81%	0.82%	0.83%	0.84%	0.85%	0.87%	0.89%	0.91%	0.93%	0.96%	286.9	Total Area	
$C_{B,Butter Fat}$	0.06%	0.06%	0.07%	0.08%	0.09%	0.11%	0.13%	0.16%	0.21%	0.28%	83.7	Total Permea	

11 Stages	1	2	3	4	5	6	7	8	9	10	11	Total Out		
$\sigma_n$	1.094	1.101	1.110	1.121	1.133	1.149	1.168	1.192	1.224	1.264	1.329	gal/day	Protein	
$C_{B,NPN}$	0.65%	0.72%	0.80%	0.89%	1.00%	1.15%	1.33%	1.58%	1.92%	2.37%	3.17%	947.1	Concentrati	
$C_{B,TP}$	0.31%	0.32%	0.33%	0.34%	0.35%	0.37%	0.39%	0.41%	0.43%	0.50%	0.54%	148.7	Yield	
$C_{B,Protein}$	0.96%	1.04%	1.12%	1.23%	1.36%	1.52%	1.72%	1.99%	2.35%	3.66%	4.71%	1095.8	Final	
$C_{B,Lactose}$	4.94%	4.97%	5.02%	5.06%	5.11%	5.17%	5.24%	5.31%	5.39%	5.59%	5.71%	1669.9	Protein % (dry weight)	
$C_{B,Ash}$	0.81%	0.82%	0.83%	0.84%	0.85%	0.86%	0.88%	0.89%	0.91%	0.96%	0.98%	285.7	Total Area	
$C_{B,Butter Fat}$	0.05%	0.06%	0.07%	0.07%	0.08%	0.10%	0.11%	0.14%	0.17%	0.28%	0.37%	83.7	Total Permea	

gal/day

3.68%
72.94%
5772.6
137548.0 gal/day

Protein Concentrat	3.66%
Yield	72.71%
Protein %	
Total Area	154731.2
Total Perm	15274.1 gal/day

Appendix C

Based on 35%, 10 stages		Total Soln into 35% (gal/day)										29949.04	28879.04
Area	1 Stage	2 Stages	3 Stages	4 Stages	5 Stages	6 Stages	7 Stages	8 Stages	9 Stages	10 Stages		ft <sup>2</sup>	
F actual	7,555.8	7,555.8	7,555.8	7,555.8	7,555.8	7,555.8	7,555.8	7,555.8	7,555.8	7,555.8	7,555.8	gal/day	
F calc	7,613	7,613	7,613	7,613	7,613	7,613	7,613	7,613	7,613	7,613	7,613	gal/day	
CF <sub>1</sub>		6.2	5.2	4.9	4.7	4.5	4.4	4.4	4.3	4.3			
J <sub>1</sub>		18.2	19.1	19.5	19.7	19.9	20.0	20.1	20.1	20.2		gsfd	
P <sub>1</sub>		2782.6	1885.4	1451.8	1187.7	1007.9	876.8	776.5	697.3	632.9		gal/day	
	-57.2	-57.2	-57.2	-57.2	-57.2	-57.2	-57.2	-57.2	-57.2	-57.2			
CF <sub>2</sub>			7.4	8.2	8.7	9.0	9.3	9.5	9.7	9.9			
J <sub>2</sub>			17.3	16.8	16.5	16.2	16.1	15.9	15.8	15.8		gsfd	
P <sub>2</sub>			1701.3	1247.2	989.9	822.7	704.7	616.7	548.5	494.1		gal/day	
B <sub>1</sub>			5727.6	6161.2	6425.3	6605.1	6736.3	6836.5	6915.8	6980.1		gal/day	
CF <sub>3</sub>				8.2	8.7	9.0	9.3	9.5	9.7	9.9			
J <sub>3</sub>				16.8	16.5	16.2	16.1	15.9	15.8	15.8		gsfd	
P <sub>3</sub>				1247.2	989.9	822.7	704.7	616.7	548.5	494.1		gal/day	
B <sub>2</sub>				4914.0	5435.4	5782.5	6031.6	6219.8	6367.2	6486.0		gal/day	
CF <sub>4</sub>					8.7	9.0	9.3	9.5	9.7	9.9			
J <sub>4</sub>					16.5	16.2	16.1	15.9	15.8	15.8		gsfd	
P <sub>4</sub>					989.9	822.7	704.7	616.7	548.5	494.1		gal/day	
B <sub>3</sub>					4445.4	4959.8	5326.9	5603.1	5818.7	5991.9		gal/day	
CF <sub>5</sub>						9.0	9.3	9.5	9.7	9.9			
J <sub>5</sub>						16.2	16.1	15.9	15.8	15.8		gsfd	
P <sub>5</sub>						822.7	704.7	616.7	548.5	494.1		gal/day	
B <sub>4</sub>						4137.2	4622.2	4986.4	5270.1	5497.8		gal/day	
CF <sub>6</sub>							9.3	9.5	9.7	9.9			
J <sub>6</sub>							16.1	15.9	15.8	15.8		gsfd	
P <sub>6</sub>							704.7	616.7	548.5	494.1		gal/day	
B <sub>5</sub>							3917.6	4369.7	4721.6	5003.7		gal/day	
CF <sub>7</sub>								9.5	9.7	9.9			
J <sub>7</sub>								15.9	15.8	15.8		gsfd	
P <sub>7</sub>								616.7	548.5	494.1		gal/day	
B <sub>6</sub>								3753.0	4173.1	4509.6		gal/day	
CF <sub>8</sub>									9.7	9.9			
J <sub>8</sub>									15.8	15.8		gsfd	
P <sub>8</sub>									548.5	494.1		gal/day	
B <sub>7</sub>									3624.5	4015.6		gal/day	
CF <sub>9</sub>										9.9			
J <sub>9</sub>										15.8		gsfd	
P <sub>9</sub>										494.1		gal/day	
B <sub>8</sub>										3521.5		gal/day	
n=	1	2	3	4	5	6	7	8	9	10			
CF <sub>n</sub>	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7		CF total	
J <sub>n</sub>	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9		gsfd	
B <sub>n</sub>	2561.0	2561.1	2561.2	2561.1	2561.1	2561.1	2560.9	2561.2	2561.1	2561.1		gal/day	
P <sub>n</sub>	5052.0	2269.3	1465.1	1105.7	894.4	753.4	652.0	575.2	514.9	466.3		gal/day	
B <sub>n-1</sub>	7,613.0	4,830.4	4,026.2	3,666.8	3,455.5	3,314.5	3,212.9	3,136.3	3,076.0	3,027.4		gal/day	

	No. of Stages										ft <sup>2</sup>
	1	2	3	4	5	6	7	8	9	10	
Area/Stage	339.8	152.6	98.5	74.4	60.2	50.7	43.9	38.7	34.6	31.4	
No. of Cartridges/Stage	12.82	5.76	3.72	2.81	2.27	1.91	1.65	1.46	1.31	1.18	26.5 ft <sup>2</sup> /cartridge
Total Recirculation	294.93	132.48	85.53	64.55	52.22	43.98	38.06	33.58	30.06	27.22	gal/min
Max Flow	301.23	138.78	91.83	70.85	58.51	50.28	44.36	39.87	36.36	33.52	gal/min
Final Stream											0.8
C <sub>B,NPN</sub>	8.87%	8.99%	9.03%	9.04%	9.05%	9.04%	9.04%	9.04%	9.05%	9.05%	
C <sub>B,TP</sub>	0.64%	0.67%	0.68%	0.69%	0.69%	0.69%	0.70%	0.70%	0.70%	0.70%	
C <sub>B,Lactose</sub>	5.94%	6.02%	6.06%	6.08%	6.09%	6.10%	6.10%	6.11%	6.11%	6.11%	
C <sub>B,Ash</sub>	1.04%	1.06%	1.07%	1.07%	1.07%	1.08%	1.08%	1.08%	1.08%	1.08%	

Appendix C

C <sub>B</sub> Butter Fat	0.83%	0.83%	0.83%	0.83%	0.83%	0.83%	0.83%	0.83%	0.83%	0.83%
Yield this part	87.45%	88.87%	89.31%	89.52%	89.64%	89.50%	89.56%	89.60%	89.64%	89.66%
Diafiltration										
	1 Stage	2 Stages	3 Stages	4 Stages	5 Stages	6 Stages	7 Stages	8 Stages	9 Stages	10 Stages
<b>1 Diafiltration</b>	1.0									
Soin Feed (gpd)	2,561.0	2,561.1	2,561.2	2,561.1	2,561.1	2,561.1	2,560.9	2,561.2	2,561.1	2,561.1
Water Added (gpd)	7,076.6	7,033.9	6,920.1	6,925.7	6,930.9	6,935.2	7,022.3	7,027.0	7,028.9	7,031.0
Total Feed (gpd)	9,637.6	9,595.0	9,481.3	9,486.8	9,492.0	9,496.3	9,583.2	9,588.2	9,590.0	9,592.1
CF, D1	3.8	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
<b>Concentrations</b>										
True Protein	8.191%	8.309%	8.351%	8.366%	8.374%	8.357%	8.354%	8.355%	8.358%	8.359%
Non-Protein Nitrogen	0.221%	0.233%	0.240%	0.242%	0.244%	0.243%	0.243%	0.244%	0.244%	0.244%
Lactose	1.683%	1.714%	1.744%	1.749%	1.752%	1.753%	1.739%	1.740%	1.740%	1.741%
Ash	0.301%	0.309%	0.315%	0.316%	0.316%	0.317%	0.314%	0.315%	0.315%	0.315%
Butter Fat	0.828%	0.828%	0.828%	0.828%	0.828%	0.826%	0.826%	0.826%	0.826%	0.826%
Total Protein (dry weight)	74.9%	75.0%	74.8%	74.8%	74.8%	74.8%	74.9%	74.9%	74.9%	74.9%
Yield this part	88.48%	88.41%	88.48%	88.45%	88.42%	88.40%	88.29%	88.27%	88.27%	88.26%
CF overall	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
Area/stage	476.0	473.1	465.5	465.8	466.2	466.5	472.4	472.7	472.8	472.9
Cartridges/stage	17.96	17.85	17.56	17.58	17.59	17.60	17.82	17.84	17.84	17.85
Max Flow Rate (gpm)	421.16	418.63	411.89	412.22	412.53	412.79	417.95	418.22	418.34	418.46
Overall Yield	77.38%	78.57%	79.03%	79.18%	79.26%	79.12%	79.07%	79.09%	79.12%	79.14%
<b>2 Diafiltration</b>	2.0									
Water Added/Stage (gpd)	2,362.8	2,345.4	2,345.8	2,347.3	2,348.6	2,349.7	2,350.3	2,351.5	2,351.9	2,352.4
Total Feed (gpd)	4,923.8	4,906.5	4,907.0	4,908.4	4,909.7	4,910.8	4,911.2	4,912.6	4,913.0	4,913.5
CF, D1	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
<b>Concentrations</b>										
True Protein	8.399%	8.519%	8.552%	8.567%	8.575%	8.558%	8.563%	8.565%	8.567%	8.569%
Non-Protein Nitrogen	0.241%	0.254%	0.259%	0.261%	0.263%	0.263%	0.264%	0.265%	0.265%	0.265%
Lactose	1.746%	1.783%	1.793%	1.798%	1.800%	1.801%	1.803%	1.804%	1.804%	1.805%
Ash	0.315%	0.323%	0.325%	0.327%	0.327%	0.328%	0.328%	0.328%	0.328%	0.329%
Butter Fat	0.828%	0.828%	0.828%	0.828%	0.828%	0.826%	0.826%	0.826%	0.826%	0.826%
Total Protein (dry weight)	74.9%	74.9%	74.9%	74.9%	74.9%	74.9%	74.9%	74.9%	74.9%	74.9%
Yield this part	90.87%	90.80%	90.74%	90.71%	90.68%	90.66%	90.65%	90.64%	90.63%	90.63%
CF overall	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
Area/stage	79.5	78.9	78.9	78.9	79.0	79.0	79.0	79.1	79.1	79.1
Cartridges/stage	3.00	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.99
Max Flow Rate (gpm)	73.07	72.55	72.56	72.61	72.65	72.68	72.70	72.73	72.75	72.76
Overall Yield	79.46%	80.69%	81.04%	81.20%	81.29%	81.14%	81.18%	81.21%	81.24%	81.26%

Flow Rates: Feed + Recycle

Flow Rates (gpm)	1	2	3	4	5	6	7	8	9	10
Cart/Stage	12.8	5.8	3.7	2.8	2.3	1.9	1.7	1.5	1.3	1.2
Actual	13.00	6.00	4.00	3.00	3.00	2.00	2.00	2.00	2.00	2.00
1	58909.8	58912.1	58912.9	58911.6	58911.6	58911.6	58907.4	58913.2	58911.6	58911.6
2		58905.8	58911.4	58910.4	58910.6	58910.8	58906.7	58912.6	58911.0	58911.1
3			58906.6	58909.4	58909.8	58910.1	58906.1	58912.1	58910.6	58910.7
4				58905.3	58909.0	58909.4	58905.5	58911.6	58910.1	58910.2
5					58905.3	58908.7	58904.9	58911.1	58909.6	58909.8
6						58905.3	58904.3	58910.6	58909.2	58909.4
7							58901.1	58910.0	58908.7	58909.0
8								58906.9	58908.3	58908.6
9									58905.3	58908.2
10										58907.8
Cart/Stage	18.0	17.9	17.6	17.6	17.6	17.6	17.8	17.8	17.8	17.8
Actual	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
D1	422.0	422.0	421.9	421.9	421.9	421.9	422.0	422.0	422.0	422.0
Cart/Stage	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Actual	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
D2	73.1	72.6	72.6	72.6	72.6	72.7	72.7	72.7	72.7	72.8

1 Stage	1	Total Out		
$f_n$	2.950	gal/day	Final Protein	9.51%
$C_{B,NPN}$	8.8701%	227.2	Concentration	
$C_{B,TP}$	0.6376%	16.3	Yield	87.45%
$C_{B,Protein}$	9.51%	243.5	Final Protein %	
$C_{B,Lactose}$	5.9377%	152.1	(dry weight)	
$C_{B,Ash}$	1.0388%	26.6	Total Area	339.8
$C_{B,Butter Fat}$	0.8284%	21.2	Total Permeate	5052.0 gal/day

2 Stages	1	2	Total Out		
$f_n$	1.564	1.886	gal/day	Final Protein	9.66%
$C_{B,NPN}$	4.8951%	8.9934%	230.3	Concentration	
$C_{B,TP}$	0.5683%	0.6689%	17.1	Yield	88.87%
$C_{B,Protein}$	5.46%	9.66%	247.5	Final Protein %	
$C_{B,Lactose}$	5.7813%	6.02%	154.2	(dry weight)	
$C_{B,Ash}$	1.0013%	1.06%	27.1	Total Area	305.3
$C_{B,Butter Fat}$	0.4392%	0.83%	21.2	Total Permeate	5051.9 gal/day

3 Stages	1	2	3	Total Out		
$f_n$	1.319	1.423	1.572	gal/day	Final Protein	9.71%
$C_{B,NPN}$	4.16%	5.84%	9.03%	231.2	Concentration	
$C_{B,TP}$	0.54%	0.60%	0.68%	17.5	Yield	89.31%
$C_{B,Protein}$	4.70%	6.44%	9.71%	248.7	Final Protein %	
$C_{B,Lactose}$	5.72%	5.87%	6.06%	155.1	(dry weight)	
$C_{B,Ash}$	0.99%	1.02%	1.07%	27.3	Total Area	295.6
$C_{B,Butter Fat}$	0.37%	0.53%	0.83%	21.2	Total Permeate	5051.9 gal/day

4 Stages	1	2	3	4	Total Out		
$f_n$	1.226	1.254	1.340	1.432	gal/day	Final Protein	9.73%
$C_{B,NPN}$	3.88%	4.82%	6.40%	9.04%	231.6	Concentration	
$C_{B,TP}$	0.53%	0.57%	0.62%	0.69%	17.6	Yield	89.52%
$C_{B,Protein}$	4.41%	5.39%	7.02%	9.73%	249.3	Final Protein %	
$C_{B,Lactose}$	5.69%	5.79%	5.92%	6.08%	156.6	(dry weight)	
$C_{B,Ash}$	0.98%	1.00%	1.03%	1.07%	27.4	Total Area	297.5
$C_{B,Butter Fat}$	0.34%	0.43%	0.58%	0.83%	21.2	Total Permeate	5051.9 gal/day

5 Stages	1	2	3	4	5	Total Out		
$f_n$	1.176	1.182	1.223	1.286	1.349	gal/day	Final Protein	9.75%
$C_{B,NPN}$	3.72%	4.38%	5.32%	6.78%	9.05%	231.9	Concentration	
$C_{B,TP}$	0.53%	0.56%	0.59%	0.64%	0.69%	17.7	Yield	89.64%
$C_{B,Protein}$	4.25%	4.93%	5.91%	7.42%	9.75%	249.6	Final Protein %	
$C_{B,Lactose}$	5.68%	5.75%	5.84%	5.95%	6.09%	155.9	(dry weight)	
$C_{B,Ash}$	0.98%	0.99%	1.02%	1.04%	1.07%	27.5	Total Area	300.8
$C_{B,Butter Fat}$	0.33%	0.39%	0.48%	0.61%	0.83%	21.2	Total Permeate	5051.9 gal/day

6 Stages	1	2	3	4	5	6	Total Out		
$f_n$	1.144	1.142	1.166	1.199	1.248	1.294	gal/day	Final Protein	9.73%
$C_{B,NPN}$	3.62%	4.11%	4.77%	5.69%	7.04%	9.04%	231.4	Concentration	
$C_{B,TP}$	0.52%	0.55%	0.57%	0.60%	0.64%	0.69%	17.8	Yield	89.50%
$C_{B,Protein}$	4.14%	4.66%	5.34%	6.29%	7.69%	9.73%	249.2	Final Protein %	
$C_{B,Lactose}$	5.66%	5.72%	5.79%	5.88%	5.98%	6.10%	156.1	(dry weight)	
$C_{B,Ash}$	0.97%	0.99%	1.00%	1.02%	1.05%	1.08%	27.6	Total Area	304.1
$C_{B,Butter Fat}$	0.32%	0.37%	0.43%	0.51%	0.64%	0.83%	21.2	Total Permeate	5051.9 gal/day

7 Stages	1	2	3	4	5	6	7	Total Out		
$f_n$	1.122	1.117	1.132	1.152	1.180	1.219	1.255	gal/day	Final Protein	9.74%
$C_{B,NPN}$	3.55%	3.95%	4.45%	5.11%	5.99%	7.26%	9.04%	231.5	Concentration	
$C_{B,TP}$	0.52%	0.54%	0.56%	0.58%	0.61%	0.65%	0.70%	17.8	Yield	89.56%
$C_{B,Protein}$	4.07%	4.49%	5.01%	5.69%	6.61%	7.91%	9.74%	249.4	Final Protein %	
$C_{B,Lactose}$	5.65%	5.71%	5.76%	5.83%	5.90%	6.00%	6.10%	156.3	(dry weight)	
$C_{B,Ash}$	0.97%	0.98%	1.00%	1.01%	1.03%	1.05%	1.08%	27.6	Total Area	307.0
$C_{B,Butter Fat}$	0.31%	0.35%	0.40%	0.46%	0.54%	0.66%	0.83%	21.2	Total Permeate	5052.1 gal/day

8 Stages	1	2	3	4	5	6	7	8	Total Out		
$f_n$	1.105	1.099	1.110	1.124	1.141	1.164	1.197	1.225	gal/day	Final Protein	9.74%
$C_{B,NPN}$	3.50%	3.83%	4.24%	4.75%	5.39%	6.25%	7.43%	9.04%	231.6	Concentration	
$C_{B,TP}$	0.52%	0.53%	0.55%	0.57%	0.59%	0.62%	0.66%	0.70%	17.9	Yield	89.60%

Appendix C

C <sub>B,Protein</sub>	4.02%	4.37%	4.79%	5.32%	5.99%	6.87%	8.09%	9.74%	249.5	Final Protein %	
C <sub>B,Lactose</sub>	5.65%	5.69%	5.74%	5.79%	5.86%	5.93%	6.01%	6.11%	156.4	(dry weight)	
C <sub>B,Ash</sub>	0.97%	0.98%	0.99%	1.00%	1.02%	1.04%	1.06%	1.08%	27.6	Total Area	309.5
C <sub>B,Butter Fat</sub>	0.31%	0.34%	0.38%	0.42%	0.48%	0.56%	0.67%	0.83%	21.2	Total Permeate	5051.8

9 Stages	1	2	3	4	5	6	7	8	9	Total Out	
<i>g<sub>n</sub></i>	1.093	1.086	1.094	1.104	1.116	1.131	1.151	1.178	1.201	gal/day	Protein
C <sub>B,NPN</sub>	3.46%	3.75%	4.09%	4.50%	5.00%	5.64%	6.46%	7.58%	9.05%	231.7	Concent
C <sub>B,TP</sub>	0.52%	0.53%	0.54%	0.56%	0.58%	0.60%	0.63%	0.66%	0.70%	17.9	Yield
C <sub>B,Protein</sub>	3.97%	4.28%	4.63%	5.06%	5.59%	6.24%	7.09%	8.24%	9.75%	249.6	Final
C <sub>B,Lactose</sub>	5.64%	5.68%	5.72%	5.77%	5.82%	5.88%	5.95%	6.02%	6.11%	156.5	Protein
C <sub>B,Ash</sub>	0.97%	0.98%	0.99%	1.00%	1.01%	1.02%	1.04%	1.06%	1.08%	27.6	% /dry
C <sub>B,Butter Fat</sub>	0.31%	0.33%	0.36%	0.40%	0.45%	0.51%	0.58%	0.69%	0.83%	21.2	Total Pe

10 Stages	1	2	3	4	5	6	7	8	9	10	Total Out
<i>g<sub>n</sub></i>	1.082	1.076	1.082	1.090	1.099	1.110	1.123	1.140	1.163	1.182	gal/day
C <sub>B,NPN</sub>	3.43%	3.68%	3.97%	4.32%	4.73%	5.23%	5.86%	6.65%	7.70%	9.05%	231.7
C <sub>B,TP</sub>	0.51%	0.53%	0.54%	0.55%	0.57%	0.59%	0.61%	0.64%	0.67%	0.70%	17.9
C <sub>B,Protein</sub>	3.94%	4.21%	4.51%	4.87%	5.30%	5.82%	6.47%	7.28%	8.36%	9.75%	249.7
C <sub>B,Lactose</sub>	5.64%	5.67%	5.71%	5.75%	5.79%	5.84%	5.90%	5.96%	6.03%	6.11%	156.6
C <sub>B,Ash</sub>	0.97%	0.98%	0.98%	0.99%	1.00%	1.02%	1.03%	1.04%	1.06%	1.08%	27.7
C <sub>B,Butter Fat</sub>	0.30%	0.33%	0.35%	0.38%	0.42%	0.47%	0.53%	0.60%	0.70%	0.83%	21.2

17.77%

gal/day

9.75%
89.64%
4933.6
5051.9 gal/day

it

Protein Concentrat	9.75%
Yield	89.66%
Protein % (dry)	
Total Area	127.5
Total Perm	5051.9 gal/day











Appendix C

Water Added (gpd)	7,076.6	7,033.9	6,920.1	6,925.7	6,930.9	6,935.2	7,022.3	7,027.0	7,028.9	7,031.0
Total Feed (gpd)	9,637.6	9,595.0	9,481.3	9,486.8	9,492.0	9,496.3	9,583.2	9,588.2	9,590.0	9,592.1
CF, D1	3.8	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
<b>Concentrations</b>										
True Protein	8.226%	8.347%	8.390%	8.405%	8.413%	8.418%	8.415%	8.416%	8.419%	8.420%
Non-Protein Nitrogen	0.222%	0.233%	0.240%	0.243%	0.244%	0.245%	0.244%	0.244%	0.245%	0.245%
Lactose	1.683%	1.714%	1.745%	1.750%	1.752%	1.754%	1.740%	1.741%	1.741%	1.742%
Ash	0.301%	0.309%	0.315%	0.316%	0.317%	0.317%	0.315%	0.315%	0.315%	0.315%
Butter Fat	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%
Total Protein (dry weight)	75.0%	75.0%	74.9%	74.9%	74.9%	74.9%	75.0%	75.0%	75.0%	75.0%
Yield diafiltration	88.50%	88.42%	88.50%	88.46%	88.43%	88.42%	88.30%	88.29%	88.28%	88.28%
CF overall	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8
Area/stage	477.2	474.3	466.6	467.0	467.4	467.6	473.5	473.8	474.0	474.1
Cartridges/stage	18.01	17.90	17.61	17.62	17.64	17.65	17.87	17.88	17.89	17.89
Max Flow Rate (gpm)	422.19	419.65	412.90	413.23	413.54	413.79	418.98	419.24	419.36	419.48
Overall Yield 55%-75%	77.30%	78.52%	78.98%	79.13%	79.22%	79.27%	79.23%	79.25%	79.28%	79.29%
<b>2 Diafiltration</b>										
Water Added/Stage (gpd)	2,362.8	2,345.4	2,345.8	2,347.3	2,348.6	2,349.7	2,350.3	2,351.5	2,351.9	2,352.4
Total Feed (gpd)	4,923.8	4,906.5	4,907.0	4,908.4	4,909.7	4,910.8	4,911.2	4,912.6	4,913.0	4,913.5
CF, D1	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
<b>Concentrations</b>										
True Protein	8.435%	8.558%	8.591%	8.607%	8.615%	8.621%	8.625%	8.627%	8.630%	8.632%
Non-Protein Nitrogen	0.241%	0.254%	0.259%	0.262%	0.263%	0.264%	0.265%	0.265%	0.266%	0.266%
Lactose	1.746%	1.783%	1.793%	1.798%	1.801%	1.802%	1.804%	1.805%	1.805%	1.806%
Ash	0.315%	0.323%	0.326%	0.327%	0.327%	0.328%	0.328%	0.328%	0.329%	0.329%
Butter Fat	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%
Total Protein (dry weight)	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Yield this part	90.88%	90.81%	90.75%	90.72%	90.70%	90.68%	90.67%	90.66%	90.65%	90.64%
CF overall	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8
Area/stage	79.7	79.1	79.1	79.1	79.2	79.2	79.2	79.3	79.3	79.3
Cartridges/stage	3.01	2.98	2.98	2.99	2.99	2.99	2.99	2.99	2.99	2.99
Max Flow Rate (gpm)	73.24	72.72	72.73	72.78	72.82	72.85	72.87	72.90	72.92	72.93
Overall Yield	79.39%	80.64%	80.99%	81.15%	81.24%	81.30%	81.35%	81.38%	81.40%	81.42%

<b>9 Stages</b>	<b>1</b>	<b>2</b>
$f_n$	1.101	1.086
$C_{B,NPN}$	3.48%	3.77%
$C_{B,TP}$	0.52%	0.53%
$C_{B,Protein}$	4.00%	4.30%
$C_{B,Lactose}$	5.65%	5.69%
$C_{B,Ash}$	0.97%	0.98%
$C_{B,Butter Fat}$	0.31%	0.33%

<b>10 Stages</b>	<b>1</b>	<b>2</b>
$f_n$	1.091	1.076
$C_{B,NPN}$	3.45%	3.71%
$C_{B,TP}$	0.52%	0.53%
$C_{B,Protein}$	3.97%	4.24%
$C_{B,Lactose}$	5.64%	5.68%
$C_{B,Ash}$	0.97%	0.98%
$C_{B,Butter Fat}$	0.31%	0.33%

Flow Rates: Feed + Recycle

Flow Rates (gpm)	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
Cart/Stage	12.9	5.8	3.7	2.8	2.3	1.9	1.7	1.5	1.3	1.2
Actual	13.00	6.00	4.00	3.00	3.00	2.00	2.00	2.00	2.00	2.00
1	58909.8	58912.2	58913.0	58911.6	58911.6	58911.6	58907.4	58913.3	58911.6	58911.6
2		58905.8	58911.4	58910.4	58910.6	58910.8	58906.7	58912.6	58911.0	58911.1
3			58906.6	58909.4	58909.8	58910.1	58906.1	58912.1	58910.6	58910.7
4				58905.3	58909.0	58909.4	58905.5	58911.6	58910.1	58910.2
5					58905.3	58908.7	58904.9	58911.1	58909.6	58909.8
6						58905.3	58904.3	58910.6	58909.2	58909.4
7							58901.1	58910.0	58908.7	58909.0
8								58906.9	58908.3	58908.6
9									58905.3	58908.2
10										58907.8
Cart/Stage	18.0	17.9	17.6	17.6	17.6	17.6	17.9	17.9	17.9	17.9
Actual	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
D1	422.0	422.0	421.9	421.9	421.9	421.9	422.0	422.0	422.0	422.0
Cart/Stage	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Actual	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
D2	73.2	72.7	72.7	72.8	72.8	72.9	72.9	72.9	72.9	72.9

Final Protein Concentration	9.55%
Yield	87.35%
Final Protein % (dry weight)	
Total Area	340.7
Total Permeate	5052.0 gal/day

<b>Total Out</b>			
gal/day	Final Protein Concentration	9.70%	
231.4	Yield	88.80%	
17.1	Final Protein % (dry weight)		
248.5	Total Area	306.0	
154.3	Total Permeate	5051.9	gal/day
27.1			
21.3			

<b>3</b>	<b>Total Out</b>		
1.572	gal/day	Final Protein Concentration	9.75%
9.07%	232.3	Yield	89.24%
0.68%	17.5	Final Protein % (dry weight)	
9.75%	249.8	Total Area	296.3
6.06%	155.2	Total Permeate	5051.9
1.07%	27.3		
0.83%	21.3		

<b>3</b>	<b>4</b>	<b>Total Out</b>		
1.340	1.432	gal/day	Final Protein Concentration	9.78%
6.43%	9.09%	232.7	Yield	89.45%
0.62%	0.69%	17.6	Final Protein % (dry weight)	
7.05%	9.78%	250.4	Total Area	298.2
5.92%	6.08%	155.7	Total Permeate	5051.9
1.03%	1.07%	27.4		
0.58%	0.83%	21.3		

<b>3</b>	<b>4</b>	<b>5</b>	<b>Total Out</b>		
1.223	1.286	1.349	gal/day	Final Protein Concentration	9.79%
5.34%	6.81%	9.10%	233.0	Yield	89.58%
0.59%	0.64%	0.69%	17.8	Final Protein % (dry weight)	
5.93%	7.45%	9.79%	250.7	Total Area	301.5
5.84%	5.96%	6.09%	156.0	Total Permeate	5051.9
1.02%	1.04%	1.07%	27.5		
0.48%	0.62%	0.83%	21.3		

<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>Total Out</b>		
1.166	1.199	1.248	1.294	gal/day	Final Protein Concentration	9.80%
4.81%	5.73%	7.10%	9.10%	233.1	Yield	89.66%
0.57%	0.60%	0.65%	0.70%	17.8	Final Protein % (dry weight)	
5.38%	6.33%	7.74%	9.80%	250.9	Total Area	304.7
5.80%	5.88%	5.98%	6.10%	156.2	Total Permeate	5051.9
1.00%	1.02%	1.05%	1.08%	27.6		
0.43%	0.52%	0.64%	0.83%	21.3		

<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>Total Out</b>		
1.132	1.152	1.180	1.219	1.255	gal/day	Final Protein Concentration	9.81%
4.49%	5.15%	6.04%	7.31%	9.11%	233.2	Yield	89.72%
0.56%	0.59%	0.62%	0.65%	0.70%	17.9	Final Protein % (dry weight)	
5.05%	5.73%	6.65%	7.97%	9.81%	251.1	Total Area	307.7
5.77%	5.83%	5.91%	6.00%	6.11%	156.4	Total Permeate	5052.1
1.00%	1.01%	1.03%	1.05%	1.08%	27.6		
0.40%	0.46%	0.54%	0.66%	0.83%	21.3		

<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>Total Out</b>		
1.110	1.124	1.141	1.164	1.197	1.225	gal/day	Final Protein Concentration	9.81%
4.27%	4.78%	5.43%	6.30%	7.49%	9.11%	233.3	Yield	89.76%
0.55%	0.57%	0.60%	0.62%	0.66%	0.70%	17.9	Final Protein % (dry weight)	
4.82%	5.35%	6.03%	6.92%	8.15%	9.81%	251.2	Total Area	310.2
5.74%	5.80%	5.86%	5.93%	6.01%	6.11%	156.5	Total Permeate	5051.8
0.99%	1.01%	1.02%	1.04%	1.06%	1.08%	27.6		
0.38%	0.43%	0.49%	0.57%	0.68%	0.83%	21.3		

Appendix C

3	4	5	6	7	8	9	Total Out		
1.094	1.104	1.116	1.131	1.151	1.178	1.201	gal/day	Protein	9.81%
4.12%	4.53%	5.04%	5.68%	6.51%	7.63%	9.11%	233.4	Concentrat	
0.55%	0.56%	0.58%	0.60%	0.63%	0.66%	0.70%	18.0	Yield	89.80%
4.66%	5.10%	5.62%	6.29%	7.14%	8.30%	9.81%	251.3	Final	
5.73%	5.77%	5.82%	5.88%	5.95%	6.03%	6.11%	156.6	Protein %	
0.99%	1.00%	1.01%	1.03%	1.04%	1.06%	1.08%	27.7	(dry weight)	
0.37%	0.40%	0.45%	0.51%	0.59%	0.69%	0.83%	21.3	Total Area	4933.3
								Total Perme	5051.9 gal/day

3	4	5	6	7	8	9	10	Total Out		
1.082	1.090	1.099	1.110	1.123	1.140	1.163	1.182	gal/day	Protein	9.82%
4.00%	4.35%	4.77%	5.27%	5.90%	6.70%	7.75%	9.11%	233.4	Concentrat	
0.54%	0.56%	0.57%	0.59%	0.61%	0.64%	0.67%	0.70%	18.0	Yield	89.82%
4.54%	4.91%	5.34%	5.86%	6.51%	7.34%	8.42%	9.82%	251.4	Final	
5.71%	5.75%	5.80%	5.85%	5.90%	5.96%	6.04%	6.12%	156.7	Protein %	
0.99%	0.99%	1.01%	1.02%	1.03%	1.04%	1.06%	1.08%	27.7	(dry weight)	
0.36%	0.39%	0.43%	0.47%	0.53%	0.61%	0.70%	0.83%	21.3	Total Area	127.2
								Total Perme	5051.9 gal/day	

Appendix C

Total Soln into 35% (gal/day) 12301.03 12301.03

From 75% (One Dia. Stage)	1 Stage	2 Stages	3 Stages	4 Stages	5 Stages	6 Stages	7 Stages	8 Stages	9 Stages	10 Stages
<b>1 Diafiltration</b>	1.0									
Soln Feed (gpd)	748.7	748.8	748.8	748.7	748.7	748.7	748.5	748.8	748.7	748.7
Water Added (gpd)	2,430.8	2,344.5	2,362.6	2,354.5	2,350.0	2,347.2	2,317.9	2,317.2	2,315.9	2,315.0
Total Feed (gpd)	3,179.5	3,093.2	3,111.4	3,103.2	3,098.8	3,095.9	3,066.4	3,066.0	3,064.6	3,063.7
CF, D1	4.2	4.1	4.2	4.1	4.1	4.1	4.1	4.1	4.1	4.1
<i>Concentrations</i>		0.1								
True Protein	7.496%	7.630%	7.664%	7.680%	7.689%	7.694%	7.699%	7.701%	7.704%	7.706%
Non-Protein Nitrogen	0.069%	0.075%	0.076%	0.077%	0.078%	0.078%	0.078%	0.079%	0.079%	0.079%
Lactose	0.424%	0.444%	0.449%	0.451%	0.453%	0.453%	0.454%	0.454%	0.455%	0.455%
Ash	0.078%	0.082%	0.083%	0.083%	0.084%	0.084%	0.084%	0.084%	0.084%	0.084%
Butter Fat	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%
Total Protein (dry weight)	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
Yield this part	89.55%	89.80%	89.69%	89.71%	89.72%	89.72%	89.83%	89.83%	89.83%	89.84%
CF overall	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4
Area/stage	186.1	179.4	180.8	180.2	179.9	179.7	177.4	177.4	177.3	177.2
Cartridges/stage	7.02	6.77	6.82	6.80	6.79	6.78	6.70	6.69	6.69	6.69
Max Flow Rate (gpm)	164.14	158.32	159.54	159.00	158.70	158.51	156.55	156.49	156.40	156.34
<b>2 Diafiltration</b>	2.0									
Water Added/Stage (gpd)	745.5	729.7	733.9	732.4	731.6	731.1	724.9	724.9	724.6	724.5
Total Feed (gpd)	1,494.1	1,478.4	1,482.7	1,481.1	1,480.3	1,479.8	1,473.5	1,473.7	1,473.3	1,473.2
CF, D1	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
<i>Concentrations</i>										
True Protein	7.756%	7.879%	7.917%	7.932%	7.940%	7.946%	7.946%	7.948%	7.950%	7.952%
Non-Protein Nitrogen	0.079%	0.084%	0.087%	0.088%	0.088%	0.088%	0.089%	0.089%	0.089%	0.089%
Lactose	0.461%	0.479%	0.485%	0.487%	0.488%	0.489%	0.489%	0.489%	0.490%	0.490%
Ash	0.085%	0.089%	0.090%	0.091%	0.091%	0.091%	0.091%	0.091%	0.091%	0.091%
Butter Fat	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%
Total Protein (dry weight)	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
Yield this part	92.74%	92.82%	92.74%	92.74%	92.74%	92.74%	92.80%	92.80%	92.80%	92.80%
CF overall	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4
Area/stage	28.5	27.9	28.1	28.0	28.0	28.0	27.7	27.7	27.7	27.7
Cartridges/stage	1.08	1.05	1.06	1.06	1.06	1.06	1.05	1.05	1.05	1.05
Max Flow Rate (gpm)	26.01	25.47	25.61	25.56	25.53	25.52	25.31	25.31	25.30	25.29
From 75% (Two Dia. Stage)	1 Stage	2 Stages	3 Stages	4 Stages	5 Stages	6 Stages	7 Stages	8 Stages	9 Stages	10 Stages
<b>1 Diafiltration</b>	1.0									
Soln Feed (gpd)	748.7	748.8	748.8	748.7	748.7	748.7	748.5	748.8	748.7	748.7
Water Added (gpd)	2,306.6	2,242.2	2,226.3	2,219.1	2,215.1	2,212.6	2,210.2	2,209.6	2,208.4	2,207.6
Total Feed (gpd)	3,055.2	2,990.9	2,975.1	2,967.8	2,963.9	2,961.3	2,958.8	2,958.4	2,957.1	2,956.3
CF, D1	4.1	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.9	3.9
<i>Concentrations</i>										
True Protein	7.721%	7.852%	7.888%	7.904%	7.913%	7.919%	7.924%	7.926%	7.928%	7.930%
Non-Protein Nitrogen	0.078%	0.084%	0.086%	0.087%	0.087%	0.088%	0.088%	0.088%	0.088%	0.089%
Lactose	0.457%	0.477%	0.482%	0.484%	0.486%	0.487%	0.487%	0.488%	0.488%	0.488%
Ash	0.084%	0.088%	0.090%	0.090%	0.090%	0.091%	0.091%	0.091%	0.091%	0.091%
Butter Fat	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%
Total Protein (dry weight)	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
Yield this part	89.90%	90.06%	90.09%	90.10%	90.11%	90.11%	90.12%	90.12%	90.12%	90.12%
CF overall	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4
Area/stage	176.6	171.6	170.4	169.9	169.5	169.3	169.2	169.1	169.0	169.0
Cartridges/stage	6.66	6.48	6.43	6.41	6.40	6.39	6.38	6.38	6.38	6.38
Max Flow Rate (gpm)	155.78	151.44	150.37	149.89	149.62	149.45	149.31	149.25	149.17	149.12
<b>2 Diafiltration</b>	2.0									
Water Added/Stage (gpd)	722.9	710.7	707.7	706.2	705.5	705.0	704.5	704.4	704.2	704.0
Total Feed (gpd)	1,471.5	1,459.5	1,456.4	1,455.0	1,454.2	1,453.7	1,453.0	1,453.2	1,452.9	1,452.7
CF, D1	2.0	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
<i>Concentrations</i>										
True Protein	7.967%	8.091%	8.124%	8.139%	8.148%	8.154%	8.158%	8.160%	8.163%	8.165%
Non-Protein Nitrogen	0.088%	0.094%	0.096%	0.097%	0.098%	0.098%	0.098%	0.099%	0.099%	0.099%
Lactose	0.492%	0.511%	0.516%	0.518%	0.519%	0.520%	0.521%	0.521%	0.522%	0.522%
Ash	0.092%	0.095%	0.097%	0.097%	0.097%	0.098%	0.098%	0.098%	0.098%	0.098%
Butter Fat	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%	0.832%
Total Protein (dry weight)	85.0%	85.1%	85.1%	85.1%	85.1%	85.1%	85.1%	85.1%	85.1%	85.1%
Yield this part	92.84%	92.88%	92.88%	92.88%	92.88%	92.88%	92.87%	92.87%	92.87%	92.87%
CF overall	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4
Area/stage	27.7	27.2	27.1	27.0	27.0	27.0	27.0	27.0	26.9	26.9
Cartridges/stage	1.04	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Max Flow Rate (gpm)	25.24	24.82	24.72	24.67	24.64	24.63	24.61	24.61	24.60	24.59



Appendix C

Year	Actual	Calc	Diff.	A	B	C	\$	a	b	c
1	9000.0	9000.0	0.00	14000.0	1237.7	400.0	\$ 11,647.17	4900.0	928.3	340.0
2	9360.0	9360.0	0.00	14560.0	1287.2	416.0	\$ 12,113.06	5096.0	965.4	353.6
3	9734.4	9734.4	0.00	15142.4	1338.7	432.6	\$ 12,597.58	5299.8	1004.1	367.7
4	10123.8	10123.8	0.00	15748.1	1392.3	449.9	\$ 13,101.49	5511.8	1044.2	382.5
5	10528.7	10528.7	0.00	16378.0	1448.0	467.9	\$ 13,625.55	5732.3	1086.0	397.8
6	10949.9	10949.9	0.00	17033.1	1505.9	486.7	\$ 14,170.57	5961.6	1129.4	413.7
7	11387.9	11387.9	0.00	17714.5	1566.1	506.1	\$ 14,737.39	6200.1	1174.6	430.2
8	11843.4	11843.4	0.00	18423.0	1628.8	526.4	\$ 15,326.89	6448.1	1221.6	447.4
9	12317.1	12317.1	0.00	19160.0	1693.9	547.4	\$ 15,939.96	6706.0	1270.4	465.3
10	12809.8	12809.8	0.00	19926.4	1761.7	569.3	\$ 16,577.56	6974.2	1321.3	483.9

Total Protein available		max	max	lbs/day product (dry weight)		lbs/day protein	
Year	Actual	Calc	Diff.	A	B	C	\$
Year 1	746433	180105.1	73461.6	6717.9	1620.95	661.154	
Year 10	87815.7	21188.8	8642.54	9561.7	2307.11	941.029	
	1062407	256345.7	104559				
	124989	30158.3	12301				



Appendix C

Stream Description Stream Number	Feed 1	Exit 1 2	Waste 1 3	35% 4	Feed 2 5	Exit 2 6	Waste 2 7	75% 8	Feed 3 9	85% 10	Waste 3 11
<b>Component</b>					Doesn't include water						
<b>lbs/day</b>											
Protein	12809.806	9343.4	3466.4	6964.4	2379.0	5552.3		951.9	4600.5	0.0	0.0
True Protein	8539.8709	8066.8	473.0	6012.9	2053.9	5401.3		926.0	4475.3	0.0	0.0
Non-Protein Nitrogen	4269.9354	1276.6	2993.4	951.5	325.0	151.1		25.9	125.2	0.0	0.0
Lactose	69742.279	14239.4	55502.9	10613.8	3625.6	1109.5		190.2	919.3	0.0	0.0
Ash	11386.494	2438.6	8947.9	1817.7	620.9	199.7		34.2	165.5	0.0	0.0
Butter Fat	711.65591	711.7	0.0	530.5	181.2	538.6		92.3	446.3	0.0	0.0
Water	1328661.6	227417.0	1101244.6	169513.1	57903.9	48552.5		9825.1	38727.4	0.0	0.0
Total	1,423,312	254,150	1,169,162	189,439	64,710.6	64,711		11,094	53616.8	0	0
Total Solids	94,650	26,733	67,917	19,926	6806.6	7,400		1,269	6131.5	0	0
<b>gal/day</b>											
Protein	1507.0	1099.2	407.8	819.3	279.9	653.2		112.0	541.2	0.0	0.0
True Protein	1004.7	949.0	55.7	707.4	241.6	635.4		108.9	526.5	0.0	0.0
Non-Protein Nitrogen	502.3	150.2	352.2	111.9	38.2	17.8		3.0	14.7	0.0	0.0
Lactose	8205.0	1675.2	6529.8	1248.7	426.5	130.5		22.4	108.1	0.0	0.0
Ash	1339.6	286.9	1052.7	213.8	73.0	23.5		4.0	19.5	0.0	0.0
Butter Fat	83.7	83.7	0.0	62.4	21.3	63.4		10.9	52.5	0.0	0.0
Water	156313.1	26754.9	129558.2	19942.7	6812.2	5712.1		1155.9	4556.2	0.0	0.0
Total	167,448	29,900	137,548	22,287	7613.0	7,613		1,305	6307.9	0	0
<b>Mass %</b>											
Protein	0.90%	3.68%	0.30%	3.68%	3.68%	8.58%		8.58%	8.58%	0.00%	0.00%
True Protein	0.60%	3.17%	0.04%	3.17%	3.17%	8.35%		8.35%	8.35%	0.00%	0.00%
Non-Protein Nitrogen	0.30%	0.50%	0.26%	0.50%	0.50%	0.23%		0.23%	0.23%	0.00%	0.00%
Lactose	4.90%	5.60%	4.75%	5.60%	5.60%	1.71%		1.71%	1.71%	0.00%	0.00%
Ash	0.80%	0.96%	0.77%	0.96%	0.96%	0.31%		0.31%	0.31%	0.00%	0.00%
Butter Fat	0.05%	0.28%	0.00%	0.28%	0.28%	0.83%		0.83%	0.83%	0.00%	0.00%
Water	93.35%	89.48%	94.19%	89.48%	89.48%	75.03%		88.56%	76.98%	100.00%	100.00%
Total	100%	100%	100%	100%	100%	88.42%		100%	88%	100%	100%
% Solids	6.7%	10.5%	5.8%	10.5%	10.5%	11.4%		11.4%	11.4%	#DIV/0!	#DIV/0!
% Protein of Solids	13.5%	35.0%	5.1%	35.0%	35.0%	75.0%		75.0%	75.0%	#DIV/0!	#DIV/0!

Appendix C

Stream/Description	Feed 1	Feed 2	Feed 3	Feed 4	Feed 5	Feed 6	Feed 7	Feed 8	Feed 9	Feed 10	Feed 11	Feed 12	Feed 13	Feed 14	Feed 15	Feed 16	Feed 17	Feed 18	Feed 19	Feed 20	Feed 21	Feed 22	Feed 23		
Stream Number	6,000	3,000	48,000	8,000	500	833,500	1,000,000	66,500	117,647	0.60%	0.30%	4.00%	0.80%	0.05%	93.35%	6.7%	13.5%	0.60%	0.30%	4.00%	0.80%	0.05%	93.35%	6.7%	13.5%
lbs/day	5978.0	2779.2	44268.5	7295.0	500.0	834628.9	1045993.2	60777.7	105342	0.67%	0.31%	4.94%	0.81%	0.06%	93.21%	6.8%	14.4%	0.67%	0.31%	4.94%	0.81%	0.06%	93.21%	6.8%	14.4%
True Protein	21.0	220.8	2571.3	207.9	42.2	5834.5	10965.8	55.514	94.148	0.74%	0.02%	0.74%	0.02%	0.02%	5.5%	5.5%	4.2%	0.74%	0.02%	0.74%	0.02%	0.02%	5.5%	5.5%	4.2%
Non-Protein Nitrogen	21.0	220.8	2571.3	207.9	42.2	5834.5	10965.8	55.514	94.148	0.74%	0.02%	0.74%	0.02%	0.02%	5.5%	5.5%	4.2%	0.74%	0.02%	0.74%	0.02%	0.02%	5.5%	5.5%	4.2%
Lactose	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%
Ash	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%
Butter Fat	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%
Water	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%
Total Solids	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
% Solids	6.7%	13.5%	0.60%	0.30%	4.00%	0.80%	0.05%	93.35%	6.7%	13.5%	0.60%	0.30%	4.00%	0.80%	0.05%	93.35%	6.7%	13.5%	0.60%	0.30%	4.00%	0.80%	0.05%	93.35%	6.7%
% Protein of Solids	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%

Stream/Description	Feed 1	Feed 2	Feed 3	Feed 4	Feed 5	Feed 6	Feed 7	Feed 8	Feed 9	Feed 10	Feed 11	Feed 12	Feed 13	Feed 14	Feed 15	Feed 16	Feed 17	Feed 18	Feed 19	Feed 20	Feed 21	Feed 22	Feed 23		
Stream Number	6,240	3,120	50,960	8,320	520	970,840	1,040,000	69,160	122,353	0.60%	0.30%	4.00%	0.80%	0.05%	93.35%	6.7%	13.5%	0.60%	0.30%	4.00%	0.80%	0.05%	93.35%	6.7%	13.5%
lbs/day	6218.1	2899.3	46228.0	7470.2	520.0	97882.4	104683.0	63435.5	110397	0.67%	0.31%	4.94%	0.81%	0.06%	93.21%	6.8%	14.4%	0.67%	0.31%	4.94%	0.81%	0.06%	93.21%	6.8%	14.4%
True Protein	20.9	220.7	2571.3	207.9	42.2	5834.5	10965.8	55.514	94.148	0.74%	0.02%	0.74%	0.02%	0.02%	5.5%	5.5%	4.2%	0.74%	0.02%	0.74%	0.02%	0.02%	5.5%	5.5%	4.2%
Non-Protein Nitrogen	20.9	220.7	2571.3	207.9	42.2	5834.5	10965.8	55.514	94.148	0.74%	0.02%	0.74%	0.02%	0.02%	5.5%	5.5%	4.2%	0.74%	0.02%	0.74%	0.02%	0.02%	5.5%	5.5%	4.2%
Lactose	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%
Ash	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%
Butter Fat	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%
Water	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%
Total Solids	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
% Solids	6.7%	13.5%	0.60%	0.30%	4.00%	0.80%	0.05%	93.35%	6.7%	13.5%	0.60%	0.30%	4.00%	0.80%	0.05%	93.35%	6.7%	13.5%	0.60%	0.30%	4.00%	0.80%	0.05%	93.35%	6.7%
% Protein of Solids	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%

Stream/Description	Feed 1	Feed 2	Feed 3	Feed 4	Feed 5	Feed 6	Feed 7	Feed 8	Feed 9	Feed 10	Feed 11	Feed 12	Feed 13	Feed 14	Feed 15	Feed 16	Feed 17	Feed 18	Feed 19	Feed 20	Feed 21	Feed 22	Feed 23		
Stream Number	6,490	3,245	52,938	8,653	541	1,009,674	1,081,600	71,926	123,353	0.60%	0.30%	4.00%	0.80%	0.05%	93.35%	6.7%	13.5%	0.60%	0.30%	4.00%	0.80%	0.05%	93.35%	6.7%	13.5%
lbs/day	6467.5	3011.1	47987.1	7659.0	540.8	104936.3	110799.2	65865	110397	0.67%	0.31%	4.94%	0.81%	0.06%	93.21%	6.8%	14.4%	0.67%	0.31%	4.94%	0.81%	0.06%	93.21%	6.8%	14.4%
True Protein	22.1	233.7	2787.4	223.7	45.0	605103.6	66832.8	30198	104737.3	0.74%	0.02%	0.74%	0.02%	0.02%	5.5%	5.5%	4.3%	0.74%	0.02%	0.74%	0.02%	0.02%	5.5%	5.5%	4.3%
Non-Protein Nitrogen	22.1	233.7	2787.4	223.7	45.0	605103.6	66832.8	30198	104737.3	0.74%	0.02%	0.74%	0.02%	0.02%	5.5%	5.5%	4.3%	0.74%	0.02%	0.74%	0.02%	0.02%	5.5%	5.5%	4.3%
Lactose	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%
Ash	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%
Butter Fat	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%
Water	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%	93.35%
Total Solids	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
% Solids	6.7%	13.5%	0.60%	0.30%	4.00%	0.80%	0.05%	93.35%	6.7%	13.5%	0.60%	0.30%	4.00%	0.80%	0.05%	93.35%	6.7%	13.5%	0.60%	0.30%	4.00%	0.80%	0.05%	93.35%	6.7%
% Protein of Solids	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%

Total	127,247	114,212	13,035	102,153	12,059	25,094.0	90,403.1	11,750	388,440.0	78,994.2	11,409	482,521.9	67,965.4	11,029	562,817.7	57,366.3	10,600	698,811.8	47,255.3	10,110	799,911.8	37,715.4	9,540	
<b>Mass %</b>																								
<b>True Protein</b>	0.60%	0.31%	0.02%	0.74%	0.02%	0.02%	0.84%	0.03%	0.02%	0.95%	0.03%	0.02%	0.36%	0.25%	0.03%	1.30%	0.04%	0.03%	1.56%	0.05%	0.03%	0.24%	0.19%	0.06%
<b>Non-Protein Nitrogen</b>	0.30%	0.17%	0.01%	0.32%	0.02%	0.21%	0.33%	0.23%	0.22%	0.35%	0.24%	0.22%	0.36%	0.25%	0.23%	0.38%	0.26%	0.23%	0.41%	0.28%	0.24%	0.24%	0.24%	0.29%
<b>Lactose</b>	4.90%	4.94%	4.62%	4.99%	4.66%	4.54%	5.04%	4.61%	4.56%	5.09%	4.66%	4.56%	5.15%	4.71%	4.61%	5.22%	4.78%	4.64%	5.30%	4.85%	4.66%	4.66%	4.66%	4.84%
<b>ASD</b>	0.80%	0.81%	0.72%	0.82%	0.73%	0.72%	0.83%	0.73%	0.73%	0.84%	0.75%	0.73%	0.86%	0.76%	0.75%	0.87%	0.75%	0.74%	0.89%	0.79%	0.75%	0.75%	0.75%	0.81%
<b>Butter Fat</b>	0.05%	0.06%	0.00%	0.06%	0.00%	0.00%	0.07%	0.00%	0.00%	0.08%	0.00%	0.00%	0.09%	0.00%	0.00%	0.11%	0.00%	0.00%	0.13%	0.00%	0.00%	0.00%	0.17%	0.00%
<b>Water</b>	93.35%	93.22%	94.53%	93.07%	94.47%	94.50%	92.89%	94.40%	94.47%	92.69%	94.33%	94.44%	92.43%	94.25%	94.40%	92.11%	94.15%	94.36%	91.70%	94.04%	94.32%	91.45%	93.90%	93.00%
<b>Total</b>	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
<b>% Solids</b>	6.7%	6.8%	5.5%	6.9%	5.5%	5.5%	7.1%	5.6%	5.5%	7.3%	5.7%	5.6%	7.6%	5.8%	5.6%	7.9%	5.8%	5.6%	8.3%	6.0%	5.7%	8.9%	6.1%	
<b>% Protein of Solids</b>	13.5%	14.4%	4.2%	15.3%	4.4%	4.3%	16.4%	4.5%	4.4%	17.5%	4.7%	4.4%	18.4%	4.9%	4.5%	21.3%	5.1%	4.6%	23.7%	5.4%	4.7%	26.9%	5.8%	

Year 4

Stream/Description	Feed 1	Bleed 1	Perm. 1	Bleed 2	Perm. 2	Perm. Mix	Bleed 3	Perm. 3	Perm. Mix	Bleed 4	Perm. 4	Perm. Mix	Bleed 5	Perm. 5	Perm. Mix	Bleed 6	Perm. 6	Perm. Mix	Bleed 7	Perm. 7	Perm. Mix	Bleed 8	Perm. 8
Stream Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
<b>Component</b>																							
<b>Insidiv</b>																							
<b>True Protein</b>	6.749	6727.1	22.1	6704.2	22.9	44.9	6679.2	25	69.9	6651.0	31	97.5	6621.0	31	128.2	6586.5	35	162.7	6547.0	39	202.2	6501.1	46
<b>Non-Protein Nitrogen</b>	3.375	3141.0	233.6	2915.6	226.4	459.0	2687.6	228	687.0	2458.9	231	917.7	2223.4	233	1151.2	1987.2	236	1387.3	1748.4	239	1828.2	1507.2	241
<b>Lactose</b>	55.118	50104.6	5013.8	45983.1	4721.5	9735.3	40733.0	4950	14385.4	36163.7	4569	18954.6	31687.2	4477	23431.2	27318.2	4369	27800.1	23078.4	4242	32041.9	18988.0	4088
<b>Ash</b>	8.989	8204.8	784.1	7454.7	750.1	1544.2	6713.4	741	2285.5	5982.3	731	3016.6	5263.2	719	3735.8	4558.1	705	4440.8	3870.0	688	5128.9	3203.0	667
<b>Butter Fat</b>	52	522.4	0.0	522.4	0.0	0.0	522.4	0.0	0.0	522.4	0.0	0.0	522.4	0.0	0.0	522.4	0.0	0.0	522.4	0.0	0.0	522.4	0.0
<b>Water</b>	1,050,061	945233.8	847434.3	97799.5	202826.3	752085.8	85.348	297974.7	659431.1	92.655	390629.4	587673.0	89.688	480297.5	483444.3	86.322	566619.2	400916.8	82.525	688142.8	322767.9	78.149	
<b>Total</b>	1,124,864	1,013,974	1,10890.3	910,454	1,03519.4	2,14409.7	809,461	100,993	3,15402.5	711,248	98,213	4,13615.8	616,120	95,128	508743.8	524,454	91,666	600410.2	436,721	87,733	688142.8	353,530	83,191
<b>Total Solids</b>	74,803	68,740	6,064	63,020	5,720	11783.4	57,376	17427.8	51,817	5,559	22986.4	46,357	5,460	28446.3	41,012	5,345	33781.0	35,804	5,208	38989.1	30,762	5,043	
<b>Insidiv</b>																							
<b>Total</b>	132,337	119,291	13,046	107,112	12,179	25224.7	95230.8	11,882	37106.2	83676.3	11,555	48860.7	72464.7	11,192	59852.2	61700.4	10,784	70636.5	51979.0	10,321	80958.0	41591.7	9,787
<b>Mass %</b>																							
<b>True Protein</b>	0.60%	0.66%	0.02%	0.74%	0.02%	0.02%	0.83%	0.02%	0.02%	0.94%	0.03%	0.02%	1.07%	0.03%	0.03%	1.26%	0.04%	0.03%	1.50%	0.04%	0.03%	0.24%	0.06%
<b>Non-Protein Nitrogen</b>	0.30%	0.31%	0.21%	0.32%	0.22%	0.21%	0.33%	0.23%	0.22%	0.35%	0.23%	0.22%	0.36%	0.25%	0.23%	0.38%	0.26%	0.23%	0.40%	0.27%	0.24%	0.24%	0.29%
<b>Lactose</b>	4.90%	4.94%	4.52%	4.98%	4.56%	4.54%	5.03%	4.60%	4.56%	5.09%	4.65%	4.56%	5.14%	4.71%	4.61%	5.21%	4.77%	4.63%	5.28%	4.83%	4.66%	4.66%	4.81%
<b>Ash</b>	0.80%	0.81%	0.72%	0.82%	0.73%	0.72%	0.83%	0.73%	0.73%	0.84%	0.74%	0.73%	0.86%	0.76%	0.75%	0.87%	0.75%	0.74%	0.89%	0.78%	0.75%	0.75%	0.80%
<b>Butter Fat</b>	0.05%	0.06%	0.00%	0.06%	0.00%	0.00%	0.07%	0.00%	0.00%	0.08%	0.00%	0.00%	0.09%	0.00%	0.00%	0.11%	0.00%	0.00%	0.13%	0.00%	0.00%	0.17%	0.00%
<b>Water</b>	93.35%	93.22%	94.53%	93.08%	94.47%	94.50%	92.89%	94.41%	94.47%	92.71%	94.33%	94.44%	92.49%	94.25%	94.41%	92.18%	94.17%	94.37%	91.80%	94.06%	94.33%	91.30%	93.94%
<b>Total</b>	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
<b>% Solids</b>	6.7%	6.8%	5.5%	6.9%	5.5%	5.5%	7.1%	5.6%	5.5%	7.3%	5.7%	5.6%	7.5%	5.7%	5.6%	7.8%	5.8%	5.6%	8.2%	5.9%	5.7%	8.7%	6.1%
<b>% Protein of Solids</b>	13.5%	14.4%	4.2%	15.3%	4.3%	4.3%	16.3%	4.5%	4.3%	17.6%	4.6%	4.4%	19.1%	4.8%	4.5%	20.9%	5.1%	4.6%	23.2%	5.3%	4.7%	26.0%	5.7%

Year 5

Stream/Description	Feed 1	Bleed 1	Perm. 1	Bleed 2	Perm. 2	Perm. Mix	Bleed 3	Perm. 3	Perm. Mix	Bleed 4	Perm. 4	Perm. Mix	Bleed 5	Perm. 5	Perm. Mix	Bleed 6	Perm. 6	Perm. Mix	Bleed 7	Perm. 7	Perm. Mix	Bleed 8	Perm. 8
Stream Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
<b>Component</b>																							
<b>Insidiv</b>																							
<b>True Protein</b>	7,019	6995.8	28.3	6971.4	24.4	47.7	6944.6	27	74.5	6915.1	30	104.1	6882.0	33	137.2	6844.8	37	174.6	6801.6	43	217.6	6761.2	50
<b>Non-Protein Nitrogen</b>	3,510	3263.0	246.6	3023.0	240.0	486.6	2780.1	243	728.4	2534.3	246	3720.3	2457.4	249	1224.1	2033.5	252	1476.1	1778.6	255	1730.9	1521.2	257
<b>Lactose</b>	57,323	52031.7	5291.3	47012.0	5021.6	10312.9	42065.8	4844	15257.2	37209.3	4857	20115.7	32453.9	4755	24869.2	27816.6	4637	23506.5	23319.9	4487	34003.2	18994.2	4326
<b>Ash</b>	9,359	8520.8	838.1	7722.9	797.9	1636.0	6934.5	788	2424.3	6157.2	777	3201.6	5392.9	764	3965.9	4644.1	749	4714.8	3914.1	730	5444.8	3207.6	707
<b>Butter Fat</b>	585	584.9	0.0	584.9	0.0	0.0	584.9	0.0	0.0	584.9	0.0	0.0	584.9	0.0	0.0	584.9	0.0	0.0	584.9	0.0	0.0	584.9	0.0
<b>Water</b>	1,092,063	981447.8	1,08615.2	877469.8	103979.0	214593.2	776151.4	101,318	3,15911.6	677784.5	96,387	4,14288.4	592639.5	95,125	509423.5	491184.7	91,455	60878.3	403916.7	87,288	688146.2	321505.8	82,411
<b>Total</b>	1,169,859	1,052,844	1,170,014.5	942,782	1,100,619	2,270,766.4	835,461	1,07,921	3,343,971.1	731,165	104,296	4,386,983.1	630,239	539,919.9	533,108	97,130	636,750.1	440,316	92,793	729,542.7	352,565	87,751	
<b>Total Solids</b>	77,796	71,396	6,389	65,312	6,084	12489.2	59,310	6,002	18485.5	53,401	5,909	24394.7	47,599	5,602	30196.4	41,924	5,675	35871.9	36,399	5,625	41396.5	31,059	5,340
<b>Insidiv</b>																							
<b>Total</b>	137,630	123,864	13,766	110,916	12,948	26714.9	98289.6	12,626	39340.8	86019.5	12,270	51611.0	74145.7	11,874	63484.7	82718.6	11,427	74911.8	51801.9	10,917	85828.6	41478.2	10,324
<b>Mass %</b>																							
<b>True Protein</b>	0.60%	0.66%	0.02%	0.74%</																			



Appendix C

Stream #	Feed 1	Feed 2	Feed 3	Feed 4	Feed 5	Feed 6	Feed 7	Feed 8	Feed 9	Feed 10	Feed 11	Feed 12	Feed 13	Feed 14	Feed 15	Feed 16	Feed 17	Feed 18	Feed 19	Feed 20	Feed 21	Feed 22	Feed 23
Mass %	0.60%	0.66%	0.02%	0.74%	0.02%	0.02%	0.83%	0.02%	0.02%	0.95%	0.03%	0.02%	1.05%	0.03%	0.03%	1.25%	0.04%	0.03%	1.55%	0.05%	0.03%	1.93%	0.06%
Non-Protein Nitrogen	0.30%	0.31%	0.21%	0.32%	0.22%	0.21%	0.33%	0.23%	0.22%	0.35%	0.24%	0.22%	0.36%	0.23%	0.23%	0.38%	0.26%	0.23%	0.40%	0.28%	0.24%	0.43%	0.29%
Lactose	4.90%	4.94%	4.52%	4.86%	4.55%	4.54%	5.03%	4.61%	4.56%	5.08%	4.68%	4.59%	5.15%	4.71%	4.61%	5.22%	4.78%	4.63%	5.30%	4.85%	4.66%	5.35%	4.93%
Ash	0.80%	0.81%	0.72%	0.82%	0.73%	0.72%	0.83%	0.73%	0.72%	0.84%	0.76%	0.73%	0.86%	0.76%	0.74%	0.87%	0.77%	0.74%	0.89%	0.79%	0.75%	0.91%	0.81%
Butter Fat	0.05%	0.06%	0.00%	0.06%	0.00%	0.00%	0.08%	0.00%	0.00%	0.08%	0.00%	0.00%	0.09%	0.00%	0.00%	0.11%	0.00%	0.00%	0.13%	0.00%	0.00%	0.17%	0.00%
Water	93.35%	93.22%	94.53%	93.07%	94.47%	94.50%	92.80%	94.41%	94.47%	92.70%	94.33%	94.44%	92.44%	94.25%	94.40%	92.13%	94.15%	94.37%	91.72%	94.04%	94.32%	91.16%	93.91%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
% Solids	6.7%	6.8%	5.5%	6.9%	5.5%	5.5%	7.1%	5.6%	5.5%	7.3%	5.7%	4.4%	7.6%	5.7%	5.6%	7.9%	5.8%	5.6%	8.3%	6.0%	5.7%	8.8%	6.1%
% Protein of Solids	13.5%	14.4%	4.2%	13.3%	4.3%	4.3%	16.4%	4.3%	4.3%	17.7%	4.7%	4.4%	19.3%	4.9%	4.5%	21.2%	5.1%	4.6%	23.7%	5.4%	4.7%	26.8%	5.8%

Year 9

Stream #	Feed 1	Feed 2	Feed 3	Feed 4	Feed 5	Feed 6	Feed 7	Feed 8	Feed 9	Feed 10	Feed 11	Feed 12	Feed 13	Feed 14	Feed 15	Feed 16	Feed 17	Feed 18	Feed 19	Feed 20	Feed 21	Feed 22	Feed 23	
Component	8,211	8,183.8	25.7	8,167.28.1	54.8	8,124.7	32	8,089.2	85	8,049.4	40	122.2	8,049.4	40	162.0	8,004.2	45	7,963.8	52	7,918.5	52	299.6	7,889.8	62
Non-Protein Nitrogen	4,106	3,833.3	272.4	3,546.6	266.7	559.1	3,256.1	290	849.6	2,961.7	294	1,144.0	2,663.3	298	1,442.4	2,360.7	303	2,054.0	307	2,054.0	307	4021.7	1,743.9	310
Lactose	67,060	61,207.5	5,852.4	55,202.1	6,005.4	1,185.7	49,266.0	5,916	17,739.9	43,472.0	5,814	23,587.9	37,776.0	5,698	29,283.9	32,218.9	5,557	34,840.9	5,390	26,828.5	5,390	40,231.4	21,643.0	5,186
Ash	10,949	10,021.7	926.8	9,067.6	954.1	1,880.9	8,124.4	943	2,824.2	7,193.3	831	3,754.7	6,378.6	816	4,870.3	5,380.6	898	5,568.0	816	4,804.1	875	6,443.5	3,667.5	848
Butter Fat	684	684.3	0.0	684.3	0.0	0.0	684.3	0.0	0.0	684.3	0.0	0.0	684.3	0.0	0.0	684.3	0.0	684.3	0.0	684.3	0.0	684.3	0.0	684.3
Water	1,277,558	1,165,154.3	1,224,049.9	1,030,762.3	1,245,922.0	2,467,986.9	909,514.2	1,212,248	3,680,451.1	79,174.8	117,772	4,885,177.4	67,851.1	113,891	589,708.1	568,546.8	1,09,502	792,10.4	483,882.7	1,04,466	81,367.5	365,305.7	98,577	
Total	1,369,669	1,239,087	1,224,822	1,107,419	1,316,867.4	2,611,496.6	978,960	1,28,430	3,985,794	854,143	124,847	5,142,623	733,302	120,840	635,266.8	618,997	116,305	751,571.8	505,906	1,11,091	862,662.7	400,924	1,04,983	
Total Solids	91,010	83,933	7,077	76,657	7,275	14,552.6	69,475	7,182	21,534.4	62,401	7,074	286,068.8	55,451	6,950	35,558.6	48,649	6,803	42,381.2	42,024	6,825	49,886.2	35,618	6,406	
% Solids	6.7%	6.8%	5.5%	6.9%	5.5%	5.5%	7.1%	5.6%	5.5%	7.3%	5.7%	4.4%	7.6%	5.7%	5.6%	7.9%	5.8%	5.6%	8.3%	6.0%	5.7%	8.8%	6.1%	
% Protein of Solids	13.5%	14.3%	4.2%	13.3%	4.3%	4.3%	16.4%	4.3%	4.3%	17.7%	4.7%	4.4%	19.3%	4.9%	4.5%	21.3%	5.1%	4.6%	23.8%	5.4%	4.7%	27.0%	5.8%	

Year 10

Stream #	Feed 1	Feed 2	Feed 3	Feed 4	Feed 5	Feed 6	Feed 7	Feed 8	Feed 9	Feed 10	Feed 11	Feed 12	Feed 13	Feed 14	Feed 15	Feed 16	Feed 17	Feed 18	Feed 19	Feed 20	Feed 21	Feed 22	Feed 23	
Component	8,540	8,514.3	25.6	8,485.1	129.1	54.7	8,453.2	132	8,417.9	35	121.9	8,378.6	39	161.3	8,334.0	45	8,292.8	51	8,248.3	51	257.0	8,203.8	60	
Non-Protein Nitrogen	4,270	3,987.7	272.3	3,708.9	283.8	561.0	3,416.5	292	3,120.1	296	1,149.8	2,819.7	300	1,450.2	2,515.2	305	2,149.8	309	2,064.4	309	2,063.5	1,653.0	313	
Lactose	65,742	63,887.2	5,855.1	57,829.1	6,058.1	1,191.3	51,856.1	5,973	17,866.2	45,980.0	5,876	32,762.3	40,215.2	5,765	29,527.1	34,580.6	5,635	35,161.7	5,480	29,100.7	5,480	40,641.6	23,809.0	5,292
Ash	11,386	10,459.4	927.1	9,487.1	982.3	1,889.4	8,545.1	982	2,841.4	7,605.0	940	3,781.5	6,678.0	926	4,707.5	5,769.7	909	6,516.8	889	4,707.5	889	6,507.2	4,017.8	864
Butter Fat	712	711.7	0.0	711.7	0.0	0.0	711.7	0.0	0.0	711.7	0.0	0.0	711.7	0.0	0.0	711.7	0.0	711.7	0.0	711.7	0.0	711.7	0.0	
Water	1,328,662	1,206,160.8	1,225,008	1,096,594.7	1,255,668.1	2,480,666.9	958,653.7	1,225,541	3,706,079.9	83,884.5	119,209	4,888,166.6	72,334.1	115,504	605,320.2	612,004.7	1,111,337	718,656.9	505,418.9	1,08,586	823,427.7	404,343.2	1,01,076	
Total	1,423,312	1,293,731	1,285,680.9	1,160,827	1,329,004.4	2,624,665.3	1,031,036	1,29,780	3,922,756.6	904,880	128,357	5,186,532.1	782,146	122,534	641,166.2	663,916	118,230	759,936.0	550,601	113,315	872,710.6	442,868	107,604	
Total Solids	94,650	87,670	7,080	80,232	7,338	14,418.4	72,983	7,249	21,667.7	65,895	7,148	288,155.5	58,804	7,031	35,846.1	51,911	6,893	42,739.1	45,182	6,729	49,467.9	38,655	6,528	
% Solids	6.7%	6.8%	5.5%	6.9%	5.5%	5.5%	7.1%	5.6%	5.5%	7.3%	5.7%	4.4%	7.6%	5.7%	5.6%	7.9%	5.8%	5.6%	8.3%	6.0%	5.7%	8.9%	6.1%	
% Protein of Solids	13.5%	14.3%	4.2%	13.3%	4.3%	4.3%	16.4%	4.3%	4.3%	17.7%	4.7%	4.4%	19.3%	4.9%	4.5%	21.3%	5.1%	4.6%	23.8%	5.4%	4.7%	27.0%	5.8%	













Appendix C

Table with 13 columns: 35% Prod, 75% Prod, 81% Prod, 85% Prod, Evap, Perm, Wet, Perm, Seed, Perm, Store, Perm, Waste, Perm, Waste, 92253.7, 2334.90, 92253.7, 92253.7, 2342.91, 94596.6

COD 48.051.5 mg/liter soin
BOD 28.818.9 mg/liter so
0.24048 lb/gal

5249.8
2834.8
47244.1
7691.5
420.8
1050128.5
1113569.5

131008.2

0.47%
0.25%
4.24%
0.89%
0.64%
94.30%
100.00%
5.7%
0.0%

COD 48.481.2 mg/liter soin
BOD 29.088.7 mg/liter so
0.24273 lb/gal

Table with 13 columns: 35% Prod, 75% Prod, 81% Prod, 85% Prod, Evap, Perm, Wet, Perm, Seed, Perm, Store, Perm, Waste, Perm, Waste, 92253.7, 2334.90, 92253.7, 92253.7, 2342.91, 94596.6

6415
2696.5
48387.7
7626.3
0.0
1082132.6
1151684.7

135492.3

0.06%
0.23%
4.20%
0.68%
0.00%
94.83%
100.00%
5.2%
0.0%

COD 48.011.4 mg/liter so
BOD 28.806.8 mg/liter so
0.24038 lb/gal

Table with 13 columns: 35% Prod, 75% Prod, 81% Prod, 85% Prod, Evap, Perm, Wet, Perm, Seed, Perm, Store, Perm, Waste, Perm, Waste, 92253.7, 2334.90, 92253.7, 92253.7, 2342.91, 94596.6

COD 48.051.5 mg/liter soin
BOD 28.818.9 mg/liter so
0.24048 lb/gal

5249.8
2834.8
47244.1
7691.5
420.8
1050128.5
1113569.5

131008.2

0.47%
0.25%
4.24%
0.89%
0.64%
94.30%
100.00%
5.7%
0.0%

COD 48.481.2 mg/liter soin
BOD 29.088.7 mg/liter so
0.24273 lb/gal

Table with 13 columns: 35% Prod, 75% Prod, 81% Prod, 85% Prod, Evap, Perm, Wet, Perm, Seed, Perm, Store, Perm, Waste, Perm, Waste, 92253.7, 2334.90, 92253.7, 92253.7, 2342.91, 94596.6

6415
2696.5
48387.7
7626.3
0.0
1082132.6
1151684.7

135492.3

0.06%
0.23%
4.20%
0.68%
0.00%
94.83%
100.00%
5.2%
0.0%

COD 48.011.4 mg/liter so
BOD 28.806.8 mg/liter so
0.24038 lb/gal





Residence Time < Holdup Volume/Bleed Rate	Year						
	1	2	3	4	5	6	7
1	17	17	18	18	19	20	20
2	17	17	18	18	19	20	20
3	17	17	18	18	19	20	20
4	17	17	18	18	19	20	20
5	17	17	18	18	19	20	20
6	17	17	18	18	19	20	20
7	17	17	18	18	19	20	20
8	17	17	18	18	19	20	20
9	17	17	18	18	19	20	20
10	11	17	13	18	15	12	18
Total Time	55%						
1	8	8	9	10	10	10	11
Total Time	75%						
1	16	15	14	14	15	18	16
Total Time	85%						
1	6	5	6	6	6	7	7
Volume	237.5	242.4	249.7	257.0	265.6	277.8	284.0

Stage	# of Cartridges	Holdup Volume (gal)	Bleed Rate (gpd)	Time (days)	Time (hours)
<b>35%</b>					
1	22.0	26.9	151645.605	0.000	0.004
2	22.0	26.9	136172.485	0.000	0.004
3	22.0	26.9	121059.290	0.000	0.004
4	22.0	26.9	106342.650	0.000	0.005
5	22.0	26.9	92067.035	0.000	0.006
6	22.0	26.9	78287.457	0.000	0.007
7	22.0	26.9	65073.489	0.000	0.008
8	22.0	26.9	52516.505	0.001	0.010
9	22.0	26.9	40734.719	0.001	0.013
10	20.0	24.5	29900.000	0.001	0.016
Total Time	55% - 1 Stage				
1	12.0	14.7	2561.021	0.006	0.115
Total Time	75%				
1	20.0	24.480	2561.021	0.010	0.191
Total Time	85%				
1	8.0	9.792	825.483	0.012	0.237
Total Volume	55% - 2 Stage				
1	6.0	7.344	2561.123	0.003	0.057
2	6.0	7.344	2561.123	0.003	0.057
Total Time	75%				
1	18.0	22.032	2561.123	0.009	0.172
Total Time	85%				
1	8.0	9.792	748.755	0.013	0.262
Total Volume	85%				

Cleaning Solutions	%	Year 1			Year 6		
		Conc.	H2O	Total	Conc.	H2O	Total
Acid	1	3.2	319.2	322.5	193.5	33	324.1
Caustic	1	3.2	319.2	322.5	193.5	3.3	324.1
Na Hypochlorite	200 ppm	1.2	321.2	322.5	73.7	1.2	326.1
Soft H2O			322.5	322.5			327.4
Total Water			2249.5				2283.7

Year	Acid	Caustic	Na Hypo.	
			Conc.	H2O
1	3.2	3.2	1.2	1.2
2	3.3	3.3	1.2	1.2
3	3.3	3.3	1.3	1.3
4	3.4	3.4	1.3	1.3
5	3.5	3.5	1.3	1.3
6	3.6	3.6	1.4	1.4
7	3.7	3.7	1.4	1.4
8	3.8	3.8	1.4	1.4
9	3.9	3.9	1.5	1.5
10	4.0	4.0	1.5	1.5

Cleaning Solutions	%	Year 1			Year 6		
		Conc.	H2O	Total	Conc.	H2O	Total
Acid	1	3.2	319.2	322.5	193.5	3.3	324.1
Caustic	1	3.2	319.2	322.5	193.5	3.3	324.1
Na Hypochlorite	200 ppm	1.2	321.2	322.5	73.7	1.2	326.1
Soft H2O			322.5	322.5			327.4
Total Water			2249.5				2283.7

Product	Total Resistance Time (hours)	
	35%	85%
35%	0.078	0.621
75%	0.364	0.621
85%	0.621	0.621

Year	Acid	Caustic	Na Hypo.	
			Conc.	H2O
1	3.2	3.2	1.2	1.2
2	3.3	3.3	1.2	1.2
3	3.3	3.3	1.3	1.3
4	3.4	3.4	1.3	1.3
5	3.5	3.5	1.3	1.3
6	3.6	3.6	1.4	1.4
7	3.7	3.7	1.4	1.4
8	3.8	3.8	1.4	1.4
9	3.9	3.9	1.5	1.5
10	4.0	4.0	1.5	1.5



	8	9	10
21	21	21	21
21	22	22	22
21	22	22	22
21	22	22	22
21	22	22	22
21	22	22	22
21	22	22	22
21	22	22	22
21	22	22	22
16	14	21	
11	12	12	
17	18	20	
7	7	8	
293.8	303.6	315.8	

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Year 2	Year 3			Year 4			Year 5		
	60 day supply	Conc.	Volume (gal/day)	60 day supply	Conc.	Volume (gal/day)	60 day supply	Conc.	Volume (gal/day)
Total			Total			Total			Total
327.4	196.4	3.3	331.3	334.7	3.4	338.6	342.0	3.5	347.1
327.4	196.4	3.3	331.3	334.7	3.4	338.6	342.0	3.5	347.1
327.4	74.8	1.3	333.4	334.7	1.3	340.7	342.0	1.3	349.3
327.4			334.7	334.7		342.0	342.0		350.6
			2334.9			2386.1			2446.9
Year 7	Year 8			Year 9			Year 10		
60 day supply	Conc.	Volume (gal/day)	60 day supply	Conc.	Volume (gal/day)	60 day supply	Conc.	Volume (gal/day)	60 day supply
Total			Total			Total			Total
369.0	221.4	3.8	375.0	378.8	3.9	384.7	388.6	4.0	396.8
369.0	221.4	3.8	375.0	378.8	3.9	384.7	388.6	4.0	396.8
369.0	84.3	1.4	377.3	378.8	1.5	387.1	388.6	1.5	396.3
369.0			378.8	378.8		388.6	388.6		400.8
			2642.3			2710.6			2796.0

Appendix D

A		B	C	D	E	F	G	H	I	J	K
1	Composition		Percentage	Flow Rate	gal/day	Membrane Rejections		Year	lbs/day	Whely Feed gal/day	Increase
2	Feed			lbs/day		$\sigma$		1	1000000	=13/\$B\$13	=13*0.04
3	Protein		=D4/D11	=D5+D6	=D4/\$B\$13			2	=13+K3	=14/\$B\$13	=14*0.04
4	True Protein TP		0.006	=D\$11*C5	=D5/\$B\$13	0.97		3	=14+K4	=15/\$B\$13	=15*0.04
5	Non-Protein Nitrogen NPN		0.003	=D\$11*C6	=D6/\$B\$13	0.32		4	=15+K5	=16/\$B\$13	=16*0.04
6	Lactose		0.049	=D\$11*C7	=D7/\$B\$13	0.085		5	=16+K6	=17/\$B\$13	=17*0.04
7	Ash		0.008	=D\$11*C8	=D8/\$B\$13	0.115		6	=17+K7	=18/\$B\$13	=18*0.04
8	Buffer Fat		0.0005	=D\$11*C9	=D9/\$B\$13	1		7	=18+K8	=19/\$B\$13	=19*0.04
9	Water		=1-SUM(C5:C9)	=D\$11*C10	=D10/\$B\$13	0		8	=19+K9	=110/\$B\$13	=110*0.04
10				1000000	=D11/\$B\$13			9	=110+K10	=111/\$B\$13	=111*0.04
11								10	=111+K11	=112/\$B\$13	=112*0.04
12	Density	8.5	lbs/gal								
13	Membrane Conditions										
14	Cartridge inlet pressure	30	psig								
15	Crossflow pressure drop	15	psig								
16	Permeate pressure	5	psig								
17	Recirculation Rate/Cartridge	23	gpm								

Appendix D

A	B	C	D	E	F	G	H	I	J
Storage Tank	Use	Jan. 1990 Capacity (days)	Jan. 1990 Marshall and Swift Cost Index	Actual (gal)	Cost (1990)	Material Factor	Cost (3.16 SS (1990))	Cost (2000)	
1					=804	Jan. 2001	1094.5		
2	35% Holding	0.01	=FullMass/AF304*20*60	=D5+D5*0.25	40000	3.5	=F5*G5	=H5*\$H\$/I\$F\$1	
3	75% Holding	0.01	=FullMass/AP304*60*20	=D6+D6*0.25	9500	3.5	=F6*G6	=H6*\$H\$/I\$F\$1	
4	85% Holding	0.01	=FullMass/AT304*20*60	=D7+D7*0.25	6000	3.5	=F7*G7	=H7*\$H\$/I\$F\$1	
5	D1 H2O	1	=FullMass/BH304	=D8+D8*0.25	26000	3.5	=F8*G8	=H8*\$H\$/I\$F\$1	
6	Perm. Storage	1	=FullMass/BE304*60*20	=D9+D9*0.25	80000	3.5	=F9*G9	=H9*\$H\$/I\$F\$1	Cone roof tank
7	35% Product	60	=FullMass/AV304*60	=D10+D10*0.25	50000	3.5	=F10*G10	=H10*\$H\$/I\$F\$1	
8	75% Product	60	=FullMass/AX304*60	=D11+D11*0.25	60000	3.5	=F11*G11	=H11*\$H\$/I\$F\$1	Cone roof tank
9	85% Product	60	=FullMass/AY304*60	=D12+D12*0.25	30000	3.5	=F12*G12	=H12*\$H\$/I\$F\$1	
10	Soft H2O	1	=TimeI/29	=D13+D13*0.25	18000	3.5	=F13*G13	=H13*\$H\$/I\$F\$1	
11	CIP Acid	60	=TimeI/25	=D14+D14*0.25				3140	
12	Causatic	60	=TimeI/26	=D15+D15*0.25				331	
13	Sodium Hypochlorite	7	35	45				331	
14	Mixing Tank	1	400	=D18+D18*0.25	8000	3.5	=F18*G18	=H18*\$H\$/I\$F\$1	Carbon steel with agitator
19								=SUM(I5:I13, I14:I18)	
20								=I19/(1-0.35)	
21	** 60 days, all other 1 day			* Jan. 1990 for CS		1990			
22	*** 1 week supply, rest can be stored in original containers from Walmart			pg 539					
23									
24	Pumps								
25	0.35								
26	Number	Flow Rate (gpm)	Pump	speed	diameter (in)	HP	Energy (kw-hr)		
27	P-100	=max35%/IK4/(20*60)	328	1750	7	5	=G27*550*60*60*24/2655223.737		
28	P-101	=max35%/IK80	4410	1750	8.25	15	=G28*550*60*60*24/2655223.737		
29	P-102	=max35%/IK81	4410	1750	8.25	15	=G29*550*60*60*24/2655223.737		
30	P-103	=max35%/IK82	4410	1750	8	15	=G30*550*60*60*24/2655223.737		
31	P-104	=max35%/IK83	4410	1750	8	15	=G31*550*60*60*24/2655223.737		
32	P-105	=max35%/IK84	4410	1750	8	15	=G32*550*60*60*24/2655223.737		
33	P-106	=max35%/IK85	4410	1750	8	15	=G33*550*60*60*24/2655223.737		
34	P-107	=max35%/IK86	4410	1750	8	15	=G34*550*60*60*24/2655223.737		
35	P-108	=max35%/IK87	4410	1750	8	10	=G35*550*60*60*24/2655223.737		
36	P-109	=max35%/IK88	4410	1750	8	10	=G36*550*60*60*24/2655223.737		
37	P-110	=max35%/IK89	4410	1750	8	10	=G37*550*60*60*24/2655223.737		
38	0.75								
39	P-201	=10-55%/IK55	218	1750	6.75	2	=G39*550*60*60*24/2655223.737		
40	P-202W	=1max55%/IB75/(20*60)	218	1750	6.5	1.5	=G40*550*60*60*24/2655223.737		
41	P-202	=1max55%/IB125	4410	1750	7.75	10	=G41*550*60*60*24/2655223.737		
42									
43	0.85								
44	P-301W	=1max85%/IB5/(20*60)	218	1750	6.5	1	=G44*550*60*60*24/2655223.737		
45	P-301	=10-85%/IK23	328	1750	7	5	=G45*550*60*60*24/2655223.737		
46				Permeate					
47	0.35								
48	P-111	=FullMassIY304	328	1750	6.75	3	=G48*550*60*60*24/2655223.737		
49	0.75								
50	P-203	=FullMassIAJ304	328	1750	6.75	2	=G50*550*60*60*24/2655223.737		
51	Cleaning								
52	P-400	=TimeI/25/30	328	1750	6.75	2	=G52*550*60*60*24/2655223.737		

A		B		C	
1	Operating Costs				
2	per day		Cost to pay for Whey Feed		
3	Year		lbs Protein Feed	Cost	
4	1		=1\$1opt.'IB3	=0.05*B4	
5	2		=1\$1opt.'IB4	=0.05*B5	
6	3		=1\$1opt.'IB5	=0.05*B6	
7	4		=1\$1opt.'IB6	=0.05*B7	
8	5		=1\$1opt.'IB7	=0.05*B8	
9	6		=1\$1opt.'IB8	=0.05*B9	
10	7		=1\$1opt.'IB9	=0.05*B10	
11	8		=1\$1opt.'IB10	=0.05*B11	
12	9		=1\$1opt.'IB11	=0.05*B12	
13	10		=1\$1opt.'IB12	=0.05*B13	
14	per year				
15	Item		Cost	Margin	
16	Cartridges	200		0.75	
17	Gaskets	15		0.35	
18					
19	Engineering Costs				
20	Item		Number	Cartridges	
21	Stage 1	13		258	
22	Add. Stages	12			
23	Automation	13			
24	Computer				
25	Cleaning				
26					
27					
28	Economics				
29	Case with evaporation permeate				
30	Year		Total Cap. Invest.	Income	
31	0		=Equip.'I20+CostsIE27+G16+E18		
32	1			=1\$1opt.'IH3*365	
33	2			=1\$1opt.'IH4*365	
34	3			=1\$1opt.'IH5*365	
35	4			=1\$1opt.'IH6*365	
36	5			=1\$1opt.'IH7*365	
37	6			=1\$1opt.'IH8*365	
38	7			=1\$1opt.'IH9*365	
39	8			=1\$1opt.'IH10*365	
40	9			=1\$1opt.'IH11*365	
41	10			=1\$1opt.'IH12*365	
42					
43					
44					
45	Case without evaporating permeate				
46	Year		Total Cap. Invest.	Income	
47	0		=Equip.'I20+CostsIE27+G16+E18		
48	1			=1\$1opt.'IH3*365	
49	2			=1\$1opt.'IH4*365	
50	3			=1\$1opt.'IH5*365	
51	4			=1\$1opt.'IH6*365	
52	5			=1\$1opt.'IH7*365	
53	6			=1\$1opt.'IH8*365	
54	7			=1\$1opt.'IH9*365	
55	8			=1\$1opt.'IH10*365	
56	9			=1\$1opt.'IH11*365	
57	10			=1\$1opt.'IH12*365	
58					

Appendix D

D		E
1	Per year	Margin-75%
2	=SUM(TimeI\$4:I\$19)	=D4)*B\$16/(1-C\$16)
3	=SUM(TimeJ\$4:J\$19)	=D5)*B\$16/(1-C\$16)
4	=SUM(TimeK\$4:K\$19)	=D6)*B\$16/(1-C\$16)
5	=SUM(TimeL\$4:L\$19)	=D7)*B\$16/(1-C\$16)
6	=SUM(TimeM\$4:M\$19)	=D8)*B\$16/(1-C\$16)
7	=SUM(TimeN\$4:N\$19)	=D9)*B\$16/(1-C\$16)
8	=SUM(TimeO\$4:O\$19)	=D10)*B\$16/(1-C\$16)
9	=SUM(TimeP\$4:P\$19)	=D11)*B\$16/(1-C\$16)
10	=SUM(TimeQ\$4:Q\$19)	=D12)*B\$16/(1-C\$16)
11	=SUM(TimeR\$4:R\$19)	=D13)*B\$16/(1-C\$16)
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Appendix D

	F	G	H	I	J	K	L	M
1								
2	Margin-35%			Cleaning solidify				
3	Gasket Cost	Acid	Caustic	Na Hypo.	Cost	Waste Flow	Hydraulic	BOD
4	=D4*B\$17/(1-C\$17)	=TimeI40	=TimeI40	=TimeI40	=G4*9.09+11.86*H4+0.9*I4	=FullMassIBN116	=(K4)/1000	0
5	=D5*B\$17/(1-C\$17)	=TimeI41	=TimeI41	=TimeI41	=G5*9.09+11.86*H5+0.9*I5	=FullMassIBN48	=(K5)/1000	0
6	=D6*B\$17/(1-C\$17)	=TimeI42	=TimeI42	=TimeI42	=G6*9.09+11.86*H6+0.9*I6	=FullMassIBN80	=(K6)/1000	0
7	=D7*B\$17/(1-C\$17)	=TimeI43	=TimeI43	=TimeI43	=G7*9.09+11.86*H7+0.9*I7	=FullMassIBN112	=(K7)/1000	0
8	=D8*B\$17/(1-C\$17)	=TimeI44	=TimeI44	=TimeI44	=G8*9.09+11.86*H8+0.9*I8	=FullMassIBN144	=(K8)/1000	0
9	=D9*B\$17/(1-C\$17)	=TimeI45	=TimeI45	=TimeI45	=G9*9.09+11.86*H9+0.9*I9	=FullMassIBN176	=(K9)/1000	=FullMassIBP187-FullMassIBR187*0.12*(K9)
10	=D10*B\$17/(1-C\$17)	=TimeI46	=TimeI46	=TimeI46	=G10*9.09+11.86*H10+0.9*I10	=FullMassIBN208	=(K10)/1000	=FullMassIBP219-FullMassIBR219*0.12*(K10)
11	=D11*B\$17/(1-C\$17)	=TimeI47	=TimeI47	=TimeI47	=G11*9.09+11.86*H11+0.9*I11	=FullMassIBN240	=(K11)/1000	=FullMassIBP251-FullMassIBR251*0.12*(K11)
12	=D12*B\$17/(1-C\$17)	=TimeI48	=TimeI48	=TimeI48	=G12*9.09+11.86*H12+0.9*I12	=FullMassIBN272	=(K12)/1000	=FullMassIBP283-FullMassIBR283*0.12*(K12)
13	=D13*B\$17/(1-C\$17)	=TimeI49	=TimeI49	=TimeI49	=G13*9.09+11.86*H13+0.9*I13	=FullMassIBN304	=(K13)/1000	=FullMassIBP315-FullMassIBR315*0.12*(K13)
14								
15	Equip. Cost	Equip. Cost	Equip. Cost	Equip. Cost	Equip. Cost			
16	=0.5*(H16+I16)	=Equip.I120	=Equip.I120	=Equip.I120	for 1 eng. For 1 year			
17								
18								
19								
20	Utilities	Amount/day	Cost	Total				
21	Electrical	=SUM(Equip.IH27:H52)	0.07	=I21*H21				
22	Steam		5	=I21*365				
23								
24								
25								
26								
27								
28								
29	Rate of Return	Rate of Return	Rate of Return	Rate of Return	Present Value			
30	Profit/Factor	Tax	Cash Flow	Discount Factor				
31			=C31-D31-B31		Year			Accounts Receivable
32	=C32-D32-E32	=F32*(0.36*0.04)	=C32-D32-G32	=1/(1+\$29)^A32	=H32*I32	1	=8*45/365*C32	
33	=C33-D33-E33	=F33*(0.36*0.04)	=C33-D33-G33	=1/(1+\$29)^A33	=H33*I33	2	=(1-45/8/365)*C32+8*45/365*C33	
34	=C34-D34-E34	=F34*(0.36*0.04)	=C34-D34-G34	=1/(1+\$29)^A34	=H34*I34	3	=(1-45/8/365)*C33+8*45/365*C34	
35	=C35-D35-E35	=F35*(0.36*0.04)	=C35-D35-G35	=1/(1+\$29)^A35	=H35*I35	4	=(1-45/8/365)*C34+8*45/365*C35	
36	=C36-D36-E36	=F36*(0.36*0.04)	=C36-D36-G36	=1/(1+\$29)^A36	=H36*I36	5	=(1-45/8/365)*C35+8*45/365*C36	
37	=C37-D37-E37	=F37*(0.36*0.04)	=C37-D37-G37	=1/(1+\$29)^A37	=H37*I37	6	=(1-45/8/365)*C36+8*45/365*C37	
38	=C38-D38-E38	=F38*(0.36*0.04)	=C38-D38-G38	=1/(1+\$29)^A38	=H38*I38	7	=(1-45/8/365)*C37+8*45/365*C38	
39	=C39-D39-E39	=F39*(0.36*0.04)	=C39-D39-G39	=1/(1+\$29)^A39	=H39*I39	8	=(1-45/8/365)*C38+8*45/365*C39	
40	=C40-D40-E40	=F40*(0.36*0.04)	=C40-D40-G40	=1/(1+\$29)^A40	=H40*I40	9	=(1-45/8/365)*C39+8*45/365*C40	
41	=C41-D41-E41	=F41*(0.36*0.04)	=C41-D41-G41	=1/(1+\$29)^A41	=H41*I41	10	=(1-45/8/365)*C40+8*45/365*C41	
42				ratio	=SUM(J32:J41)/(B31)			
43								
44								
45	Rate of Return	Rate of Return	Rate of Return	Rate of Return				
46	Profit/Factor	Tax	Cash Flow	Discount Factor	Present Value			
47			=C47-D47-B47		Year			Inventory
48	=C48-D48-E48	=F48*(0.36*0.04)	=C48-D48-G48	=1/(1+\$45)^A48	=H48*I48	1	=60/365*\$19*C48	
49	=C49-D49-E49	=F49*(0.36*0.04)	=C49-D49-G49	=1/(1+\$45)^A49	=H49*I49	2	=60/365*\$19*C49	
50	=C50-D50-E50	=F50*(0.36*0.04)	=C50-D50-G50	=1/(1+\$45)^A50	=H50*I50	3	=60/365*\$19*C50	
51	=C51-D51-E51	=F51*(0.36*0.04)	=C51-D51-G51	=1/(1+\$45)^A51	=H51*I51	4	=60/365*\$19*C51	
52	=C52-D52-E52	=F52*(0.36*0.04)	=C52-D52-G52	=1/(1+\$45)^A52	=H52*I52	5	=60/365*\$19*C52	
53	=C53-D53-E53	=F53*(0.36*0.04)	=C53-D53-G53	=1/(1+\$45)^A53	=H53*I53	6	=60/365*\$19*C53	
54	=C54-D54-E54	=F54*(0.36*0.04)	=C54-D54-G54	=1/(1+\$45)^A54	=H54*I54	7	=60/365*\$19*C54	
55	=C55-D55-E55	=F55*(0.36*0.04)	=C55-D55-G55	=1/(1+\$45)^A55	=H55*I55	8	=60/365*\$19*C55	
56	=C56-D56-E56	=F56*(0.36*0.04)	=C56-D56-G56	=1/(1+\$45)^A56	=H56*I56	9	=60/365*\$19*C56	
57	=C57-D57-E57	=F57*(0.36*0.04)	=C57-D57-G57	=1/(1+\$45)^A57	=H57*I57	10	=60/365*\$19*C57	
58				ratio	=SUM(J46:J57)/(B47)			

	N	O	P	Q	R	S
1		=2675.5*1000/1065.056/2.205	BTU/lb steam			
2		Steam	\$5/mil BTU			
3	TSS	Amount/day	Cost		Waste Flow	Hydraulic
4	0	=0.35*(FullMass/AZ12)	=O4*O8\$1*\$22/1000000		=FullDayBP16	=(R4)/1000
5	0	=(FullMass/AZ44)*0.35	=O5*O8\$1*\$22/1000000		=FullDayBP46	=(R5)/1000
6	0	=(FullMass/AZ76)*0.35	=O6*O8\$1*\$22/1000000		=FullDayBP76	=(R6)/1000
7	0	=(FullMass/AZ108)*0.35	=O7*O8\$1*\$22/1000000		=FullDayBP106	=(R7)/1000
8	0	=(FullMass/AZ140)*0.35	=O8*O8\$1*\$22/1000000		=FullDayBP136	=(R8)/1000
9	=(K9)*8.5*0.1*(FullMass BN166+FullMass BN167+FullMass BN169)/FullMass BN172	=(FullMass/AZ172)*0.35	=O9*O8\$1*\$22/1000000		=FullDayBP166	=(R9)/1000
10	=(K10)*8.5*0.1*(FullMass BN198+FullMass BN199+FullMass BN201)/FullMass BN204	=(FullMass/AZ204)*0.35	=O10*O8\$1*\$22/1000000		=FullDayBP196	=(R10)/1000
11	=(K11)*8.5*0.1*(FullMass BN230+FullMass BN231+FullMass BN233)/FullMass BN236	=(all years BT244+all years BO244)*0.35	=O11*O8\$1*\$22/1000000		=FullDayBP226	=(R11)/1000
12	=(K12)*8.5*0.1*(FullMass BN262+FullMass BN263+FullMass BN265)/FullMass BN268	=(all years BT277+all years BO277)*0.35	=O12*O8\$1*\$22/1000000		=FullDayBP266	=(R12)/1000
13	=(K13)*8.5*0.1*(FullMass BN294+FullMass BN295+FullMass BN297)/FullMass BN300	=(all years BT310+all years BO310)*0.35	=O13*O8\$1*\$22/1000000		=FullDayBP286	=(R13)/1000
14						* w/o evap permeate
15						Assum
16			Operation Lab.	\$21/hr	=21*24*365	
17	Of Sales		Dir. Super & Clerical	15% oper labor	=0.15*R16	
18	0.04		Main. & Repairs	6% capital invest	=0.06*(H16+E18)	
19	0.12		Oper. Supplies	15% m&r	=0.15*R18	
20	0.05		Lab. Charges	15% oper labor	=0.15*R16	
21	1250					
22						
23						
24						
25						
26						
27						
28						
29						
30						
31	Inventory					
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47	Accounts Receivable					
48	=45/365*C48					
49	=45/365*C49					
50	=45/365*C50					
51	=45/365*C51					
52	=45/365*C52					
53	=45/365*C53					
54	=45/365*C54					
55	=45/365*C55					
56	=45/365*C56					
57	=45/365*C57					
58						

Appendix D

	T	U	V	W
	Costs per day*		Steam	BTU/lb steam
			Amount/day	\$5/mil BTU
			Cost	
1			=2675.5*1000/1055.056/2.205	
2				
3				
4	=FullDay BP31-FullDay BR31)*0.12*(R4)		=0.35*FullDay AZ11-FullDay BD11)	=V4*V\$1*\$22/1000000
5	=FullDay BP61-FullDay BR61)*0.12*(R5)		=allyears \$BO46*0.35	=V5*V\$1*\$22/1000000
6	=FullDay BP91-FullDay BR91)*0.12*(R6)		=allyears \$BO79*0.35	=V6*V\$1*\$22/1000000
7	=FullDay BP121-FullDay BR121)*0.12*(R7)		=allyears \$BO112*0.35	=V7*V\$1*\$22/1000000
8	=FullDay BP151-FullDay BR151)*0.12*(R8)		=allyears \$BO145*0.35	=V8*V\$1*\$22/1000000
9	=FullDay BP181-FullDay BR181)*0.12*(R9)		=allyears \$BO178*0.35	=V9*V\$1*\$22/1000000
10	=FullDay BP211-FullDay BR211)*0.12*(R10)		=allyears \$BO211*0.35	=V10*V\$1*\$22/1000000
11	=FullDay BP241-FullDay BR241)*0.12*(R11)		=allyears \$BO244*0.35	=V11*V\$1*\$22/1000000
12	=FullDay BP271-FullDay BR271)*0.12*(R12)		=allyears \$BO277*0.35	=V12*V\$1*\$22/1000000
13	=FullDay BP301-FullDay BR301)*0.12*(R13)		=allyears \$BO310*0.35	=V13*V\$1*\$22/1000000
14				
15	ps that all the Lactose is oxidized			
16				
17				
18				
19				
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56				
57				
58				



Appendix D

1 Year	A		B		C		D		E		F		G		H		I		J		K	
	Equipment Cost	Engineering Expenses	Installation	Fixed Capital Investment	Working Capital	Total Capital Investment	Sales	Raw Materials	Cartridges & Parts	Operator Labor												
2	=CostsE16+CostsE18	=CostsE27	=CostsG16	=G3-F3	=G3*0.2	=C3+B3+D3																
3	0																					
4	1																					
5	2																					
6	3																					
7	4																					
8	5																					
9	6																					
10	7																					
11	8																					
12	9																					
13	10																					
14																						
15																						
16																						
17																						
18	Year																					
19		Initial Investments																				
20	0	=B3	=C3	=D3	=E3	=F3	=G3+B3+D3															
21	1																					
22	2																					
23	3																					
24	4																					
25	5																					
26	6																					
27	7																					
28	8																					
29	9																					
30	10																					
31																						

Appendix D

	W	X	Y	Z	AA	AB	AC	AD	AE
		Total Product Cost	Annual Operating Income	Annual Depreciation	Income before Tax	Tax	Annual Cash Flow	Rate of Return	Present Value
1									0.291751974045724
2	Total							Discount Factor	Present Value
3		=W4+S4	=H4-X4	=CostsE32	=Y4-Z4	=G3	=Y4-AB4	=1/(1+AE\$1)^A4	=AC4*AD4
4	=SUM(T4:V4)	=W5+S5	=H5-X5	=CostsE33	=Y5-Z5		=Y5-AB5	=1/(1+AE\$1)^A5	=AC5*AD5
5	=SUM(T5:V5)	=W6+S6	=H6-X6	=CostsE34	=Y6-Z6		=Y6-AB6	=1/(1+AE\$1)^A6	=AC6*AD6
6	=SUM(T6:V6)	=W7+S7	=H7-X7	=CostsE35	=Y7-Z7		=Y7-AB7	=1/(1+AE\$1)^A7	=AC7*AD7
7	=SUM(T7:V7)	=W8+S8	=H8-X8	=CostsE36	=Y8-Z8		=Y8-AB8	=1/(1+AE\$1)^A8	=AC8*AD8
8	=SUM(T8:V8)	=W9+S9	=H9-X9	=CostsE37	=Y9-Z9		=Y9-AB9	=1/(1+AE\$1)^A9	=AC9*AD9
9	=SUM(T9:V9)	=W10+S10	=H10-X10	=CostsE38	=Y10-Z10		=Y10-AB10	=1/(1+AE\$1)^A10	=AC10*AD10
10	=SUM(T10:V10)	=W11+S11	=H11-X11	=CostsE39	=Y11-Z11		=Y11-AB11	=1/(1+AE\$1)^A11	=AC11*AD11
11	=SUM(T11:V11)	=W12+S12	=H12-X12	=CostsE40	=Y12-Z12		=Y12-AB12	=1/(1+AE\$1)^A12	=AC12*AD12
12	=SUM(T12:V12)	=W13+S13	=H13-X13	=CostsE41	=Y13-Z13		=Y13-AB13	=1/(1+AE\$1)^A13	=AC13*AD13
13	=SUM(T13:V13)							ratio	
14									=SUM(AE4:AE13)/(G3)
15									
16									
17									
18								Rate of Return	0.0888325946442237
19	Total							Discount Factor	Present Value
20									
21	=SUM(T21:V21)	=W21+S21	=H21-X21	=CostsE49	=Y21-Z21		=Y21-AB21	=1/(1+AE\$18)^A21	=AC21*AD21
22	=SUM(T22:V22)	=W22+S22	=H22-X22	=CostsE50	=Y22-Z22		=Y22-AB22	=1/(1+AE\$18)^A22	=AC22*AD22
23	=SUM(T23:V23)	=W23+S23	=H23-X23	=CostsE51	=Y23-Z23		=Y23-AB23	=1/(1+AE\$18)^A23	=AC23*AD23
24	=SUM(T24:V24)	=W24+S24	=H24-X24	=CostsE52	=Y24-Z24		=Y24-AB24	=1/(1+AE\$18)^A24	=AC24*AD24
25	=SUM(T25:V25)	=W25+S25	=H25-X25	=CostsE53	=Y25-Z25		=Y25-AB25	=1/(1+AE\$18)^A25	=AC25*AD25
26	=SUM(T26:V26)	=W26+S26	=H26-X26	=CostsE54	=Y26-Z26		=Y26-AB26	=1/(1+AE\$18)^A26	=AC26*AD26
27	=SUM(T27:V27)	=W27+S27	=H27-X27	=CostsE55	=Y27-Z27		=Y27-AB27	=1/(1+AE\$18)^A27	=AC27*AD27
28	=SUM(T28:V28)	=W28+S28	=H28-X28	=CostsE56	=Y28-Z28		=Y28-AB28	=1/(1+AE\$18)^A28	=AC28*AD28
29	=SUM(T29:V29)	=W29+S29	=H29-X29	=CostsE57	=Y29-Z29		=Y29-AB29	=1/(1+AE\$18)^A29	=AC29*AD29
30	=SUM(T30:V30)	=W30+S30	=H30-X30	=CostsE58	=Y30-Z30		=Y30-AB30	=1/(1+AE\$18)^A30	=AC30*AD30
31								ratio	=SUM(AE21:AE30)/(G20)

1	AF
2	Payback Period
3	
4	=AC4
5	=AC5+AF4
6	=AC6+AF5
7	=AC7+AF6
8	=AC8+AF7
9	=AC9+AF8
10	=AC10+AF9
11	
12	
13	Years
14	=IF(AF4>G3,A4,IF(AF5>G3,A5,IF(AF6>G3,A6,IF(AF7>G3,A7,IF(AF8>G3,A8))))
15	
16	
17	
18	
19	Payback Period
20	
21	=AC21
22	=AC22+AF21
23	=AC23+AF22
24	=AC24+AF23
25	=AC25+AF24
26	=AC26+AF25
27	=AC27+AF26
28	
29	
30	Years
31	=IF(AF21>G20,A21,IF(AF22>G20,A22,IF(AF23>G20,A23,IF(AF24>G20,A24,IF(AF25>G20,A25))))

Appendix D

	A	B	C	D	E	F
1						
2	10 Stages	1	2	3	4	5
3	No. of Cart./Stage	17	17	18	18	19
4	Area	=B3*26.5	=C3*26.5	=D3*26.5	=E3*26.5	=F3*26.5
5	F actual	=Given!\$J3	=Given!\$J4	=Given!\$J5	=Given!\$J6	=Given!\$J7
6	F calc	=B9+B14	=C9+C14	=D9+D14	=E9+E14	=F9+F14
7	CF <sub>1</sub>	=B5/B14	=C5/C14	=D5/D14	=E5/E14	=F5/F14
8	J <sub>1</sub>	=27.9-5.3*LN(B7)	=27.9-5.3*LN(C7)	=27.9-5.3*LN(D7)	=27.9-5.3*LN(E7)	=27.9-5.3*LN(F7)
9	P <sub>1</sub>	=B\$4*B8	=C\$4*C8	=D\$4*D8	=E\$4*E8	=F\$4*F8
10						
11	CF <sub>2</sub>	=K\$5/B19	=K\$5/C19	=K\$5/D19	=K\$5/E19	=K\$5/F19
12	J <sub>2</sub>	=27.9-5.3*LN(B11)	=27.9-5.3*LN(C11)	=27.9-5.3*LN(D11)	=27.9-5.3*LN(E11)	=27.9-5.3*LN(F11)
13	P <sub>2</sub>	=B\$4*B12	=C\$4*C12	=D\$4*D12	=E\$4*E12	=F\$4*F12
14	B <sub>1</sub>	=B13+B19	=C13+C19	=D13+D19	=E13+E19	=F13+F19
15						
16	CF <sub>3</sub>	=K\$5/B24	=K\$5/C24	=K\$5/D24	=K\$5/E24	=K\$5/F24
17	J <sub>3</sub>	=27.9-5.3*LN(B16)	=27.9-5.3*LN(C16)	=27.9-5.3*LN(D16)	=27.9-5.3*LN(E16)	=27.9-5.3*LN(F16)
18	P <sub>3</sub>	=B\$4*B17	=C\$4*C17	=D\$4*D17	=E\$4*E17	=F\$4*F17
19	B <sub>2</sub>	=B18+B24	=C18+C24	=D18+D24	=E18+E24	=F18+F24
20						
21	CF <sub>4</sub>	=K\$5/B29	=K\$5/C29	=K\$5/D29	=K\$5/E29	=K\$5/F29
22	J <sub>4</sub>	=27.9-5.3*LN(B21)	=27.9-5.3*LN(C21)	=27.9-5.3*LN(D21)	=27.9-5.3*LN(E21)	=27.9-5.3*LN(F21)
23	P <sub>4</sub>	=B\$4*B22	=C\$4*C22	=D\$4*D22	=E\$4*E22	=F\$4*F22
24	B <sub>3</sub>	=B23+B29	=C23+C29	=D23+D29	=E23+E29	=F23+F29
25						
26	CF <sub>5</sub>	=K\$5/B34	=K\$5/C34	=K\$5/D34	=K\$5/E34	=K\$5/F34
27	J <sub>5</sub>	=27.9-5.3*LN(B26)	=27.9-5.3*LN(C26)	=27.9-5.3*LN(D26)	=27.9-5.3*LN(E26)	=27.9-5.3*LN(F26)
28	P <sub>5</sub>	=B\$4*B27	=C\$4*C27	=D\$4*D27	=E\$4*E27	=F\$4*F27
29	B <sub>4</sub>	=B28+B34	=C28+C34	=D28+D34	=E28+E34	=F28+F34
30						
31	CF <sub>6</sub>	=K\$5/B39	=K\$5/C39	=K\$5/D39	=K\$5/E39	=K\$5/F39
32	J <sub>6</sub>	=27.9-5.3*LN(B31)	=27.9-5.3*LN(C31)	=27.9-5.3*LN(D31)	=27.9-5.3*LN(E31)	=27.9-5.3*LN(F31)
33	P <sub>6</sub>	=B\$4*B32	=C\$4*C32	=D\$4*D32	=E\$4*E32	=F\$4*F32
34	B <sub>5</sub>	=B33+B39	=C33+C39	=D33+D39	=E33+E39	=F33+F39
35						
36	CF <sub>7</sub>	=K\$5/B44	=K\$5/C44	=K\$5/D44	=K\$5/E44	=K\$5/F44
37	J <sub>7</sub>	=27.9-5.3*LN(B36)	=27.9-5.3*LN(C36)	=27.9-5.3*LN(D36)	=27.9-5.3*LN(E36)	=27.9-5.3*LN(F36)
38	P <sub>7</sub>	=B\$4*B37	=C\$4*C37	=D\$4*D37	=E\$4*E37	=F\$4*F37
39	B <sub>6</sub>	=B38+B44	=C38+C44	=D38+D44	=E38+E44	=F38+F44
40						
41	CF <sub>8</sub>	=K\$5/B49	=K\$5/C49	=K\$5/D49	=K\$5/E49	=K\$5/F49
42	J <sub>8</sub>	=27.9-5.3*LN(B41)	=27.9-5.3*LN(C41)	=27.9-5.3*LN(D41)	=27.9-5.3*LN(E41)	=27.9-5.3*LN(F41)
43	P <sub>8</sub>	=B\$4*B42	=C\$4*C42	=D\$4*D42	=E\$4*E42	=F\$4*F42
44	B <sub>7</sub>	=B43+B49	=C43+C49	=D43+D49	=E43+E49	=F43+F49
45						
46	CF <sub>9</sub>	=K\$5/B56	=K\$5/C56	=K\$5/D56	=K\$5/E56	=K\$5/F56
47	J <sub>9</sub>	=27.9-5.3*LN(B46)	=27.9-5.3*LN(C46)	=27.9-5.3*LN(D46)	=27.9-5.3*LN(E46)	=27.9-5.3*LN(F46)
48	P <sub>9</sub>	=B\$4*B47	=C\$4*C47	=D\$4*D47	=E\$4*E47	=F\$4*F47
49	B <sub>8</sub>	=B48+B56	=C48+C56	=D48+D56	=E48+E56	=F48+F56
50		=B6-B5	=C6-C5	=D6-D5	=E6-E5	=F6-F5
51	n=	1	2	3	4	5
52	CF <sub>n</sub>	=B5/B54	=C5/C54	=D5/D54	=E5/E54	=F5/F54
53	J <sub>n</sub>	=27.9-5.3*LN(B52)	=27.9-5.3*LN(C52)	=27.9-5.3*LN(D52)	=27.9-5.3*LN(E52)	=27.9-5.3*LN(F52)
54	B <sub>n</sub>	20895.2657204414	21246.0572602531	22411.8157340852	23494.9714370971	24412.014374819
55	P <sub>n</sub>	=B57*26.5*B53	=C57*26.5*C53	=D57*26.5*D53	=E57*26.5*E53	=F57*26.5*F53
56	B <sub>n-1</sub>	=B55+B54	=C55+C54	=D55+D54	=E55+E54	=F55+F54
57		11	17	13	18	15
58		=9*B3+B57	=9*C3+C57	=9*D3+D57	=9*E3+E57	=9*F3+F57
59		1	2	3	4	5
60	Area/Stage	=B4	=C4	=D4	=E4	=F4
61	No. of Cart./Stage	=B60/26.5	=C60/26.5	=D60/26.5	=E60/26.5	=F60/26.5
62	Total Rec.	=B61*23	=C61*23	=D61*23	=E61*23	=F61*23
63	Max Flow	=B62+B5/(20*60)	=C62+C5/(20*60)	=D62+D5/(20*60)	=E62+E5/(20*60)	=F62+F5/(20*60)
64						
65	Final Stream					
66	C <sub>B,NPH</sub>	=X6	=X15	=X24	=X33	=X42
67	C <sub>B,TP</sub>	=X7	=X16	=X25	=X34	=X43
68	C <sub>B,Lactose</sub>	=X8	=X17	=X26	=X35	=X44
69	C <sub>B,Ash</sub>	=X9	=X18	=X27	=X36	=X45
70	C <sub>B,Butter Fat</sub>	=X10	=X19	=X28	=X37	=X46
71	% Protein	=(B66+B67)/SUM(B66:B70)	=(C66+C67)/SUM(C66:C70)	=(D66+D67)/SUM(D66:D70)	=(E66+E67)/SUM(E66:E70)	=(F66+F67)/SUM(F66:F70)
72	% of Solids	=SUM(B66:B70)/1	=SUM(C66:C70)/1	=SUM(D66:D70)/1	=SUM(E66:E70)/1	=SUM(F66:F70)/1
73	Yield	=Z6	=Z15	=Z24	=Z33	=Z42

Appendix D

	G	H	I	J	K	L
1	Year					
2	6	7	8	9	10	Unit
3	20	20	21	22	22	22(1-9),20(10)
4	=G3*26.5	=H3*26.5	=I3*26.5	=J3*26.5	=K3*26.5	ft <sup>2</sup>
5	=Given!\$J8	=Given!\$J9	=Given!\$J10	=Given!\$J11	=Given!\$J12	gal/day
6	=G9+G14	=H9+H14	=I9+I14	=J9+J14	=K9+K14	gal/day
7	=G5/G14	=H5/H14	=I5/I14	=J5/J14	=K5/K14	
8	=27.9-5.3*LN(G7)	=27.9-5.3*LN(H7)	=27.9-5.3*LN(I7)	=27.9-5.3*LN(J7)	=27.9-5.3*LN(K7)	gsfd
9	=G\$4*G8	=H\$4*H8	=I\$4*I8	=J\$10*J8	=K\$10*K8	gal/day
10				=26.5*L10	=L10*26.5	21
11	=\$K\$5/G19	=\$K\$5/H19	=\$K\$5/I19	=\$K\$5/J19	=\$K\$5/K19	
12	=27.9-5.3*LN(G11)	=27.9-5.3*LN(H11)	=27.9-5.3*LN(I11)	=27.9-5.3*LN(J11)	=27.9-5.3*LN(K11)	gsfd
13	=G\$4*G12	=H\$4*H12	=I\$4*I12	=J\$4*J12	=K\$4*K12	gal/day
14	=G13+G19	=H13+H19	=I13+I19	=J13+J19	=K13+K19	gal/day
15						
16	=\$K\$5/G24	=\$K\$5/H24	=\$K\$5/I24	=\$K\$5/J24	=\$K\$5/K24	
17	=27.9-5.3*LN(G16)	=27.9-5.3*LN(H16)	=27.9-5.3*LN(I16)	=27.9-5.3*LN(J16)	=27.9-5.3*LN(K16)	gsfd
18	=G\$4*G17	=H\$4*H17	=I\$4*I17	=J\$4*J17	=K\$4*K17	gal/day
19	=G18+G24	=H18+H24	=I18+I24	=J18+J24	=K18+K24	gal/day
20						
21	=\$K\$5/G29	=\$K\$5/H29	=\$K\$5/I29	=\$K\$5/J29	=\$K\$5/K29	
22	=27.9-5.3*LN(G21)	=27.9-5.3*LN(H21)	=27.9-5.3*LN(I21)	=27.9-5.3*LN(J21)	=27.9-5.3*LN(K21)	gsfd
23	=G\$4*G22	=H\$4*H22	=I\$4*I22	=J\$4*J22	=K\$4*K22	gal/day
24	=G23+G29	=H23+H29	=I23+I29	=J23+J29	=K23+K29	gal/day
25						
26	=\$K\$5/G34	=\$K\$5/H34	=\$K\$5/I34	=\$K\$5/J34	=\$K\$5/K34	
27	=27.9-5.3*LN(G26)	=27.9-5.3*LN(H26)	=27.9-5.3*LN(I26)	=27.9-5.3*LN(J26)	=27.9-5.3*LN(K26)	gsfd
28	=G\$4*G27	=H\$4*H27	=I\$4*I27	=J\$4*J27	=K\$4*K27	gal/day
29	=G28+G34	=H28+H34	=I28+I34	=J28+J34	=K28+K34	gal/day
30						
31	=\$K\$5/G39	=\$K\$5/H39	=\$K\$5/I39	=\$K\$5/J39	=\$K\$5/K39	
32	=27.9-5.3*LN(G31)	=27.9-5.3*LN(H31)	=27.9-5.3*LN(I31)	=27.9-5.3*LN(J31)	=27.9-5.3*LN(K31)	gsfd
33	=G\$4*G32	=H\$4*H32	=I\$4*I32	=J\$4*J32	=K\$4*K32	gal/day
34	=G33+G39	=H33+H39	=I33+I39	=J33+J39	=K33+K39	gal/day
35						
36	=\$K\$5/G44	=\$K\$5/H44	=\$K\$5/I44	=\$K\$5/J44	=\$K\$5/K44	
37	=27.9-5.3*LN(G36)	=27.9-5.3*LN(H36)	=27.9-5.3*LN(I36)	=27.9-5.3*LN(J36)	=27.9-5.3*LN(K36)	gsfd
38	=G\$4*G37	=H\$4*H37	=I\$4*I37	=J\$4*J37	=K\$4*K37	gal/day
39	=G38+G44	=H38+H44	=I38+I44	=J38+J44	=K38+K44	gal/day
40						
41	=\$K\$5/G49	=\$K\$5/H49	=\$K\$5/I49	=\$K\$5/J49	=\$K\$5/K49	
42	=27.9-5.3*LN(G41)	=27.9-5.3*LN(H41)	=27.9-5.3*LN(I41)	=27.9-5.3*LN(J41)	=27.9-5.3*LN(K41)	gsfd
43	=G\$4*G42	=H\$4*H42	=I\$4*I42	=J\$4*J42	=K\$4*K42	gal/day
44	=G43+G49	=H43+H49	=I43+I49	=J43+J49	=K43+K49	gal/day
45						
46	=\$K\$5/G56	=\$K\$5/H56	=\$K\$5/I56	=\$K\$5/J56	=\$K\$5/K56	
47	=27.9-5.3*LN(G46)	=27.9-5.3*LN(H46)	=27.9-5.3*LN(I46)	=27.9-5.3*LN(J46)	=27.9-5.3*LN(K46)	gsfd
48	=G\$4*G47	=H\$4*H47	=I\$4*I47	=J\$4*J47	=K\$4*K47	gal/day
49	=G48+G56	=H48+H56	=I48+I56	=J48+J56	=K48+K56	gal/day
50	=G6-G5	=H6-H5	=I6-I5	=J6-J5	=K6-K5	
51	6	7	8	9	10	
52	=G5/G54	=H5/H54	=I5/I54	=J5/J54	=K5/K54	CF total
53	=27.9-5.3*LN(G52)	=27.9-5.3*LN(H52)	=27.9-5.3*LN(I52)	=27.9-5.3*LN(J52)	=27.9-5.3*LN(K52)	gsfd
54	25453.6347478704	26495.0280386976	27308.661218875	28717.9964487291	29819.0744013042	gal/day
55	=G57*26.5*G53	=H57*26.5*H53	=I57*26.5*I53	=J57*26.5*J53	=K57*26.5*K53	gal/day
56	=G55+G54	=H55+H54	=I55+I54	=J55+J54	=K55+K54	gal/day
57	12	18	16	14	21	Cartridges
58	=9*G3+G57	=9*H3+H57	=9*I3+I57	=9*J3+J57	=9*K3+K57	
59	6	7	8	9	10	
60	=G4	=H4	=I4	=J4	=K4	ft <sup>2</sup>
61	=G60/26.5	=H60/26.5	=I60/26.5	=J60/26.5	=K60/26.5	26.5 ft <sup>2</sup> /cartridge
62	=G61*23	=H61*23	=I61*23	=J61*23	=K61*23	gal/min
63	=G62+G5/(20*60)	=H62+H5/(20*60)	=I62+I5/(20*60)	=J62+J5/(20*60)	=K62+K14/(20*60)	gal/min
64					=K63*4*12*12/(7.48*4.026*2*Pi)*(60)	
65						
66	=\$AO6	=\$AO15	=\$AO24	=\$AO33	=\$AO42	
67	=\$AO7	=\$AO16	=\$AO25	=\$AO34	=\$AO43	
68	=\$AO8	=\$AO17	=\$AO26	=\$AO35	=\$AO44	
69	=\$AO9	=\$AO18	=\$AO27	=\$AO36	=\$AO45	
70	=\$AO10	=\$AO19	=\$AO28	=\$AO37	=\$AO46	
71	=(G66+G67)/SUM(G66:G70)	=(H66+H67)/SUM(H66:H70)	=(I66+I67)/SUM(I66:I70)	=(J66+J67)/SUM(J66:J70)	=(K66+K67)/SUM(K66:K70)	
72	=SUM(G66:G70)/1	=SUM(H66:H70)/1	=SUM(I66:I70)/1	=SUM(J66:J70)/1	=SUM(K66:K70)/1	
73	=\$AQ6	=\$AQ15	=\$AQ24	=\$AQ33	=\$AQ42	

Appendix D

	N	O	P	Q
1				
2				
3	Year 1	1	2	3
4	$f_n$	=B5/B14	=B14/B19	=B19/B24
5	$C_{B,Protein}$	=O6+O7	=P6+P7	=Q6+Q7
6	$C_{B,NPN}$	=Given!\$C5*(O\$4/(O\$4*(1-Given!\$F5)+Given!\$F5))	=O6*(P\$4/(P\$4*(1-Given!\$F5)+Given!\$F5))	=P6*(Q\$4/(Q\$4*(1-Given!\$F5)+Given!\$F5))
7	$C_{B,TP}$	=Given!\$C6*(O\$4/(O\$4*(1-Given!\$F6)+Given!\$F6))	=O7*(P\$4/(P\$4*(1-Given!\$F6)+Given!\$F6))	=P7*(Q\$4/(Q\$4*(1-Given!\$F6)+Given!\$F6))
8	$C_{B,Lactose}$	=Given!\$C7*(O\$4/(O\$4*(1-Given!\$F7)+Given!\$F7))	=O8*(P\$4/(P\$4*(1-Given!\$F7)+Given!\$F7))	=P8*(Q\$4/(Q\$4*(1-Given!\$F7)+Given!\$F7))
9	$C_{B,Ash}$	=Given!\$C8*(O\$4/(O\$4*(1-Given!\$F8)+Given!\$F8))	=O9*(P\$4/(P\$4*(1-Given!\$F8)+Given!\$F8))	=P9*(Q\$4/(Q\$4*(1-Given!\$F8)+Given!\$F8))
10	$C_{B,Butter Fat}$	=Given!\$C9*(O\$4/(O\$4*(1-Given!\$F9)+Given!\$F9))	=O10*(P\$4/(P\$4*(1-Given!\$F9)+Given!\$F9))	=P10*(Q\$4/(Q\$4*(1-Given!\$F9)+Given!\$F9))
11				
12	Year 2	1	2	3
13	$f_n$	=C5/C14	=C14/C19	=C19/C24
14	$C_{B,Protein}$	=O15+O16	=P15+P16	=Q15+Q16
15	$C_{B,NPN}$	=Given!\$C5*(O\$13/(O\$13*(1-Given!\$F5)+Given!\$F5))	=O15*(P\$13/(P\$13*(1-Given!\$F5)+Given!\$F5))	=P15*(Q\$13/(Q\$13*(1-Given!\$F5)+Given!\$F5))
16	$C_{B,TP}$	=Given!\$C6*(O\$13/(O\$13*(1-Given!\$F6)+Given!\$F6))	=O16*(P\$13/(P\$13*(1-Given!\$F6)+Given!\$F6))	=P16*(Q\$13/(Q\$13*(1-Given!\$F6)+Given!\$F6))
17	$C_{B,Lactose}$	=Given!\$C7*(O\$13/(O\$13*(1-Given!\$F7)+Given!\$F7))	=O17*(P\$13/(P\$13*(1-Given!\$F7)+Given!\$F7))	=P17*(Q\$13/(Q\$13*(1-Given!\$F7)+Given!\$F7))
18	$C_{B,Ash}$	=Given!\$C8*(O\$13/(O\$13*(1-Given!\$F8)+Given!\$F8))	=O18*(P\$13/(P\$13*(1-Given!\$F8)+Given!\$F8))	=P18*(Q\$13/(Q\$13*(1-Given!\$F8)+Given!\$F8))
19	$C_{B,Butter Fat}$	=Given!\$C9*(O\$13/(O\$13*(1-Given!\$F9)+Given!\$F9))	=O19*(P\$13/(P\$13*(1-Given!\$F9)+Given!\$F9))	=P19*(Q\$13/(Q\$13*(1-Given!\$F9)+Given!\$F9))
20				
21	Year 3	1	2	3
22	$f_n$	=D5/D14	=D14/D19	=D19/D24
23	$C_{B,Protein}$	=O24+O25	=P24+P25	=Q24+Q25
24	$C_{B,NPN}$	=Given!\$C5*(O\$22/(O\$22*(1-Given!\$F5)+Given!\$F5))	=O24*(P\$22/(P\$22*(1-Given!\$F5)+Given!\$F5))	=P24*(Q\$22/(Q\$22*(1-Given!\$F5)+Given!\$F5))
25	$C_{B,TP}$	=Given!\$C6*(O\$22/(O\$22*(1-Given!\$F6)+Given!\$F6))	=O25*(P\$22/(P\$22*(1-Given!\$F6)+Given!\$F6))	=P25*(Q\$22/(Q\$22*(1-Given!\$F6)+Given!\$F6))
26	$C_{B,Lactose}$	=Given!\$C7*(O\$22/(O\$22*(1-Given!\$F7)+Given!\$F7))	=O26*(P\$22/(P\$22*(1-Given!\$F7)+Given!\$F7))	=P26*(Q\$22/(Q\$22*(1-Given!\$F7)+Given!\$F7))
27	$C_{B,Ash}$	=Given!\$C8*(O\$22/(O\$22*(1-Given!\$F8)+Given!\$F8))	=O27*(P\$22/(P\$22*(1-Given!\$F8)+Given!\$F8))	=P27*(Q\$22/(Q\$22*(1-Given!\$F8)+Given!\$F8))
28	$C_{B,Butter Fat}$	=Given!\$C9*(O\$22/(O\$22*(1-Given!\$F9)+Given!\$F9))	=O28*(P\$22/(P\$22*(1-Given!\$F9)+Given!\$F9))	=P28*(Q\$22/(Q\$22*(1-Given!\$F9)+Given!\$F9))
29				
30	Year 4	1	2	3
31	$f_n$	=E5/E14	=E14/E19	=E19/E24
32	$C_{B,Protein}$	=O33+O34	=P33+P34	=Q33+Q34
33	$C_{B,NPN}$	=Given!\$C5*(O\$31/(O\$31*(1-Given!\$F5)+Given!\$F5))	=O33*(P\$31/(P\$31*(1-Given!\$F5)+Given!\$F5))	=P33*(Q\$31/(Q\$31*(1-Given!\$F5)+Given!\$F5))
34	$C_{B,TP}$	=Given!\$C6*(O\$31/(O\$31*(1-Given!\$F6)+Given!\$F6))	=O34*(P\$31/(P\$31*(1-Given!\$F6)+Given!\$F6))	=P34*(Q\$31/(Q\$31*(1-Given!\$F6)+Given!\$F6))
35	$C_{B,Lactose}$	=Given!\$C7*(O\$31/(O\$31*(1-Given!\$F7)+Given!\$F7))	=O35*(P\$31/(P\$31*(1-Given!\$F7)+Given!\$F7))	=P35*(Q\$31/(Q\$31*(1-Given!\$F7)+Given!\$F7))
36	$C_{B,Ash}$	=Given!\$C8*(O\$31/(O\$31*(1-Given!\$F8)+Given!\$F8))	=O36*(P\$31/(P\$31*(1-Given!\$F8)+Given!\$F8))	=P36*(Q\$31/(Q\$31*(1-Given!\$F8)+Given!\$F8))
37	$C_{B,Butter Fat}$	=Given!\$C9*(O\$31/(O\$31*(1-Given!\$F9)+Given!\$F9))	=O37*(P\$31/(P\$31*(1-Given!\$F9)+Given!\$F9))	=P37*(Q\$31/(Q\$31*(1-Given!\$F9)+Given!\$F9))
38				
39	Year 5	1	2	3
40	$f_n$	=F5/F14	=F14/F19	=F19/F24
41	$C_{B,Protein}$	=O42+O43	=P42+P43	=Q42+Q43
42	$C_{B,NPN}$	=Given!\$C5*(O\$40/(O\$40*(1-Given!\$F5)+Given!\$F5))	=O42*(P\$40/(P\$40*(1-Given!\$F5)+Given!\$F5))	=P42*(Q\$40/(Q\$40*(1-Given!\$F5)+Given!\$F5))
43	$C_{B,TP}$	=Given!\$C6*(O\$40/(O\$40*(1-Given!\$F6)+Given!\$F6))	=O43*(P\$40/(P\$40*(1-Given!\$F6)+Given!\$F6))	=P43*(Q\$40/(Q\$40*(1-Given!\$F6)+Given!\$F6))
44	$C_{B,Lactose}$	=Given!\$C7*(O\$40/(O\$40*(1-Given!\$F7)+Given!\$F7))	=O44*(P\$40/(P\$40*(1-Given!\$F7)+Given!\$F7))	=P44*(Q\$40/(Q\$40*(1-Given!\$F7)+Given!\$F7))
45	$C_{B,Ash}$	=Given!\$C8*(O\$40/(O\$40*(1-Given!\$F8)+Given!\$F8))	=O45*(P\$40/(P\$40*(1-Given!\$F8)+Given!\$F8))	=P45*(Q\$40/(Q\$40*(1-Given!\$F8)+Given!\$F8))
46	$C_{B,Butter Fat}$	=Given!\$C9*(O\$40/(O\$40*(1-Given!\$F9)+Given!\$F9))	=O46*(P\$40/(P\$40*(1-Given!\$F9)+Given!\$F9))	=P46*(Q\$40/(Q\$40*(1-Given!\$F9)+Given!\$F9))
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Appendix D

	U	V	W
1			
2			
3	7	8	9
4	=\$B\$39/\$B\$44	=\$B\$44/\$B\$49	=\$B\$49/\$B\$56
5	=U6+U7	=V6+V7	=W6+W7
6	=T6*(U\$4/(U\$4*(1-Given!\$F5)+Given!\$F5))	=U6*(V\$4/(V\$4*(1-Given!\$F5)+Given!\$F5))	=V6*(W\$4/(W\$4*(1-Given!\$F5)+Given!\$F5))
7	=T7*(U\$4/(U\$4*(1-Given!\$F6)+Given!\$F6))	=U7*(V\$4/(V\$4*(1-Given!\$F6)+Given!\$F6))	=V7*(W\$4/(W\$4*(1-Given!\$F6)+Given!\$F6))
8	=T8*(U\$4/(U\$4*(1-Given!\$F7)+Given!\$F7))	=U8*(V\$4/(V\$4*(1-Given!\$F7)+Given!\$F7))	=V8*(W\$4/(W\$4*(1-Given!\$F7)+Given!\$F7))
9	=T9*(U\$4/(U\$4*(1-Given!\$F8)+Given!\$F8))	=U9*(V\$4/(V\$4*(1-Given!\$F8)+Given!\$F8))	=V9*(W\$4/(W\$4*(1-Given!\$F8)+Given!\$F8))
10	=T10*(U\$4/(U\$4*(1-Given!\$F9)+Given!\$F9))	=U10*(V\$4/(V\$4*(1-Given!\$F9)+Given!\$F9))	=V10*(W\$4/(W\$4*(1-Given!\$F9)+Given!\$F9))
11			
12	7	8	9
13	=\$C\$39/\$C\$44	=\$C\$44/\$C\$49	=\$C\$49/\$C\$56
14	=U15+U16	=V15+V16	=W15+W16
15	=T15*(U\$13/(U\$13*(1-Given!\$F5)+Given!\$F5))	=U15*(V\$13/(V\$13*(1-Given!\$F5)+Given!\$F5))	=V15*(W\$13/(W\$13*(1-Given!\$F5)+Given!\$F5))
16	=T16*(U\$13/(U\$13*(1-Given!\$F6)+Given!\$F6))	=U16*(V\$13/(V\$13*(1-Given!\$F6)+Given!\$F6))	=V16*(W\$13/(W\$13*(1-Given!\$F6)+Given!\$F6))
17	=T17*(U\$13/(U\$13*(1-Given!\$F7)+Given!\$F7))	=U17*(V\$13/(V\$13*(1-Given!\$F7)+Given!\$F7))	=V17*(W\$13/(W\$13*(1-Given!\$F7)+Given!\$F7))
18	=T18*(U\$13/(U\$13*(1-Given!\$F8)+Given!\$F8))	=U18*(V\$13/(V\$13*(1-Given!\$F8)+Given!\$F8))	=V18*(W\$13/(W\$13*(1-Given!\$F8)+Given!\$F8))
19	=T19*(U\$13/(U\$13*(1-Given!\$F9)+Given!\$F9))	=U19*(V\$13/(V\$13*(1-Given!\$F9)+Given!\$F9))	=V19*(W\$13/(W\$13*(1-Given!\$F9)+Given!\$F9))
20			
21	7	8	9
22	=\$D\$39/\$D\$44	=\$D\$44/\$D\$49	=\$D\$49/\$D\$56
23	=U24+U25	=V24+V25	=W24+W25
24	=T24*(U\$22/(U\$22*(1-Given!\$F5)+Given!\$F5))	=U24*(V\$22/(V\$22*(1-Given!\$F5)+Given!\$F5))	=V24*(W\$22/(W\$22*(1-Given!\$F5)+Given!\$F5))
25	=T25*(U\$22/(U\$22*(1-Given!\$F6)+Given!\$F6))	=U25*(V\$22/(V\$22*(1-Given!\$F6)+Given!\$F6))	=V25*(W\$22/(W\$22*(1-Given!\$F6)+Given!\$F6))
26	=T26*(U\$22/(U\$22*(1-Given!\$F7)+Given!\$F7))	=U26*(V\$22/(V\$22*(1-Given!\$F7)+Given!\$F7))	=V26*(W\$22/(W\$22*(1-Given!\$F7)+Given!\$F7))
27	=T27*(U\$22/(U\$22*(1-Given!\$F8)+Given!\$F8))	=U27*(V\$22/(V\$22*(1-Given!\$F8)+Given!\$F8))	=V27*(W\$22/(W\$22*(1-Given!\$F8)+Given!\$F8))
28	=T28*(U\$22/(U\$22*(1-Given!\$F9)+Given!\$F9))	=U28*(V\$22/(V\$22*(1-Given!\$F9)+Given!\$F9))	=V28*(W\$22/(W\$22*(1-Given!\$F9)+Given!\$F9))
29			
30	7	8	9
31	=\$E\$39/\$E\$44	=\$E\$44/\$E\$49	=\$E\$49/\$E\$56
32	=U33+U34	=V33+V34	=W33+W34
33	=T33*(U\$31/(U\$31*(1-Given!\$F5)+Given!\$F5))	=U33*(V\$31/(V\$31*(1-Given!\$F5)+Given!\$F5))	=V33*(W\$31/(W\$31*(1-Given!\$F5)+Given!\$F5))
34	=T34*(U\$31/(U\$31*(1-Given!\$F6)+Given!\$F6))	=U34*(V\$31/(V\$31*(1-Given!\$F6)+Given!\$F6))	=V34*(W\$31/(W\$31*(1-Given!\$F6)+Given!\$F6))
35	=T35*(U\$31/(U\$31*(1-Given!\$F7)+Given!\$F7))	=U35*(V\$31/(V\$31*(1-Given!\$F7)+Given!\$F7))	=V35*(W\$31/(W\$31*(1-Given!\$F7)+Given!\$F7))
36	=T36*(U\$31/(U\$31*(1-Given!\$F8)+Given!\$F8))	=U36*(V\$31/(V\$31*(1-Given!\$F8)+Given!\$F8))	=V36*(W\$31/(W\$31*(1-Given!\$F8)+Given!\$F8))
37	=T37*(U\$31/(U\$31*(1-Given!\$F9)+Given!\$F9))	=U37*(V\$31/(V\$31*(1-Given!\$F9)+Given!\$F9))	=V37*(W\$31/(W\$31*(1-Given!\$F9)+Given!\$F9))
38			
39	7	8	9
40	=\$F\$39/\$F\$44	=\$F\$44/\$F\$49	=\$F\$49/\$F\$56
41	=U42+U43	=V42+V43	=W42+W43
42	=T42*(U\$40/(U\$40*(1-Given!\$F5)+Given!\$F5))	=U42*(V\$40/(V\$40*(1-Given!\$F5)+Given!\$F5))	=V42*(W\$40/(W\$40*(1-Given!\$F5)+Given!\$F5))
43	=T43*(U\$40/(U\$40*(1-Given!\$F6)+Given!\$F6))	=U43*(V\$40/(V\$40*(1-Given!\$F6)+Given!\$F6))	=V43*(W\$40/(W\$40*(1-Given!\$F6)+Given!\$F6))
44	=T44*(U\$40/(U\$40*(1-Given!\$F7)+Given!\$F7))	=U44*(V\$40/(V\$40*(1-Given!\$F7)+Given!\$F7))	=V44*(W\$40/(W\$40*(1-Given!\$F7)+Given!\$F7))
45	=T45*(U\$40/(U\$40*(1-Given!\$F8)+Given!\$F8))	=U45*(V\$40/(V\$40*(1-Given!\$F8)+Given!\$F8))	=V45*(W\$40/(W\$40*(1-Given!\$F8)+Given!\$F8))
46	=T46*(U\$40/(U\$40*(1-Given!\$F9)+Given!\$F9))	=U46*(V\$40/(V\$40*(1-Given!\$F9)+Given!\$F9))	=V46*(W\$40/(W\$40*(1-Given!\$F9)+Given!\$F9))
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Appendix D

	X	Y	Z	AA	AA	AD	AE
1							
2							
3	10						Year 6
4	=B\$56/\$B\$54						$f_n$
5	=X6+X7	Final Protein Concentration	=X5				$C_{B,Protein}$
6	=W6*(X\$4/(X\$4*(1-Given!\$F5)+Given!\$F5))	Yield	=B54*Z4/(B5*(Given!C5+Given!C6))				$C_{B,NPN}$
7	=W7*(X\$4/(X\$4*(1-Given!\$F6)+Given!\$F6))						$C_{B,TP}$
8	=W8*(X\$4/(X\$4*(1-Given!\$F7)+Given!\$F7))	Final Protein % (dry weight)	=X5/SUM(X6:X10)				$C_{B,Lactose}$
9	=W9*(X\$4/(X\$4*(1-Given!\$F8)+Given!\$F8))	Total Area	=B4				$C_{B,Ash}$
10	=W10*(X\$4/(X\$4*(1-Given!\$F9)+Given!\$F9))	Total Permeate	=B55	gal/day			$C_{B,Butter Fat}$
11							
12	10						Year 7
13	=C\$56/\$C\$54						$f_n$
14	=X15+X16	Final Protein Concentration	=X14				$C_{B,Protein}$
15	=W15*(X\$13/(X\$13*(1-Given!\$F5)+Given!\$F5))	Yield	=C54*Z13/(C5*(Given!C5+Given!C6))				$C_{B,NPN}$
16	=W16*(X\$13/(X\$13*(1-Given!\$F6)+Given!\$F6))						$C_{B,TP}$
17	=W17*(X\$13/(X\$13*(1-Given!\$F7)+Given!\$F7))	Final Protein % (dry weight)	=X14/SUM(X15:X19)				$C_{B,Lactose}$
18	=W18*(X\$13/(X\$13*(1-Given!\$F8)+Given!\$F8))	Total Area	=2*C4				$C_{B,Ash}$
19	=W19*(X\$13/(X\$13*(1-Given!\$F9)+Given!\$F9))	Total Permeate	=C9+C55	gal/day			$C_{B,Butter Fat}$
20							
21	10						Year 8
22	=D\$56/\$D\$54						$f_n$
23	=X24+X25	Final Protein Concentration	=X23				$C_{B,Protein}$
24	=W24*(X\$22/(X\$22*(1-Given!\$F5)+Given!\$F5))	Yield	=D54*Z22/(D5*(Given!C5+Given!C6))				$C_{B,NPN}$
25	=W25*(X\$22/(X\$22*(1-Given!\$F6)+Given!\$F6))						$C_{B,TP}$
26	=W26*(X\$22/(X\$22*(1-Given!\$F7)+Given!\$F7))	Final Protein % (dry weight)	=X23/SUM(X24:X28)				$C_{B,Lactose}$
27	=W27*(X\$22/(X\$22*(1-Given!\$F8)+Given!\$F8))	Total Area	=3*D4				$C_{B,Ash}$
28	=W28*(X\$22/(X\$22*(1-Given!\$F9)+Given!\$F9))	Total Permeate	=D9+D13+D55	gal/day			$C_{B,Butter Fat}$
29							
30	10						Year 9
31	=E\$56/\$E\$54						$f_n$
32	=X33+X34	Final Protein Concentration	=X32				$C_{B,Protein}$
33	=W33*(X\$31/(X\$31*(1-Given!\$F5)+Given!\$F5))	Yield	=E54*Z31/(E5*(Given!\$C\$5+Given!\$C\$6))				$C_{B,NPN}$
34	=W34*(X\$31/(X\$31*(1-Given!\$F6)+Given!\$F6))						$C_{B,TP}$
35	=W35*(X\$31/(X\$31*(1-Given!\$F7)+Given!\$F7))	Final Protein % (dry weight)	=X32/SUM(X33:X37)				$C_{B,Lactose}$
36	=W36*(X\$31/(X\$31*(1-Given!\$F8)+Given!\$F8))	Total Area	=4*E4				$C_{B,Ash}$
37	=W37*(X\$31/(X\$31*(1-Given!\$F9)+Given!\$F9))	Total Permeate	=E9+E13+E18+E55	gal/day			$C_{B,Butter Fat}$
38							
39	10						Year 10
40	=F\$56/\$F\$54						$f_n$
41	=X42+X43	Final Protein Concentration	=X41				$C_{B,Protein}$
42	=W42*(X\$40/(X\$40*(1-Given!\$F5)+Given!\$F5))	Yield	=F54*Z40/(F5*(Given!\$C\$5+Given!\$C\$6))				$C_{B,NPN}$
43	=W43*(X\$40/(X\$40*(1-Given!\$F6)+Given!\$F6))	Final Protein % (dry weight)	=X41/SUM(X42:X46)				$C_{B,TP}$
44	=W44*(X\$40/(X\$40*(1-Given!\$F7)+Given!\$F7))						$C_{B,Lactose}$
45	=W45*(X\$40/(X\$40*(1-Given!\$F8)+Given!\$F8))	Total Area	=5*F4				$C_{B,Ash}$
46	=W46*(X\$40/(X\$40*(1-Given!\$F9)+Given!\$F9))	Total Permeate	=F9+F13+F18+F23+F55	gal/day			$C_{B,Butter Fat}$
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Appendix D

	AF	AG	AH
1			
2			
3	1	2	3
4	=G5/G14	=G14/G19	=G19/G24
5	=AF6+AF7	=AG6+AG7	=AH6+AH7
6	=Given!\$C5*(AF\$4/(AF\$4*(1-Given!\$F5)+Given!\$F5))	=AF6*(AG\$4/(AG\$4*(1-Given!\$F5)+Given!\$F5))	=AG6*(AH\$4/(AH\$4*(1-Given!\$F5)+Given!\$F5))
7	=Given!\$C6*(AF\$4/(AF\$4*(1-Given!\$F6)+Given!\$F6))	=AF7*(AG\$4/(AG\$4*(1-Given!\$F6)+Given!\$F6))	=AG7*(AH\$4/(AH\$4*(1-Given!\$F6)+Given!\$F6))
8	=Given!\$C7*(AF\$4/(AF\$4*(1-Given!\$F7)+Given!\$F7))	=AF8*(AG\$4/(AG\$4*(1-Given!\$F7)+Given!\$F7))	=AG8*(AH\$4/(AH\$4*(1-Given!\$F7)+Given!\$F7))
9	=Given!\$C8*(AF\$4/(AF\$4*(1-Given!\$F8)+Given!\$F8))	=AF9*(AG\$4/(AG\$4*(1-Given!\$F8)+Given!\$F8))	=AG9*(AH\$4/(AH\$4*(1-Given!\$F8)+Given!\$F8))
10	=Given!\$C9*(AF\$4/(AF\$4*(1-Given!\$F9)+Given!\$F9))	=AF10*(AG\$4/(AG\$4*(1-Given!\$F9)+Given!\$F9))	=AG10*(AH\$4/(AH\$4*(1-Given!\$F9)+Given!\$F9))
11			
12	1	2	3
13	=H5/H14	=H14/H19	=H19/H24
14	=AF15+AF16	=AG15+AG16	=AH15+AH16
15	=Given!\$C5*(AF\$13/(AF\$13*(1-Given!\$F5)+Given!\$F5))	=AF15*(AG\$13/(AG\$13*(1-Given!\$F5)+Given!\$F5))	=AG15*(AH\$13/(AH\$13*(1-Given!\$F5)+Given!\$F5))
16	=Given!\$C6*(AF\$13/(AF\$13*(1-Given!\$F6)+Given!\$F6))	=AF16*(AG\$13/(AG\$13*(1-Given!\$F6)+Given!\$F6))	=AG16*(AH\$13/(AH\$13*(1-Given!\$F6)+Given!\$F6))
17	=Given!\$C7*(AF\$13/(AF\$13*(1-Given!\$F7)+Given!\$F7))	=AF17*(AG\$13/(AG\$13*(1-Given!\$F7)+Given!\$F7))	=AG17*(AH\$13/(AH\$13*(1-Given!\$F7)+Given!\$F7))
18	=Given!\$C8*(AF\$13/(AF\$13*(1-Given!\$F8)+Given!\$F8))	=AF18*(AG\$13/(AG\$13*(1-Given!\$F8)+Given!\$F8))	=AG18*(AH\$13/(AH\$13*(1-Given!\$F8)+Given!\$F8))
19	=Given!\$C9*(AF\$13/(AF\$13*(1-Given!\$F9)+Given!\$F9))	=AF19*(AG\$13/(AG\$13*(1-Given!\$F9)+Given!\$F9))	=AG19*(AH\$13/(AH\$13*(1-Given!\$F9)+Given!\$F9))
20			
21	1	2	3
22	=I5/I14	=I14/I19	=I19/I24
23	=AF24+AF25	=AG24+AG25	=AH24+AH25
24	=Given!\$C5*(AF\$22/(AF\$22*(1-Given!\$F5)+Given!\$F5))	=AF24*(AG\$22/(AG\$22*(1-Given!\$F5)+Given!\$F5))	=AG24*(AH\$22/(AH\$22*(1-Given!\$F5)+Given!\$F5))
25	=Given!\$C6*(AF\$22/(AF\$22*(1-Given!\$F6)+Given!\$F6))	=AF25*(AG\$22/(AG\$22*(1-Given!\$F6)+Given!\$F6))	=AG25*(AH\$22/(AH\$22*(1-Given!\$F6)+Given!\$F6))
26	=Given!\$C7*(AF\$22/(AF\$22*(1-Given!\$F7)+Given!\$F7))	=AF26*(AG\$22/(AG\$22*(1-Given!\$F7)+Given!\$F7))	=AG26*(AH\$22/(AH\$22*(1-Given!\$F7)+Given!\$F7))
27	=Given!\$C8*(AF\$22/(AF\$22*(1-Given!\$F8)+Given!\$F8))	=AF27*(AG\$22/(AG\$22*(1-Given!\$F8)+Given!\$F8))	=AG27*(AH\$22/(AH\$22*(1-Given!\$F8)+Given!\$F8))
28	=Given!\$C9*(AF\$22/(AF\$22*(1-Given!\$F9)+Given!\$F9))	=AF28*(AG\$22/(AG\$22*(1-Given!\$F9)+Given!\$F9))	=AG28*(AH\$22/(AH\$22*(1-Given!\$F9)+Given!\$F9))
29			
30	1	2	3
31	=\$J5/\$J14	=\$J14/\$J19	=\$J19/\$J24
32	=AF33+AF34	=AG33+AG34	=AH33+AH34
33	=Given!\$C5*(AF\$31/(AF\$31*(1-Given!\$F5)+Given!\$F5))	=AF33*(AG\$31/(AG\$31*(1-Given!\$F5)+Given!\$F5))	=AG33*(AH\$31/(AH\$31*(1-Given!\$F5)+Given!\$F5))
34	=Given!\$C6*(AF\$31/(AF\$31*(1-Given!\$F6)+Given!\$F6))	=AF34*(AG\$31/(AG\$31*(1-Given!\$F6)+Given!\$F6))	=AG34*(AH\$31/(AH\$31*(1-Given!\$F6)+Given!\$F6))
35	=Given!\$C7*(AF\$31/(AF\$31*(1-Given!\$F7)+Given!\$F7))	=AF35*(AG\$31/(AG\$31*(1-Given!\$F7)+Given!\$F7))	=AG35*(AH\$31/(AH\$31*(1-Given!\$F7)+Given!\$F7))
36	=Given!\$C8*(AF\$31/(AF\$31*(1-Given!\$F8)+Given!\$F8))	=AF36*(AG\$31/(AG\$31*(1-Given!\$F8)+Given!\$F8))	=AG36*(AH\$31/(AH\$31*(1-Given!\$F8)+Given!\$F8))
37	=Given!\$C9*(AF\$31/(AF\$31*(1-Given!\$F9)+Given!\$F9))	=AF37*(AG\$31/(AG\$31*(1-Given!\$F9)+Given!\$F9))	=AG37*(AH\$31/(AH\$31*(1-Given!\$F9)+Given!\$F9))
38			
39	1	2	3
40	=\$K5/\$K14	=\$K14/\$K19	=\$K19/\$K24
41	=AF42+AF43	=AG42+AG43	=AH42+AH43
42	=Given!\$C5*(AF\$40/(AF\$40*(1-Given!\$F5)+Given!\$F5))	=AF42*(AG\$40/(AG\$40*(1-Given!\$F5)+Given!\$F5))	=AG42*(AH\$40/(AH\$40*(1-Given!\$F5)+Given!\$F5))
43	=Given!\$C6*(AF\$40/(AF\$40*(1-Given!\$F6)+Given!\$F6))	=AF43*(AG\$40/(AG\$40*(1-Given!\$F6)+Given!\$F6))	=AG43*(AH\$40/(AH\$40*(1-Given!\$F6)+Given!\$F6))
44	=Given!\$C7*(AF\$40/(AF\$40*(1-Given!\$F7)+Given!\$F7))	=AF44*(AG\$40/(AG\$40*(1-Given!\$F7)+Given!\$F7))	=AG44*(AH\$40/(AH\$40*(1-Given!\$F7)+Given!\$F7))
45	=Given!\$C8*(AF\$40/(AF\$40*(1-Given!\$F8)+Given!\$F8))	=AF45*(AG\$40/(AG\$40*(1-Given!\$F8)+Given!\$F8))	=AG45*(AH\$40/(AH\$40*(1-Given!\$F8)+Given!\$F8))
46	=Given!\$C9*(AF\$40/(AF\$40*(1-Given!\$F9)+Given!\$F9))	=AF46*(AG\$40/(AG\$40*(1-Given!\$F9)+Given!\$F9))	=AG46*(AH\$40/(AH\$40*(1-Given!\$F9)+Given!\$F9))
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Appendix D

	AI	AJ	AK
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3	4	5	6
4	=\$G\$24/\$G\$29	=\$G\$29/\$G\$34	=\$G\$34/\$G\$39
5	=AI6+AI7	=AJ6+AJ7	=AK6+AK7
6	=AH6*(AI\$4/(AI\$4*(1-Given!\$F5)+Given!\$F5))	=AI6*(AJ\$4/(AJ\$4*(1-Given!\$F5)+Given!\$F5))	=AJ6*(AK\$4/(AK\$4*(1-Given!\$F5)+Given!\$F5))
7	=AH7*(AI\$4/(AI\$4*(1-Given!\$F6)+Given!\$F6))	=AI7*(AJ\$4/(AJ\$4*(1-Given!\$F6)+Given!\$F6))	=AJ7*(AK\$4/(AK\$4*(1-Given!\$F6)+Given!\$F6))
8	=AH8*(AI\$4/(AI\$4*(1-Given!\$F7)+Given!\$F7))	=AI8*(AJ\$4/(AJ\$4*(1-Given!\$F7)+Given!\$F7))	=AJ8*(AK\$4/(AK\$4*(1-Given!\$F7)+Given!\$F7))
9	=AH9*(AI\$4/(AI\$4*(1-Given!\$F8)+Given!\$F8))	=AI9*(AJ\$4/(AJ\$4*(1-Given!\$F8)+Given!\$F8))	=AJ9*(AK\$4/(AK\$4*(1-Given!\$F8)+Given!\$F8))
10	=AH10*(AI\$4/(AI\$4*(1-Given!\$F9)+Given!\$F9))	=AI10*(AJ\$4/(AJ\$4*(1-Given!\$F9)+Given!\$F9))	=AJ10*(AK\$4/(AK\$4*(1-Given!\$F9)+Given!\$F9))
11			
12	4	5	6
13	=\$H\$24/\$H\$29	=\$H\$29/\$H\$34	=\$H\$34/\$H\$39
14	=AI15+AI16	=AJ15+AJ16	=AK15+AK16
15	=AH15*(AI\$13/(AI\$13*(1-Given!\$F5)+Given!\$F5))	=AI15*(AJ\$13/(AJ\$13*(1-Given!\$F5)+Given!\$F5))	=AJ15*(AK\$13/(AK\$13*(1-Given!\$F5)+Given!\$F5))
16	=AH16*(AI\$13/(AI\$13*(1-Given!\$F6)+Given!\$F6))	=AI16*(AJ\$13/(AJ\$13*(1-Given!\$F6)+Given!\$F6))	=AJ16*(AK\$13/(AK\$13*(1-Given!\$F6)+Given!\$F6))
17	=AH17*(AI\$13/(AI\$13*(1-Given!\$F7)+Given!\$F7))	=AI17*(AJ\$13/(AJ\$13*(1-Given!\$F7)+Given!\$F7))	=AJ17*(AK\$13/(AK\$13*(1-Given!\$F7)+Given!\$F7))
18	=AH18*(AI\$13/(AI\$13*(1-Given!\$F8)+Given!\$F8))	=AI18*(AJ\$13/(AJ\$13*(1-Given!\$F8)+Given!\$F8))	=AJ18*(AK\$13/(AK\$13*(1-Given!\$F8)+Given!\$F8))
19	=AH19*(AI\$13/(AI\$13*(1-Given!\$F9)+Given!\$F9))	=AI19*(AJ\$13/(AJ\$13*(1-Given!\$F9)+Given!\$F9))	=AJ19*(AK\$13/(AK\$13*(1-Given!\$F9)+Given!\$F9))
20			
21	4	5	6
22	=\$I\$24/\$I\$29	=\$I\$29/\$I\$34	=\$I\$34/\$I\$39
23	=AI24+AI25	=AJ24+AJ25	=AK24+AK25
24	=AH24*(AI\$22/(AI\$22*(1-Given!\$F5)+Given!\$F5))	=AI24*(AJ\$22/(AJ\$22*(1-Given!\$F5)+Given!\$F5))	=AJ24*(AK\$22/(AK\$22*(1-Given!\$F5)+Given!\$F5))
25	=AH25*(AI\$22/(AI\$22*(1-Given!\$F6)+Given!\$F6))	=AI25*(AJ\$22/(AJ\$22*(1-Given!\$F6)+Given!\$F6))	=AJ25*(AK\$22/(AK\$22*(1-Given!\$F6)+Given!\$F6))
26	=AH26*(AI\$22/(AI\$22*(1-Given!\$F7)+Given!\$F7))	=AI26*(AJ\$22/(AJ\$22*(1-Given!\$F7)+Given!\$F7))	=AJ26*(AK\$22/(AK\$22*(1-Given!\$F7)+Given!\$F7))
27	=AH27*(AI\$22/(AI\$22*(1-Given!\$F8)+Given!\$F8))	=AI27*(AJ\$22/(AJ\$22*(1-Given!\$F8)+Given!\$F8))	=AJ27*(AK\$22/(AK\$22*(1-Given!\$F8)+Given!\$F8))
28	=AH28*(AI\$22/(AI\$22*(1-Given!\$F9)+Given!\$F9))	=AI28*(AJ\$22/(AJ\$22*(1-Given!\$F9)+Given!\$F9))	=AJ28*(AK\$22/(AK\$22*(1-Given!\$F9)+Given!\$F9))
29			
30	4	5	6
31	=\$J\$24/\$J\$29	=\$J\$29/\$J\$34	=\$J\$34/\$J\$39
32	=AI33+AI34	=AJ33+AJ34	=AK33+AK34
33	=AH33*(AI\$31/(AI\$31*(1-Given!\$F5)+Given!\$F5))	=AI33*(AJ\$31/(AJ\$31*(1-Given!\$F5)+Given!\$F5))	=AJ33*(AK\$31/(AK\$31*(1-Given!\$F5)+Given!\$F5))
34	=AH34*(AI\$31/(AI\$31*(1-Given!\$F6)+Given!\$F6))	=AI34*(AJ\$31/(AJ\$31*(1-Given!\$F6)+Given!\$F6))	=AJ34*(AK\$31/(AK\$31*(1-Given!\$F6)+Given!\$F6))
35	=AH35*(AI\$31/(AI\$31*(1-Given!\$F7)+Given!\$F7))	=AI35*(AJ\$31/(AJ\$31*(1-Given!\$F7)+Given!\$F7))	=AJ35*(AK\$31/(AK\$31*(1-Given!\$F7)+Given!\$F7))
36	=AH36*(AI\$31/(AI\$31*(1-Given!\$F8)+Given!\$F8))	=AI36*(AJ\$31/(AJ\$31*(1-Given!\$F8)+Given!\$F8))	=AJ36*(AK\$31/(AK\$31*(1-Given!\$F8)+Given!\$F8))
37	=AH37*(AI\$31/(AI\$31*(1-Given!\$F9)+Given!\$F9))	=AI37*(AJ\$31/(AJ\$31*(1-Given!\$F9)+Given!\$F9))	=AJ37*(AK\$31/(AK\$31*(1-Given!\$F9)+Given!\$F9))
38			
39	4	5	6
40	=\$K\$24/\$K\$29	=\$K\$29/\$K\$34	=\$K\$34/\$K\$39
41	=AI42+AI43	=AJ42+AJ43	=AK42+AK43
42	=AH42*(AI\$40/(AI\$40*(1-Given!\$F5)+Given!\$F5))	=AI42*(AJ\$40/(AJ\$40*(1-Given!\$F5)+Given!\$F5))	=AJ42*(AK\$40/(AK\$40*(1-Given!\$F5)+Given!\$F5))
43	=AH43*(AI\$40/(AI\$40*(1-Given!\$F6)+Given!\$F6))	=AI43*(AJ\$40/(AJ\$40*(1-Given!\$F6)+Given!\$F6))	=AJ43*(AK\$40/(AK\$40*(1-Given!\$F6)+Given!\$F6))
44	=AH44*(AI\$40/(AI\$40*(1-Given!\$F7)+Given!\$F7))	=AI44*(AJ\$40/(AJ\$40*(1-Given!\$F7)+Given!\$F7))	=AJ44*(AK\$40/(AK\$40*(1-Given!\$F7)+Given!\$F7))
45	=AH45*(AI\$40/(AI\$40*(1-Given!\$F8)+Given!\$F8))	=AI45*(AJ\$40/(AJ\$40*(1-Given!\$F8)+Given!\$F8))	=AJ45*(AK\$40/(AK\$40*(1-Given!\$F8)+Given!\$F8))
46	=AH46*(AI\$40/(AI\$40*(1-Given!\$F9)+Given!\$F9))	=AI46*(AJ\$40/(AJ\$40*(1-Given!\$F9)+Given!\$F9))	=AJ46*(AK\$40/(AK\$40*(1-Given!\$F9)+Given!\$F9))
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Appendix D

	AL	AM	AN
1			
2			
3	7	8	9
4	=\$G\$39/\$G\$44	=\$G\$44/\$G\$49	=\$G\$49/\$G\$56
5	=AL6+AL7	=AM6+AM7	=AN6+AN7
6	=AK6*(AL\$4/(AL\$4*(1-Given!\$F5)+Given!\$F5))	=AL6*(AM\$4/(AM\$4*(1-Given!\$F5)+Given!\$F5))	=AM6*(AN\$4/(AN\$4*(1-Given!\$F5)+Given!\$F5))
7	=AK7*(AL\$4/(AL\$4*(1-Given!\$F6)+Given!\$F6))	=AL7*(AM\$4/(AM\$4*(1-Given!\$F6)+Given!\$F6))	=AM7*(AN\$4/(AN\$4*(1-Given!\$F6)+Given!\$F6))
8	=AK8*(AL\$4/(AL\$4*(1-Given!\$F7)+Given!\$F7))	=AL8*(AM\$4/(AM\$4*(1-Given!\$F7)+Given!\$F7))	=AM8*(AN\$4/(AN\$4*(1-Given!\$F7)+Given!\$F7))
9	=AK9*(AL\$4/(AL\$4*(1-Given!\$F8)+Given!\$F8))	=AL9*(AM\$4/(AM\$4*(1-Given!\$F8)+Given!\$F8))	=AM9*(AN\$4/(AN\$4*(1-Given!\$F8)+Given!\$F8))
10	=AK10*(AL\$4/(AL\$4*(1-Given!\$F9)+Given!\$F9))	=AL10*(AM\$4/(AM\$4*(1-Given!\$F9)+Given!\$F9))	=AM10*(AN\$4/(AN\$4*(1-Given!\$F9)+Given!\$F9))
11			
12	7	8	9
13	=\$H\$39/\$H\$44	=\$H\$44/\$H\$49	=\$H\$49/\$H\$56
14	=AL15+AL16	=AM15+AM16	=AN15+AN16
15	=AK15*(AL\$13/(AL\$13*(1-Given!\$F5)+Given!\$F5))	=AL15*(AM\$13/(AM\$13*(1-Given!\$F5)+Given!\$F5))	=AM15*(AN\$13/(AN\$13*(1-Given!\$F5)+Given!\$F5))
16	=AK16*(AL\$13/(AL\$13*(1-Given!\$F6)+Given!\$F6))	=AL16*(AM\$13/(AM\$13*(1-Given!\$F6)+Given!\$F6))	=AM16*(AN\$13/(AN\$13*(1-Given!\$F6)+Given!\$F6))
17	=AK17*(AL\$13/(AL\$13*(1-Given!\$F7)+Given!\$F7))	=AL17*(AM\$13/(AM\$13*(1-Given!\$F7)+Given!\$F7))	=AM17*(AN\$13/(AN\$13*(1-Given!\$F7)+Given!\$F7))
18	=AK18*(AL\$13/(AL\$13*(1-Given!\$F8)+Given!\$F8))	=AL18*(AM\$13/(AM\$13*(1-Given!\$F8)+Given!\$F8))	=AM18*(AN\$13/(AN\$13*(1-Given!\$F8)+Given!\$F8))
19	=AK19*(AL\$13/(AL\$13*(1-Given!\$F9)+Given!\$F9))	=AL19*(AM\$13/(AM\$13*(1-Given!\$F9)+Given!\$F9))	=AM19*(AN\$13/(AN\$13*(1-Given!\$F9)+Given!\$F9))
20			
21	7	8	9
22	=\$I\$39/\$I\$44	=\$I\$44/\$I\$49	=\$I\$49/\$I\$56
23	=AL24+AL25	=AM24+AM25	=AN24+AN25
24	=AK24*(AL\$22/(AL\$22*(1-Given!\$F5)+Given!\$F5))	=AL24*(AM\$22/(AM\$22*(1-Given!\$F5)+Given!\$F5))	=AM24*(AN\$22/(AN\$22*(1-Given!\$F5)+Given!\$F5))
25	=AK25*(AL\$22/(AL\$22*(1-Given!\$F6)+Given!\$F6))	=AL25*(AM\$22/(AM\$22*(1-Given!\$F6)+Given!\$F6))	=AM25*(AN\$22/(AN\$22*(1-Given!\$F6)+Given!\$F6))
26	=AK26*(AL\$22/(AL\$22*(1-Given!\$F7)+Given!\$F7))	=AL26*(AM\$22/(AM\$22*(1-Given!\$F7)+Given!\$F7))	=AM26*(AN\$22/(AN\$22*(1-Given!\$F7)+Given!\$F7))
27	=AK27*(AL\$22/(AL\$22*(1-Given!\$F8)+Given!\$F8))	=AL27*(AM\$22/(AM\$22*(1-Given!\$F8)+Given!\$F8))	=AM27*(AN\$22/(AN\$22*(1-Given!\$F8)+Given!\$F8))
28	=AK28*(AL\$22/(AL\$22*(1-Given!\$F9)+Given!\$F9))	=AL28*(AM\$22/(AM\$22*(1-Given!\$F9)+Given!\$F9))	=AM28*(AN\$22/(AN\$22*(1-Given!\$F9)+Given!\$F9))
29			
30	7	8	9
31	=\$J\$39/\$J\$44	=\$J\$44/\$J\$49	=\$J\$49/\$J\$56
32	=AL33+AL34	=AM33+AM34	=AN33+AN34
33	=AK33*(AL\$31/(AL\$31*(1-Given!\$F5)+Given!\$F5))	=AL33*(AM\$31/(AM\$31*(1-Given!\$F5)+Given!\$F5))	=AM33*(AN\$31/(AN\$31*(1-Given!\$F5)+Given!\$F5))
34	=AK34*(AL\$31/(AL\$31*(1-Given!\$F6)+Given!\$F6))	=AL34*(AM\$31/(AM\$31*(1-Given!\$F6)+Given!\$F6))	=AM34*(AN\$31/(AN\$31*(1-Given!\$F6)+Given!\$F6))
35	=AK35*(AL\$31/(AL\$31*(1-Given!\$F7)+Given!\$F7))	=AL35*(AM\$31/(AM\$31*(1-Given!\$F7)+Given!\$F7))	=AM35*(AN\$31/(AN\$31*(1-Given!\$F7)+Given!\$F7))
36	=AK36*(AL\$31/(AL\$31*(1-Given!\$F8)+Given!\$F8))	=AL36*(AM\$31/(AM\$31*(1-Given!\$F8)+Given!\$F8))	=AM36*(AN\$31/(AN\$31*(1-Given!\$F8)+Given!\$F8))
37	=AK37*(AL\$31/(AL\$31*(1-Given!\$F9)+Given!\$F9))	=AL37*(AM\$31/(AM\$31*(1-Given!\$F9)+Given!\$F9))	=AM37*(AN\$31/(AN\$31*(1-Given!\$F9)+Given!\$F9))
38			
39	7	8	9
40	=\$K\$39/\$K\$44	=\$K\$44/\$K\$49	=\$K\$49/\$K\$56
41	=AL42+AL43	=AM42+AM43	=AN42+AN43
42	=AK42*(AL\$40/(AL\$40*(1-Given!\$F5)+Given!\$F5))	=AL42*(AM\$40/(AM\$40*(1-Given!\$F5)+Given!\$F5))	=AM42*(AN\$40/(AN\$40*(1-Given!\$F5)+Given!\$F5))
43	=AK43*(AL\$40/(AL\$40*(1-Given!\$F6)+Given!\$F6))	=AL43*(AM\$40/(AM\$40*(1-Given!\$F6)+Given!\$F6))	=AM43*(AN\$40/(AN\$40*(1-Given!\$F6)+Given!\$F6))
44	=AK44*(AL\$40/(AL\$40*(1-Given!\$F7)+Given!\$F7))	=AL44*(AM\$40/(AM\$40*(1-Given!\$F7)+Given!\$F7))	=AM44*(AN\$40/(AN\$40*(1-Given!\$F7)+Given!\$F7))
45	=AK45*(AL\$40/(AL\$40*(1-Given!\$F8)+Given!\$F8))	=AL45*(AM\$40/(AM\$40*(1-Given!\$F8)+Given!\$F8))	=AM45*(AN\$40/(AN\$40*(1-Given!\$F8)+Given!\$F8))
46	=AK46*(AL\$40/(AL\$40*(1-Given!\$F9)+Given!\$F9))	=AL46*(AM\$40/(AM\$40*(1-Given!\$F9)+Given!\$F9))	=AM46*(AN\$40/(AN\$40*(1-Given!\$F9)+Given!\$F9))
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Appendix D

	AO	AP	AQ	AR
1				
2				
3	10			
4	=G\$56/G\$54			
5	=AO6+AO7	Final Protein Concentration	=AO5	
6	=AN6*(AO\$4/(AO\$4*(1-Given!\$F5)+Given!\$F5))	Yield	=G54*AQ4/(G5*(Given!\$C\$5+Given!\$C\$6))	
7	=AN7*(AO\$4/(AO\$4*(1-Given!\$F6)+Given!\$F6))			
8	=AN8*(AO\$4/(AO\$4*(1-Given!\$F7)+Given!\$F7))	Final Protein % (dry weight)	=AO5/SUM(AO6:AO10)	
9	=AN9*(AO\$4/(AO\$4*(1-Given!\$F8)+Given!\$F8))	Total Area	=6*G4	
10	=AN10*(AO\$4/(AO\$4*(1-Given!\$F9)+Given!\$F9))	Total Permeate	=G9+G13+G18+G23+G28+G55	gal/day
11				
12	10			
13	=H\$56/H\$54			
14	=AO15+AO16	Final Protein Concentration	=AO14	
15	=AN15*(AO\$13/(AO\$13*(1-Given!\$F5)+Given!\$F5))	Yield	=H54*AQ13/(H5*(Given!\$C\$5+Given!\$C\$6))	
16	=AN16*(AO\$13/(AO\$13*(1-Given!\$F6)+Given!\$F6))			
17	=AN17*(AO\$13/(AO\$13*(1-Given!\$F7)+Given!\$F7))	Final Protein % (dry weight)	=AO14/SUM(AO15:AO19)	
18	=AN18*(AO\$13/(AO\$13*(1-Given!\$F8)+Given!\$F8))	Total Area	=7*H4	
19	=AN19*(AO\$13/(AO\$13*(1-Given!\$F9)+Given!\$F9))	Total Permeate	=H9+H13+H18+H23+H28+H33+H55	gal/day
20				
21	10			
22	=I\$56/I\$54			
23	=AO24+AO25	Final Protein Concentration	=AO23	
24	=AN24*(AO\$22/(AO\$22*(1-Given!\$F5)+Given!\$F5))	Yield	=I54*AQ22/(I5*(Given!\$C\$5+Given!\$C\$6))	
25	=AN25*(AO\$22/(AO\$22*(1-Given!\$F6)+Given!\$F6))			
26	=AN26*(AO\$22/(AO\$22*(1-Given!\$F7)+Given!\$F7))	Final Protein % (dry weight)	=AO23/SUM(AO24:AO28)	
27	=AN27*(AO\$22/(AO\$22*(1-Given!\$F8)+Given!\$F8))	Total Area	=8*I4	
28	=AN28*(AO\$22/(AO\$22*(1-Given!\$F9)+Given!\$F9))	Total Permeate	=I9+I13+I18+I23+I28+I33+I38+I55	gal/day
29				
30	10			
31	=J\$56/J\$54			
32	=AO33+AO34	Final Protein Concentration	=AO32	
33	=AN33*(AO\$31/(AO\$31*(1-Given!\$F5)+Given!\$F5))	Yield	=J54*AQ31/(J5*(Given!\$C\$5+Given!\$C\$6))	
34	=AN34*(AO\$31/(AO\$31*(1-Given!\$F6)+Given!\$F6))			
35	=AN35*(AO\$31/(AO\$31*(1-Given!\$F7)+Given!\$F7))	Final Protein % (dry weight)	=AO32/SUM(AO33:AO37)	
36	=AN36*(AO\$31/(AO\$31*(1-Given!\$F8)+Given!\$F8))	Total Area	=9*J4	
37	=AN37*(AO\$31/(AO\$31*(1-Given!\$F9)+Given!\$F9))	Total Permeate	=J9+J13+J18+J23+J28+J33+J38+J43+J55	gal/day
38				
39	10			
40	=K\$56/K\$54			
41	=AO42+AO43	Final Protein Concentration	=AO41	
42	=AN42*(AO\$40/(AO\$40*(1-Given!\$F5)+Given!\$F5))	Yield	=K54*AQ40/(K5*(Given!\$C\$5+Given!\$C\$6))	
43	=AN43*(AO\$40/(AO\$40*(1-Given!\$F6)+Given!\$F6))			
44	=AN44*(AO\$40/(AO\$40*(1-Given!\$F7)+Given!\$F7))	Final Protein % (dry weight)	=AO41/SUM(AO42:AO46)	
45	=AN45*(AO\$40/(AO\$40*(1-Given!\$F8)+Given!\$F8))	Total Area	=10*K4	
46	=AN46*(AO\$40/(AO\$40*(1-Given!\$F9)+Given!\$F9))	Total Permeate	=K9+K13+K18+K23+K28+K33+K38+K43+K48+K55	gal/day
47				
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Appendix D

	A	B	C	D
1	Based on 35%, 10 stages		Total Soln into 35% (gal/day)	
2	Amount in 35%	=1\$1opt.'!\$D17	=1\$1opt.'!\$D19	=1\$1opt.'!\$D21
3	Amount in 35%	20380.6036663998	21121.8472878319	21857.8821465876
4	Year	1	2	3
5	# of Cartridges	8	8	9
6	Area	=B5*26.5	=C5*26.5	=D5*26.5
7	F actual	=("10years!B\$54*8.5-1\$1opt.'!\$E37!10years!B\$72)/8.5	=("10years!C\$54*8.5-1\$1opt.'!\$E4!10years!C\$72)/8.5	=("10years!D\$54*8.5-1\$1opt.'!\$E5!10years!D\$72)/8.5
8	F calc	=B7/B8	=C7/C8	=D7/D8
9	n	1	2	3
10	CF <sub>n</sub>	=B\$3/B13	=C\$3/C13	=D\$3/D13
11	J <sub>n</sub>	=27.9-5.3*LN(B11)	=27.9-5.3*LN(C11)	=27.9-5.3*LN(D11)
12	B <sub>n</sub>	1980.24469967104	1914.13901635513	1962.408826239
13	P <sub>n</sub>	=B\$6*B12	=C\$6*C12	=D\$6*D12
14	B <sub>n-1</sub>	=B14+B13	=C14+C13	=D14+D13
15				
16				
17				
18	Area/Stage	1	2	3
19	No. of Cartridges/Stage	=B6	=C6	=D6
20	Total Recirculation	=B19/26.5	=C19/26.5	=D19/26.5
21	Max Flow	=B20*23	=C20*23	=D20*23
22		=B21+B7/(20*60)	=C21+C7/(20*60)	=D21+D7/(20*60)
23				
24	Final Stream			
25	C <sub>B,NPN</sub>	=O7	=P7	=Q7
26	C <sub>B,TP</sub>	=O8	=P8	=Q8
27	C <sub>B,Lactoso</sub>	=O10	=P10	=Q10
28	C <sub>B,Ash</sub>	=O11	=P11	=Q11
29	C <sub>B,Butter Fat</sub>	=O12	=P12	=Q12
30	% Protein	=("B25*B26/SUM(B25:B29))	=("C25*C26/SUM(C25:C29))	=("D25*D26/SUM(D25:D29))
31	% Solids	=SUM(B25:B29)/1	=SUM(C25:C29)/1	=SUM(D25:D29)/1
32	Yield this part	=O15	=P15	=Q15
33	Diailtration			
34				
35	1 Diailtration			
36	Soln Feed (gpd)	=B13	=C13	=D13
37	Water Added (gpd)	=B49*(27.9-5.3*LN(B3/B36))	=C49*(27.9-5.3*LN(C3/C36))	=D49*(27.9-5.3*LN(D3/D36))
38	Total Feed (gpd)	=B37+B36	=C37+C36	=D37+D36
39	CF, D1	=B39/B36	=C39/C36	=D39/D36
40	Concentrations			
41	True Protein	=B25*(1/((B38/B36)*(1-Given\$F5)+Given\$F5))*(\$B\$35)	=C25*(1/((C38/C36)*(1-Given\$F5)+Given\$F5))*(\$B\$35)	=D25*(1/((D38/D36)*(1-Given\$F5)+Given\$F5))*(\$B\$35)
42	Non-Protein Nitrogen	=B26*(1/((B38/B36)*(1-Given\$F6)+Given\$F6))*(\$B\$35)	=C26*(1/((C38/C36)*(1-Given\$F6)+Given\$F6))*(\$B\$35)	=D26*(1/((D38/D36)*(1-Given\$F6)+Given\$F6))*(\$B\$35)
43	Lactose	=B27*(1/((B38/B36)*(1-Given\$F7)+Given\$F7))*(\$B\$35)	=C27*(1/((C38/C36)*(1-Given\$F7)+Given\$F7))*(\$B\$35)	=D27*(1/((D38/D36)*(1-Given\$F7)+Given\$F7))*(\$B\$35)
44	Ash	=B28*(1/((B38/B36)*(1-Given\$F8)+Given\$F8))*(\$B\$35)	=C28*(1/((C38/C36)*(1-Given\$F8)+Given\$F8))*(\$B\$35)	=D28*(1/((D38/D36)*(1-Given\$F8)+Given\$F8))*(\$B\$35)
45	Butter Fat	=B29*(1/((B38/B36)*(1-Given\$F9)+Given\$F9))*(\$B\$35)	=C29*(1/((C38/C36)*(1-Given\$F9)+Given\$F9))*(\$B\$35)	=D29*(1/((D38/D36)*(1-Given\$F9)+Given\$F9))*(\$B\$35)
46	Total Protein (dry weight)	=("B41+B42)/SUM(B41:B45)	=("C41+C42)/SUM(C41:C45)	=("D41+D42)/SUM(D41:D45)
47	Yield this part	=("B41+B42)*B36/((B25+B26)*B36)	=("C41+C42)*C36/((C25+C26)*C36)	=("D41+D42)*D36/((D25+D26)*D36)
48	CF overall	=B3/B36	=C3/C36	=D3/D36
49	Area/stage	=26.5*B50	=26.5*C50	=26.5*D50
50	Cartridges/stage	16	15	14
51	Max Flow Rate (gpm)	=23*B50+B38/(20*60)	=23*C50+C38/(20*60)	=23*D50+D38/(20*60)
52	Overall Yield 55%-75%	=("D41+B42)*B36/((10years!B66+10years!B67)*B7)	=("D41+B42)*C36/((10years!C66+10years!C67)*C7)	=("D41+B42)*D36/((10years!D66+10years!D67)*D7)
53	% Solids	=("B41+B42+B43+B44+B45)/1	=("C41+C42+C43+C44+C45)/1	=("D41+D42+D43+D44+D45)/1

Appendix D

	E	F	G
1			
2	=1\$opt.1\$D23	=1\$opt.1\$D25	=1\$opt.1\$D27
3	22828.821902108	23644.0995537844	24705.7275617386
4			
5			
6	=E5*26.5	=F5*26.5	=G5*26.5
7	=(10years!E\$54*8.5-1\$opt.1\$E7/10years!E\$72)/8.5	=(10years!F\$54*8.5-1\$opt.1\$F7/10years!F\$72)/8.5	=(10years!G\$54*8.5-1\$opt.1\$G7/10years!G\$72)/8.5
8			
9	=E7-E8	=F7-F8	=G7-G8
10			
11	=E\$3/E13	=F\$3/F13	=G\$3/G13
12	=27.9-5.3*LN(E11)	=27.9-5.3*LN(F11)	=27.9-5.3*LN(G11)
13	1967.66931508594	2131.58030401338	2350.80912541747
14	=E\$6*E12	=F\$6*F12	=G\$6*G12
15	=E14+E13	=F14+F13	=G14+G13
16			
17			
18			
19			
20	=E19/26.5	=F19/26.5	=G19/26.5
21	=E20*23	=F20*23	=G20*23
22	=E21+E7/(20*60)	=F21+F7/(20*60)	=G21+G7/(20*60)
23			
24			
25	=R7	=S7	=T7
26	=R8	=S8	=T8
27	=R10	=S10	=T10
28	=R11	=S11	=T11
29	=R12	=S12	=T12
30	=SUM(E25:E29)	=SUM(F25:F29)	=SUM(G25:G29)
31	=SUM(E25:E29)/1	=SUM(F25:F29)/1	=SUM(G25:G29)/1
32	=R15	=S15	=T15
33			
34			
35			
36	=E13	=F13	=G13
37	=E49*(27.9-5.3*LN(E3/E36))	=F49*(27.9-5.3*LN(F3/F36))	=G49*(27.9-5.3*LN(G3/G36))
38	=E37+E36	=F37+F36	=G37+G36
39	=E38/E36	=F38/F36	=G38/G36
40			
41	=E25*/((E\$38/E\$36)*(1-Given!\$F5)+Given!\$F5)^(\$B\$35)	=F25*/((F\$38/F\$36)*(1-Given!\$F5)+Given!\$F5)^(\$B\$35)	=G25*/((G\$38/G\$36)*(1-Given!\$F5)+Given!\$F5)^(\$B\$35)
42	=E26*/((E\$38/E\$36)*(1-Given!\$F6)+Given!\$F6)^(\$B\$35)	=F26*/((F\$38/F\$36)*(1-Given!\$F6)+Given!\$F6)^(\$B\$35)	=G26*/((G\$38/G\$36)*(1-Given!\$F6)+Given!\$F6)^(\$B\$35)
43	=E27*/((E\$38/E\$36)*(1-Given!\$F7)+Given!\$F7)^(\$B\$35)	=F27*/((F\$38/F\$36)*(1-Given!\$F7)+Given!\$F7)^(\$B\$35)	=G27*/((G\$38/G\$36)*(1-Given!\$F7)+Given!\$F7)^(\$B\$35)
44	=E28*/((E\$38/E\$36)*(1-Given!\$F8)+Given!\$F8)^(\$B\$35)	=F28*/((F\$38/F\$36)*(1-Given!\$F8)+Given!\$F8)^(\$B\$35)	=G28*/((G\$38/G\$36)*(1-Given!\$F8)+Given!\$F8)^(\$B\$35)
45	=E29*/((E\$38/E\$36)*(1-Given!\$F9)+Given!\$F9)^(\$B\$35)	=F29*/((F\$38/F\$36)*(1-Given!\$F9)+Given!\$F9)^(\$B\$35)	=G29*/((G\$38/G\$36)*(1-Given!\$F9)+Given!\$F9)^(\$B\$35)
46	=SUM(E41:E45)	=SUM(F41:F45)	=SUM(G41:G45)
47	=(E41+E42)*E36/((E25+E26)*E36)	=(F41+F42)*F36/((F25+F26)*F36)	=(G41+G42)*G36/((G25+G26)*G36)
48	=E3/E36	=F3/F36	=G3/G36
49	=26.5*E50	=26.5*F50	=26.5*G50
50			
51	=23*E50+E38/(20*60)	=23*F50+F38/(20*60)	=23*G50+G38/(20*60)
52	=(E41+E42)*E36/((10years!E66+10years!E67)*E7)	=(F41+F42)*F36/((10years!F66+10years!F67)*F7)	=(G41+G42)*G36/((10years!G66+10years!G67)*G7)
53	=(E41+E42+E43+E44+E45)/1	=(F41+F42+F43+F44+F45)/1	=(G41+G42+G43+G44+G45)/1

Appendix D

	H	I	J
1			
2	=1\$1opt.I\$D29	=1\$1opt.I\$D31	=1\$1opt.I\$D33
3	26569.680811934	26569.6583732683	27758.5182017264
4	7	8	9
5	11	11	12
6	=H5*26.5	=I5*26.5	=J5*26.5
7	=(10years^H\$54*8.5-1\$1opt.I\$E9^10years^H\$72)/8.5	=(10years^I\$54*8.5-1\$1opt.I\$E10^10years^I\$72)/8.5	=(10years^J\$54*8.5-1\$1opt.I\$E11^10years^J\$72)/8.5
8	H15	I15	J15
9	=H7-H8	=I7-I8	=J7-J8
10	7	8	9
11	=H9/H13	=I9/I13	=J9/J13
12	=27.9-5.3*LN(H11)	=27.9-5.3*LN(I11)	=27.9-5.3*LN(J11)
13	2298.6308612899	2392.44573346939	2494.13361463629
14	=H6*H12	=I6*I12	=J6*J12
15	=H14+H13	=I14+I13	=J14+J13
16			
17			
18	7	8	9
19	=H6	=I6	=J6
20	=H19/26.5	=I19/26.5	=J19/26.5
21	=H20*23	=I20*23	=J20*23
22	=H21+H7/(20*60)	=I21+I7/(20*60)	=J21+J7/(20*60)
23			
24			
25	=U7	=V7	=W7
26	=U8	=V8	=W8
27	=U10	=V10	=W10
28	=U11	=V11	=W11
29	=U12	=V12	=W12
30	=(H25+H29)/SUM(H25:H29)	=(I25+I29)/SUM(I25:I29)	=(J25+J29)/SUM(J25:J29)
31	=SUM(H25:H29)/1	=SUM(I25:I29)/1	=SUM(J25:J29)/1
32	=U15	=V15	=W15
33			
34			
35			
36	H13	I13	J13
37	=H49*(27.9-5.3*LN(H3/H36))	=I49*(27.9-5.3*LN(I3/I36))	=J49*(27.9-5.3*LN(J3/J36))
38	H37+H36	=I37+I36	=J37+J36
39	H38/H36	=I38/I36	=J38/J36
40			
41	=H25*(1/((H\$38/H\$36)^(1-Given\$F5)+Given\$F5))*(\$B\$35)	=I25*(1/((I\$38/I\$36)^(1-Given\$I\$F5)+Given\$I\$F5))*(\$B\$35)	=J25*(1/((J\$38/J\$36)^(1-Given\$F5)+Given\$F5))*(\$B\$35)
42	=H26*(1/((H\$38/H\$36)^(1-Given\$F6)+Given\$F6))*(\$B\$35)	=I26*(1/((I\$38/I\$36)^(1-Given\$I\$F6)+Given\$I\$F6))*(\$B\$35)	=J26*(1/((J\$38/J\$36)^(1-Given\$F6)+Given\$F6))*(\$B\$35)
43	=H27*(1/((H\$38/H\$36)^(1-Given\$F7)+Given\$F7))*(\$B\$35)	=I27*(1/((I\$38/I\$36)^(1-Given\$I\$F7)+Given\$I\$F7))*(\$B\$35)	=J27*(1/((J\$38/J\$36)^(1-Given\$F7)+Given\$F7))*(\$B\$35)
44	=H28*(1/((H\$38/H\$36)^(1-Given\$F8)+Given\$F8))*(\$B\$35)	=I28*(1/((I\$38/I\$36)^(1-Given\$I\$F8)+Given\$I\$F8))*(\$B\$35)	=J28*(1/((J\$38/J\$36)^(1-Given\$F8)+Given\$F8))*(\$B\$35)
45	=H29*(1/((H\$38/H\$36)^(1-Given\$F9)+Given\$F9))*(\$B\$35)	=I29*(1/((I\$38/I\$36)^(1-Given\$I\$F9)+Given\$I\$F9))*(\$B\$35)	=J29*(1/((J\$38/J\$36)^(1-Given\$F9)+Given\$F9))*(\$B\$35)
46	=(H41+H42)/SUM(H41:H45)	=(I41+I42)/SUM(I41:I45)	=(J41+J42)/SUM(J41:J45)
47	=(H41+H42)*H36/((H25+H26)*H36)	=(I41+I42)*I36/((I25+I26)*I36)	=(J41+J42)*J36/((J25+J26)*J36)
48	H3/H36	=I3/I36	=J3/J36
49	=26.5*H50	=26.5*I50	=26.5*J50
50	16	17	18
51	=23*H50+H38/(20*60)	=23*I50+I38/(20*60)	=23*J50+J38/(20*60)
52	=(H41+H42)*H36/((10years^H66+10years^H67)*H7)	=(I41+I42)*I36/((10years^I66+10years^I67)*I7)	=(J41+J42)*J36/((10years^J66+10years^J67)*J7)
53	=(H41+H42+H43+H44+H45)/1	=(I41+I42+I43+I44+I45)/1	=(J41+J42+J43+J44+J45)/1

Appendix D

	K	L	M	N	O	P	Q	R
1								
2	=1\$1opt.\$D35							
3	28879.0456320896							
4	10							
5	12			Year		2	3	4
6	=K5*26.5	ff		<i>f<sub>h</sub></i>	=B7/B13	=C7/C13	=D7/D13	=E7/E13
7	=10years!K\$54*8.6-1\$1opt.!E12/10years!K\$72/8.5	gal/day		C <sub>B,NPH</sub>	=10years!B66*(O\$6/C	=10years!C66*(P\$6/P	=10years!D66*(Q\$6/C	=10years!E66*(R\$6/R
8	K16	gal/day		C <sub>B,TP</sub>	=10years!B67*(O\$6/C	=10years!C67*(P\$6/P	=10years!D67*(Q\$6/C	=10years!E67*(R\$6/R
9	=K7-K8			C <sub>B,Protein</sub>	=O7+O8	=P7+P8	=Q7+Q8	=R7+R8
10	10			C <sub>B,Lactase</sub>	=10years!B68*(O\$6/C	=10years!C68*(P\$6/P	=10years!D68*(Q\$6/C	=10years!E68*(R\$6/R
11	=K9/K13	CF total		C <sub>B,Ash</sub>	=10years!B69*(O\$6/C	=10years!C69*(P\$6/P	=10years!D69*(Q\$6/C	=10years!E69*(R\$6/R
12	=27.9-5.3*LN(K11)	gsfd		C <sub>B,Substr. Fat</sub>	=10years!B70*(O\$6/C	=10years!C70*(P\$6/P	=10years!D70*(Q\$6/C	=10years!E70*(R\$6/R
13	2686.31708093633	gal/day		Final Protein Concentration	=O9	=P9	=Q9	=R9
14	=K\$6*K12	gal/day		Yield	=B13*O13/(B7*(10year	=C13*P13/(C7*(10year	=D13*Q13/(D7*(10year	=E13*R13/(E7*(10year
15	=K14+K13	gal/day		Final Protein % (dry weight)				
16				Total Area	=B6	=C6	=D6	=E6
17				Total Permeate	=B14	=C14	=D14	=E14
18	10							
19	=K6	ft <sup>2</sup>						
20	=K19/26.5	26.5 ft <sup>2</sup> /cartridge						
21	=K20*23	gal/min						
22	=K21+K7/(20*60)	gal/min						
23	=K22*4*12/12/(7.48*4.026-2*P10*60)							
24								
25	=X7							
26	=X8							
27	=X10							
28	=X11							
29	=X12							
30	=(K25+K26)/SUM(K25:K29)							
31	=SUM(K25:K29)/1							
32	=X15							
33								
34	Year 10							
35								
36	=K13							
37	=K49*(27.9-5.3*LN(K3/K36))							
38	=K37+K36							
39	=K38/K36							
40								
41	=K25*(1/((K\$38/K\$36)*(1-Given)\$F5)+Given)\$F5)^(\$B\$35)							
42	=K26*(1/((K\$38/K\$36)*(1-Given)\$F6)+Given)\$F6)^(\$B\$35)							
43	=K27*(1/((K\$38/K\$36)*(1-Given)\$F7)+Given)\$F7)^(\$B\$35)							
44	=K28*(1/((K\$38/K\$36)*(1-Given)\$F8)+Given)\$F8)^(\$B\$35)							
45	=K29*(1/((K\$38/K\$36)*(1-Given)\$F9)+Given)\$F9)^(\$B\$35)							
46	=(K41+K42)/SUM(K41:K45)							
47	=(K41+K42)*K36/((K25+K26)*K36)							
48	=K3/K36							
49	=26.5*K50							
50	20							
51	=23*K50+K38/(20*60)							
52	=(K41+K42)*K36/((10years!K66+10years!K67)*K7)							
53	=(K41+K42+K43+K44+K45)/1							



Appendix D

	S	T	U	V	W	X
1						
2						
3						
4						
5						
6	=F7/F13					
7	=10years!F66*(S\$6/S) =10years!G66*(T\$6/T) =10years!H66*(U\$6/U) =10years!I66*(V\$6/V\$) =10years!J66*(W\$6/W\$) =10years!K66*(X\$6/X\$6)*(1-Giv)	=G7/G13	=H7/H13	=I7/I13	=J7/J13	=K7/K13
8	=10years!F67*(S\$6/S) =10years!G67*(T\$6/T) =10years!H67*(U\$6/U) =10years!I67*(V\$6/V\$) =10years!J67*(W\$6/W\$) =10years!K67*(X\$6/X\$6)*(1-Giv)	=T7+T8	=U7+U8	=V7+V8	=W7+W8	=X7+X8
9	=S7+S8					
10	=10years!F68*(S\$6/S) =10years!G68*(T\$6/T) =10years!H68*(U\$6/U) =10years!I68*(V\$6/V\$) =10years!J68*(W\$6/W\$) =10years!K68*(X\$6/X\$6)*(1-Giv)	=10years!G68*(T\$6/T)	=10years!H68*(U\$6/U)	=10years!I68*(V\$6/V\$)	=10years!J68*(W\$6/W\$)	=10years!K68*(X\$6/X\$6)*(1-Giv)
11	=10years!F69*(S\$6/S) =10years!G69*(T\$6/T) =10years!H69*(U\$6/U) =10years!I69*(V\$6/V\$) =10years!J69*(W\$6/W\$) =10years!K69*(X\$6/X\$6)*(1-Giv)	=10years!G69*(T\$6/T)	=10years!H69*(U\$6/U)	=10years!I69*(V\$6/V\$)	=10years!J69*(W\$6/W\$)	=10years!K69*(X\$6/X\$6)*(1-Giv)
12	=10years!F70*(S\$6/S) =10years!G70*(T\$6/T) =10years!H70*(U\$6/U) =10years!I70*(V\$6/V\$) =10years!J70*(W\$6/W\$) =10years!K70*(X\$6/X\$6)*(1-Giv)	=10years!G70*(T\$6/T)	=10years!H70*(U\$6/U)	=10years!I70*(V\$6/V\$)	=10years!J70*(W\$6/W\$)	=10years!K70*(X\$6/X\$6)*(1-Giv)
13						
14	=S9	=T9	=U9	=V9	=W9	=X9
15	=F13*S13/(F7*(10years)	=G13*T13/(G7*(10years)	=H13*U13/(H7*(10years)	=I13*V13/(I7*(10years)	=J13*W13/(J7*(10years!J66+10y)	=K13*X13/(K7*(10years!K66+10y)
16						
17						
18	=F6	=G6	=H6	=I6	=J6	=K6
19	=F14	=G14	=H14	=I14	=J14	=K14
20						
21						
22						
23						
24						
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52						
53						

Appendix D

	A	B	C	D
1				
2	From 75% (One Dia. Stage)			
3	Amount in 35%	=1\$1opt.I\$E17	=1\$1opt.I\$E19	=1\$1opt.I\$E21
4	Amount in 35%	9913.25463283373	9998.15396144322	10030.7175629511
5	1 Diafiltration			
6	Solin Feed (gpd)	=10-55%IB36-1\$1opt.I\$F3/10-55%IB53/B.5	=10-55%IC36-1\$1opt.I\$F4/10-55%IC53/B.5	=10-55%ID36-1\$1opt.I\$F5/10-55%ID53/B.5
7	Water Added (gpd)	=B19*(27.9-5.3*LN(B4/B6))	=C19*(27.9-5.3*LN(C4/C6))	=D19*(27.9-5.3*LN(D4/D6))
8	Total Feed (gpd)	=B7+B6	=C7+C6	=D7+D6
9	CF, D1	=B8/B6	=C8/C6	=D8/D6
10	Concentrations			
11	True Protein	=10-55%IB41*(1/(B\$8/B\$6)*(1-Given)\$F5+Given)\$F5)*(\$B\$5)	=10-55%IC41*(1/(C\$8/C\$6)*(1-Given)\$F5+Given)\$F5)*(\$B\$5)	=10-55%ID41*(1/(D\$8/D\$6)*(1-Given)\$F5+Given)\$F5)*(\$B\$5)
12	Non-Protein Nitrogen	=10-55%IB42*(1/(B\$8/B\$6)*(1-Given)\$F6+Given)\$F6)*(\$B\$5)	=10-55%IC42*(1/(C\$8/C\$6)*(1-Given)\$F6+Given)\$F6)*(\$B\$5)	=10-55%ID42*(1/(D\$8/D\$6)*(1-Given)\$F6+Given)\$F6)*(\$B\$5)
13	Lactose	=10-55%IB43*(1/(B\$8/B\$6)*(1-Given)\$F7+Given)\$F7)*(\$B\$5)	=10-55%IC43*(1/(C\$8/C\$6)*(1-Given)\$F7+Given)\$F7)*(\$B\$5)	=10-55%ID43*(1/(D\$8/D\$6)*(1-Given)\$F7+Given)\$F7)*(\$B\$5)
14	Ash	=10-55%IB44*(1/(B\$8/B\$6)*(1-Given)\$F8+Given)\$F8)*(\$B\$5)	=10-55%IC44*(1/(C\$8/C\$6)*(1-Given)\$F8+Given)\$F8)*(\$B\$5)	=10-55%ID44*(1/(D\$8/D\$6)*(1-Given)\$F8+Given)\$F8)*(\$B\$5)
15	Butter Fat	=10-55%IB45*(1/(B\$8/B\$6)*(1-Given)\$F9+Given)\$F9)*(\$B\$5)	=10-55%IC45*(1/(C\$8/C\$6)*(1-Given)\$F9+Given)\$F9)*(\$B\$5)	=10-55%ID45*(1/(D\$8/D\$6)*(1-Given)\$F9+Given)\$F9)*(\$B\$5)
16	Total Protein (dry weight)	=B11+B12/SUM(B11:B15)	=C11+C12/SUM(C11:C15)	=D11+D12/SUM(D11:D15)
17	Yield (this part)	=((B11+B12)*B6)/((1*max55%IB79+1*max55%IB80)*B\$6)	=((C11+C12)*C6)/((1*max55%IC79+1*max55%IC80)*C\$6)	=((D11+D12)*D6)/((1*max55%ID79+1*max55%ID80)*D\$6)
18	CF overall	=B\$4/B6	=C\$4/C6	=D\$4/D6
19	Area/stage	=B20*26.5	=C20*26.5	=D20*26.5
20	Cartridges/stage	6	5	6
21	Max Flow Rate (gpm)	=23*B20+B8/(20*60)	=23*C20+C8/(20*60)	=23*D20+D8/(20*60)

Appendix D

	E	F	G
1			
2			Year
3	=1\$1opt.1\$E23	5	6
4	=10014.9788924638	=1\$1opt.1\$E25	=1\$1opt.1\$E27
5		10697.3436170854	11884.7588062544
6		5	6
7	=10-55%IE36-1\$1opt.1\$F6/10-55%IE53/8.5	=F19*(27.9-5.3*LN(F4/F6))	=10-55%IG36-1\$1opt.1\$F8/10-55%IG53/8.5
8	=E7+E6	=F7+F6	=G7+G6
9	=E8/E6	=F8/F6	=G8/G6
10			
11	=10-55%IE41*(1/((E8/E6)*(1-Given(F5)+Given(F5))^(B\$5)))	=10-55%IF41*(1/((F8/F6)*(1-Given(F5)+Given(F5))^(B\$5)))	=10-55%IG41*(1/((G8/G6)*(1-Given(F5)+Given(F5))^(B\$5)))
12	=10-55%IE42*(1/((E8/E6)*(1-Given(F6)+Given(F6))^(B\$5)))	=10-55%IF42*(1/((F8/F6)*(1-Given(F6)+Given(F6))^(B\$5)))	=10-55%IG42*(1/((G8/G6)*(1-Given(F6)+Given(F6))^(B\$5)))
13	=10-55%IE43*(1/((E8/E6)*(1-Given(F7)+Given(F7))^(B\$5)))	=10-55%IF43*(1/((F8/F6)*(1-Given(F7)+Given(F7))^(B\$5)))	=10-55%IG43*(1/((G8/G6)*(1-Given(F7)+Given(F7))^(B\$5)))
14	=10-55%IE44*(1/((E8/E6)*(1-Given(F8)+Given(F8))^(B\$5)))	=10-55%IF44*(1/((F8/F6)*(1-Given(F8)+Given(F8))^(B\$5)))	=10-55%IG44*(1/((G8/G6)*(1-Given(F8)+Given(F8))^(B\$5)))
15	=10-55%IE45*(1/((E8/E6)*(1-Given(F9)+Given(F9))^(B\$5)))	=10-55%IF45*(1/((F8/F6)*(1-Given(F9)+Given(F9))^(B\$5)))	=10-55%IG45*(1/((G8/G6)*(1-Given(F9)+Given(F9))^(B\$5)))
16	=((E1+E2)/SUM(E1:E5))	=((F1+F2)/SUM(F1:F5))	=((G1+G2)/SUM(G1:G5))
17	=((E11+E12)*E6)/((1max55%IE79+1max55%IE80)*E6)	=((F11+F12)*F6)/((1max55%IF79+1max55%IF80)*F6)	=((G11+G12)*G6)/((1max55%IG79+1max55%IG80)*G6)
18	=E3/E6	=F3/F6	=G3/G6
19	=E20*26.5	=F20*26.5	=G20*26.5
20	6	6	7
21	=23*E20+E8/(20*60)	=23*F20+F8/(20*60)	=23*G20+G8/(20*60)

Appendix D

	H	I	J
1			
2			
3	=1\$10pt.1\$E29	=1\$10pt.1\$E31	=1\$10pt.1\$E33
4	1.1519.0011928069	12150.6086426351	12442.6772630453
5			
6	=10-55%1H36-1\$10pt.1\$F9/10-55%1H53/8.5	=10-55%1H36-1\$10pt.1\$F10/10-55%1I53/8.5	=10-55%1J36-1\$10pt.1\$F11/10-55%1J53/8.5
7	=H19*(27.9-5.3*LN(H4/H6))	=I19*(27.9-5.3*LN(I4/I6))	=J19*(27.9-5.3*LN(J4/J6))
8	=H7+H6	=I7+I6	=J7+J6
9	=H8/H6	=I8/I6	=J8/J6
10			
11	=10-55%1H41*(1/((H\$8/H\$6)^(1-Given(\$F5)+Given(\$F5))*(\$B\$5))	=10-55%1I41*(1/((I\$8/I\$6)^(1-Given(\$F5)+Given(\$F5))*(\$B\$5))	=10-55%1J41*(1/((J\$8/J\$6)^(1-Given(\$F5)+Given(\$F5))*(\$B\$5))
12	=10-55%1H42*(1/((H\$8/H\$6)^(1-Given(\$F6)+Given(\$F6))*(\$B\$5))	=10-55%1I42*(1/((I\$8/I\$6)^(1-Given(\$F6)+Given(\$F6))*(\$B\$5))	=10-55%1J42*(1/((J\$8/J\$6)^(1-Given(\$F6)+Given(\$F6))*(\$B\$5))
13	=10-55%1H43*(1/((H\$8/H\$6)^(1-Given(\$F7)+Given(\$F7))*(\$B\$5))	=10-55%1I43*(1/((I\$8/I\$6)^(1-Given(\$F7)+Given(\$F7))*(\$B\$5))	=10-55%1J43*(1/((J\$8/J\$6)^(1-Given(\$F7)+Given(\$F7))*(\$B\$5))
14	=10-55%1H44*(1/((H\$8/H\$6)^(1-Given(\$F8)+Given(\$F8))*(\$B\$5))	=10-55%1I44*(1/((I\$8/I\$6)^(1-Given(\$F8)+Given(\$F8))*(\$B\$5))	=10-55%1J44*(1/((J\$8/J\$6)^(1-Given(\$F8)+Given(\$F8))*(\$B\$5))
15	=10-55%1H45*(1/((H\$8/H\$6)^(1-Given(\$F9)+Given(\$F9))*(\$B\$5))	=10-55%1I45*(1/((I\$8/I\$6)^(1-Given(\$F9)+Given(\$F9))*(\$B\$5))	=10-55%1J45*(1/((J\$8/J\$6)^(1-Given(\$F9)+Given(\$F9))*(\$B\$5))
16	=((H11+H12)/SUM(H11:H15))	=((I11+I12)/SUM(I11:I15))	=((J11+J12)/SUM(J11:J15))
17	=((H11+H12)*H6)/((1+max(5%1H79+1max(5%1H80))*\$6)	=((I11+I12)*I6)/((1+max(5%1I79+1max(5%1I80))*\$6)	=((J11+J12)*J6)/((1+max(5%1J79+1max(5%1J80))*\$6)
18	=H\$4/H6	=I\$4/I6	=J\$4/J6
19	=H20*26.5	=I20*26.5	=J20*26.5
20			
21	=23*H20+H8/(20*60)	=23*I20+I8/(20*60)	=23*J20+J8/(20*60)

	K
1	
2	10
3	=('\$!opt.'!\$E35
4	13541.4372902977
5	10
6	=10-55%!(K36-'!\$!opt.'!\$F12/10-55%!(K53/8.5
7	=K19*(27.9-5.3*LN(K4/K6))
8	=K7+K6
9	=K8/K6
10	
11	=10-55%!(K41*(1/((K\$8/K\$6)*(1-Given!\$F5)+Given!\$F5))^(55\$5)
12	=10-55%!(K42*(1/((K\$8/K\$6)*(1-Given!\$F6)+Given!\$F6))^(55\$5)
13	=10-55%!(K43*(1/((K\$8/K\$6)*(1-Given!\$F7)+Given!\$F7))^(55\$5)
14	=10-55%!(K44*(1/((K\$8/K\$6)*(1-Given!\$F8)+Given!\$F8))^(55\$5)
15	=10-55%!(K45*(1/((K\$8/K\$6)*(1-Given!\$F9)+Given!\$F9))^(55\$5)
16	<del>=K11+K12</del>
17	=((K11+K12)*K6)/((1+max(55%!(K78+'!max(55%!(K60)*K\$6
18	=K\$4/K6
19	=K20*26.5
20	8
21	=23*K20+K8/(20*60)













Appendix D

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
301	Total Solids	76.88	72.98	5.90	66.86	6.12	12.02	60.82	6.04	18.06	54.86	5.96	24.01	49.00	5.86	29.87	43.26	5.74	35.62	37.65	5.61	41.22
302																						
303	gall/min																					
304	Total	139.54	126.84	12.70	113.81	13.03	25.73	101.08	12.72	38.46	88.69	12.39	50.85	76.88	12.01	62.86	65.09	11.59	74.45	53.98	11.11	85.56
305																						
306	Mass %																					
307	True Protein	0.60%	0.66%	0.02%	0.73%	0.02%	0.02%	0.82%	0.02%	0.02%	0.93%	0.03%	0.02%	1.07%	0.03%	0.03%	1.26%	0.04%	0.03%	1.50%	0.05%	0.03%
308	Non-Protein Nitrogen	0.30%	0.31%	0.21%	0.32%	0.22%	0.21%	0.33%	0.23%	0.22%	0.34%	0.23%	0.22%	0.36%	0.25%	0.23%	0.38%	0.26%	0.23%	0.40%	0.27%	0.24%
309	Lactose	4.90%	4.94%	4.52%	4.98%	4.56%	4.54%	5.03%	4.60%	4.58%	5.08%	4.65%	4.58%	5.14%	4.70%	4.61%	5.21%	4.77%	4.63%	5.29%	4.84%	4.66%
310	Ash	0.80%	0.81%	0.72%	0.82%	0.72%	0.81%	0.83%	0.73%	0.72%	0.84%	0.74%	0.73%	0.85%	0.76%	0.73%	0.87%	0.77%	0.74%	0.86%	0.78%	0.75%
311	Butter Fat	0.05%	0.06%	0.00%	0.06%	0.00%	0.00%	0.07%	0.00%	0.00%	0.08%	0.00%	0.00%	0.09%	0.00%	0.00%	0.11%	0.00%	0.00%	0.13%	0.00%	0.00%
312	Water	83.35%	83.23%	94.54%	93.09%	94.48%	94.51%	92.92%	94.41%	94.48%	92.72%	94.34%	94.44%	92.48%	94.25%	94.41%	92.18%	94.17%	94.37%	91.79%	94.06%	94.33%
313	Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
314	% Solids	6.7%	6.8%	5.5%	6.9%	5.5%	5.5%	7.1%	5.6%	5.5%	7.3%	5.7%	5.6%	7.5%	5.7%	5.6%	7.8%	5.8%	5.6%	8.2%	5.9%	5.7%
315	% Protein of Solids	13.5%	14.3%	4.2%	15.2%	4.3%	4.3%	16.3%	4.5%	4.3%	17.5%	4.6%	4.4%	19.0%	4.8%	4.5%	20.9%	5.1%	4.6%	23.2%	5.3%	4.7%
316																						
317	Properties																					
318	Temperature (°C)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
319	Pressure (psi)	15	15	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5

Appendix D

	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
Bleed 8	Perm. Mix	Bleed 9	Perm. Mix	Bleed 10	Perm. Mix	Bleed 10	Perm. Mix	35% Wet	55% Feed	55% Bleed	55% Perm.	Perm. Mix	55% Perm.	Perm. Mix	H2O Feed	Dia. 1 Feed	Dia. 1 Bleed	Dia. 1 Perm.	Perm. Mix	75% Wet	Dia. 2																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
0.04	0.20	4.76	0.04	0.27	4.72	0.04	0.23	3.53	1.19	1.14	0.06	0.19	1.14	0.00	1.03	0.10	0.13	0.71	0.32	0.18	1.44	0.88	0.18	1.44	0.09	0.17	0.03	0.06	0.07	0.02	0.01	3.20	6.20	2.10	0.63	0.83	0.00	0.21	0.63	0.14	0.06	0.06	4.44	1.75	0.48	0.48	0.00	0.11	0.00	0.11	0.00	0.00	0.00	0.00	0.12	0.03	0.01	55.16	168.61	54.14	171.47	132.40	36.21	117.32	98.97	33.43	11.72	21.71	81.11	57.55	45.83	12.62	44.83	59.41	8.70	3.92	58.52	58.87	186.70	57.76	180.19	148.01	38.70	122.43	110.64	37.37	14.03	83.74	59.86	45.83	60.40	9.66	4.36	3.80	33.71	18.09	3.62	8.73	15.61	2.48	5.11	11.67	3.94	2.31	1.64	2.63	0.00	1.41	0.90	0.99	0.97	0.44	7.33	69.28	21.97	6.80	21.33	17.41	4.55	14.54	13.02	4.40	1.65	2.75	9.98	7.14	1.65	5.49	7.24	1.14	0.51	0.06	0.30	0.08	0.08	0.15	0.10	0.19	0.19	3.19	0.15	8.10	0.24	0.23	0.00	7.36	0.22	0.22	7.36	0.19	0.19	0.30	0.47	0.32	0.32	0.51	0.34	0.50	0.24	0.50	0.27	0.63	0.43	0.20	0.00	0.19	0.13	0.13	0.19	0.19	0.19	4.94	4.89	5.19	5.04	3.79	5.61	3.20	5.61	5.61	3.79	5.92	5.42	2.31	0.39	1.46	1.36	1.46	1.46	1.46	1.46	1.46	0.81	0.75	0.94	0.83	0.63	0.85	0.54	0.96	0.63	1.03	0.39	0.92	0.31	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.00	0.00	0.22	0.00	0.00	0.28	0.00	0.00	0.28	0.00	0.75	0.00	0.00	0.00	0.75	0.00	0.75	0.00	0.00	0.00	0.00	93.90	94.28	90.31	93.73	95.16	89.46	93.58	95.83	89.46	95.16	83.57	92.99	96.86	99.15	100	99.97	98.04	98.36	89.97	89.97	89.97	100	100	700	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	6.1	9.7	6.3	4.8	4.8	10.5	6.4	4.2	10.5	10.5	16.4	7.0	3.1	3.1	3.9	2.0	2.0	1.6	10.0	10.0	10.0	5.8	4.8	31.2	6.3	8.7	35.0	6.8	10.3	35.0	35.0	53.1	9.6	13.6	13.6	0.0	75.3	18.3	20.2	75.3	75.3	75.3	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	0.19	4.96	0.04	0.28	4.91	0.06	0.24	3.72	1.19	1.13	0.06	0.18	1.13	0.00	1.03	0.10	0.12	0.74	0.29	0.19	1.45	0.97	0.19	0.65	0.76	0.20	0.37	0.58	0.18	0.09	0.10	0.16	0.09	0.00	0.03	0.06	0.02	0.01	3.15	27.97	11.50	2.99	7.92	8.45	3.05	4.93	6.41	2.04	0.80	1.24	1.88	0.80	0.00	0.21	0.60	0.64	0.15	0.06	0.51	4.49	1.95	0.49	1.32	1.45	0.51	0.83	1.10	0.35	0.14	0.21	0.32	0.14	0.00	0.04	0.10	0.11	0.03	0.01	0.00	0.00	0.43	0.00	0.00	0.43	0.00	0.00	0.33	0.10	0.10	0.00	0.00	0.10	0.00	0.10	0.00	0.00	0.08	0.03	60.10	562.91	190.10	56.03	180.50	134.50	55.60	124.48	106.81	27.69	11.30	16.39	68.88	53.24	41.85	12.15	41.09	52.48	8.71	3.44	63.98	597.01	209.91	59.74	185.37	150.49	59.42	135.63	114.15	36.35	13.56	22.79	76.21	55.51	41.95	13.56	41.95	53.42	9.72	3.84	3.88	34.10	19.82	3.72	10.07	16.00	3.82	6.36	12.13	3.86	2.26	1.60	2.54	2.26	0.00	1.41	0.86	0.94	1.01	0.40	7.53	70.24	24.70	7.03	23.10	17.71	6.99	16.07	13.43	4.28	1.60	2.68	9.08	6.62	5.03	1.60	5.03	6.40	1.14	0.45	0.06	0.03	2.37	0.07	0.14	3.26	0.17	0.17	3.26	0.14	8.32	0.26	0.23	0.00	7.60	0.23	0.23	7.60	0.23	0.23	0.29	0.24	0.46	0.31	0.28	0.51	0.34	0.27	0.51	0.28	0.63	0.43	0.21	0.15	0.00	0.20	0.14	0.12	0.20	0.20	4.92	4.69	5.48	5.01	4.08	5.61	5.14	3.63	5.61	4.08	5.93	5.43	2.46	1.45	0.00	1.58	1.42	1.20	1.53	1.53	0.80	0.75	0.93	0.82	0.67	0.96	0.61	0.61	0.96	0.67	1.04	0.92	0.42	0.25	0.00	0.27	0.25	0.21	0.27	0.27	0.00	0.00	0.21	0.00	0.00	0.29	0.00	0.00	0.29	0.00	0.77	0.00	0.00	0.19	0.00	0.77	0.00	0.00	0.77	0.77	93.93	94.29	90.66	93.78	94.84	89.37	93.57	95.31	93.57	94.84	83.31	92.98	96.67	99.15	100	99.92	98.04	98.36	89.97	89.97	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	6.1	9.4	6.2	4.8	4.8	10.6	4.7	4.7	10.6	10.6	16.7	7.0	3.3	3.3	4.1	2.0	2.0	1.8	10.4	10.4	5.7	4.8	29.9	6.2	8.3	35.4	6.9	9.5	35.4	35.4	53.6	9.7	13.4	13.4	0.0	75.2	18.2	20.2	75.2	75.2











Appendix D

	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ
301	32.21	5.44	46.66	26.98	5.23	13.72	22.24	4.74	8.49	16.61	5.64	3.21	2.42	3.75	3.21	0.00	2.02	1.19	1.32	1.38	0.64
302																					
303																					
304	43.43	10.65	96.11	33.55	9.88	31.75	24.85	8.70	21.86	18.55	6.30	2.24	4.06	13.16	9.00	6.76	2.24	6.76	9.11	1.53	0.71
305																					
306	1.86%	0.06%	0.03%	2.38%	0.07%	0.15%	3.18%	0.10%	0.18%	3.18%	0.15%	8.49%	0.25%	0.24%	2.14%	0.00%	7.78%	0.24%	0.23%	7.78%	7.78%
308	0.43%	0.29%	0.24%	0.46%	0.31%	0.28%	0.50%	0.34%	0.27%	0.50%	0.28%	0.63%	0.43%	0.22%	0.16%	0.00%	0.21%	0.14%	0.12%	0.21%	0.21%
309	5.37%	4.92%	4.69%	5.48%	5.01%	4.01%	5.60%	5.13%	3.56%	5.60%	4.01%	5.93%	5.42%	2.51%	1.49%	0.00%	1.57%	1.47%	1.18%	1.57%	1.57%
310	0.81%	0.80%	0.75%	0.93%	0.82%	0.67%	0.86%	0.85%	0.60%	0.96%	0.67%	1.04%	0.92%	0.45%	0.26%	0.00%	0.28%	0.25%	0.21%	0.28%	0.28%
311	0.16%	0.00%	0.00%	0.21%	0.00%	0.00%	0.28%	0.00%	0.00%	0.28%	0.00%	0.79%	0.00%	0.00%	0.20%	0.00%	0.79%	0.00%	0.00%	0.79%	0.79%
312	91.27%	93.93%	94.29%	90.54%	93.78%	94.89%	89.47%	93.59%	95.40%	89.47%	94.89%	83.12%	92.97%	96.61%	95.74%	100%	89.36%	97.90%	96.26%	89.36%	89.36%
313	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
314	8.7%	6.1%	5.7%	9.5%	6.2%	5.1%	10.5%	6.4%	4.6%	10.5%	10.5%	16.9%	7.0%	3.4%	4.3%	0.0%	10.6%	2.1%	1.7%	10.6%	10.6%
315	26.2%	5.7%	4.8%	30.0%	6.2%	8.4%	35.0%	6.8%	9.7%	35.0%	35.0%	54.1%	9.8%	13.4%	54.1%	0.0%	75.1%	18.1%	20.1%	75.1%	75.1%
316																					
317																					
318	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
319	15	5	5	15	5	5	15	5	5	15	15	15	15	5	15	15	15	5	5	15	15











Appendix D

	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ
301	0.65	0.00	0.51	0.14	60.38	19,926.37	1,655.97	810.78	0.00	43,806.61	13,504.83	57,311.44	43,806.61	47.76	12.62	57,311.44	0.00	0.00	0.00
302																			
303																			
304	3.05	2.34	0.71	2.34	127.85	2,344.28	194.82	71.86	111,863.39	5,153.72	28,558.89	33,712.61	92,636.61	101.00	26.69	121,197.50	10,926.75	100,936.64	2,796.00
305																			
306																			
307	1.84%	0.00%	7.09%	0.22%	0.06%	30.22%	73.17%	84.31%	0.00%	1.09%	0.06%	0.22%	0.06%	0.06%	0.06%	0.06%	0.00%	0.00%	0.00%
308	0.05%	0.00%	0.06%	0.04%	0.25%	4.77%	1.95%	0.76%	0.00%	4.53%	0.25%	0.91%	0.25%	0.25%	0.25%	0.25%	0.00%	0.00%	0.00%
309	0.37%	0.00%	0.39%	0.37%	4.52%	53.22%	14.80%	4.68%	0.00%	81.24%	4.52%	16.25%	4.52%	4.52%	4.52%	4.52%	0.00%	0.00%	0.00%
310	0.07%	0.00%	0.07%	0.07%	0.73%	9.12%	2.65%	0.86%	0.00%	13.14%	0.73%	2.63%	0.73%	0.73%	0.73%	0.73%	0.00%	0.00%	0.00%
311	0.19%	0.00%	0.79%	0.00%	0.00%	2.67%	7.42%	9.40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
312	97.48%	100%	91.60%	99.31%	94.44%	0.00%	0.00%	0.00%	100%	94.44%	100%	80.00%	94.44%	94.44%	94.44%	94.44%	100%	100%	100%
313	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
314	2.5%	0.0%	8.4%	0.7%	5.6%	100.0%	100.0%	100.0%	0.0%	100.0%	5.6%	20.0%	5.6%	5.6%	5.6%	5.6%	0.0%	0.0%	0.0%
315	75.1%	0.0%	85.1%	37.7%	5.6%	35.0%	75.1%	85.1%	0.0%	5.6%	5.6%	5.6%	5.6%	5.6%	5.6%	5.6%	0.0%	0.0%	0.0%
316																			
317																			
318	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
319	15	15	15	5	5	15	15	15	5	5	5	5	5	5	5	5	5	5	5

Appendix D

BK	BL	BM	BN	BO	BP	BQ	BR
1							
2	Waste H <sub>2</sub> O	H <sub>2</sub> O, Perm. Cleaning Waste	Total Waste				
3	82	83	84	85			
4							
5	lbs/day	lbs/day	lbs/day				
6	0.00	0.00	0.00				
7	0.00	0.00	0.00				
8	0.00	0.00	0.00				
9	0.00	0.00	0.00				
10	0.00	0.00	0.00				
11	711,037.84	711,037.84	18,836.23	729,874.07			
12	711,037.84	711,037.84	18,836.23	729,874.07			
13	0.00	0.00	0.00				
14							
15	gal/day	gal/day	gal/day				
16	85,205.25	85,205.25	2,257.19	87,462.44			
17							
18							
19	0.00%	0.00%	0.00%	0.00%			
20	0.00%	0.00%	0.00%	0.00%			
21	0.00%	0.00%	0.00%	0.00%			
22	0.00%	0.00%	0.00%	0.00%			
23	0.00%	0.00%	0.00%	0.00%			
24	100%	100%	100%	100%			
25	100%	100%	100%	100%			
26	0.0%	0.0%	0.0%	0.0%			
27	0.0%	0.0%	0.0%	0.0%			
28							
29							
30	30	30	30	30			
31	5	5	5	5			
32							
33							
34	Waste H <sub>2</sub> O	H <sub>2</sub> O, Perm. Cleaning Waste	Total Waste				
35	82	83	84	85			
36							
37	lbs/day	lbs/day	lbs/day				
38	0.00	0.00	0.00	0.00			
39	0.00	0.00	0.00	0.00			
40	0.00	0.00	0.00	0.00			
41	0.00	0.00	0.00	0.00			
42	0.00	0.00	0.00	0.00			
43	739,749.15	739,749.15	2,731.75	742,480.90			
44	739,749.15	739,749.15	2,731.75	742,480.90			
45	0.00	0.00	0.00	0.00			
46							
47	gal/day	gal/day	gal/day				
48	88,645.79	88,645.79	327.35	88,973.15			
49							
50							
51	0.00%	0.00%	0.00%	0.00%			
52	0.00%	0.00%	0.00%	0.00%			
53	0.00%	0.00%	0.00%	0.00%			
54	0.00%	0.00%	0.00%	0.00%			
55	0.00%	0.00%	0.00%	0.00%			
56	100%	100%	100%	100%			
57	100%	100%	100%	100%			
58	0.0%	0.0%	0.0%	0.0%			
59	0.0%	0.0%	0.0%	0.0%			
60							



	BK	BL	BM	BN	BO	BP	BQ	BR
61								
62	30	30	30	30				
63	5	5	5	5				
64								
65								
66	Waste H2O - Farm - Cleaning Waste - Total Waste							
67	63	64	65	65				
68								
69	lbs/day	lbs/day	lbs/day	lbs/day				
70	0.00	0.00	0.00	0.00				
71	0.00	0.00	0.00	0.00				
72	0.00	0.00	0.00	0.00				
73	0.00	0.00	0.00	0.00				
74	0.00	0.00	0.00	0.00				
75	769,857.31	769,857.31	19,551.23	769,408.55				
76	769,857.31	769,857.31	19,551.23	769,408.55				
77	0.00	0.00	0.00	0.00				
78								
79	gal/day	gal/day	gal/day	gal/day				
80	92,253.72	92,253.72	2,342.87	94,596.59				
81								
82								
83	0.00%	0.00%	0.00%	0.00%				
84	0.00%	0.00%	0.00%	0.00%				
85	0.00%	0.00%	0.00%	0.00%				
86	0.00%	0.00%	0.00%	0.00%				
87	100%	100%	100%	100%				
88	100%	100%	100%	100%				
89	0.00%	0.00%	0.00%	0.00%				
90	0.0%	0.0%	0.0%	0.0%				
91	0.0%	5.6%	0.0%	0.0%				
92								
93								
94	30	30	30	30				
95	5	5	5	5				
96								
97								
98	Waste H2O - Farm - Cleaning Waste - Total Waste							
99	63	64	65	65				
100								
101	lbs/day	lbs/day	lbs/day	lbs/day				
102	0.00	0.00	0.00	0.00				
103	0.00	0.00	0.00	0.00				
104	0.00	0.00	0.00	0.00				
105	0.00	0.00	0.00	0.00				
106	0.00	0.00	0.00	0.00				
107	776,383.06	776,383.06	19,980.23	796,363.29				
108	776,383.06	776,383.06	19,980.23	796,363.29				
109	0.00	0.00	0.00	0.00				
110								
111	gal/day	gal/day	gal/day	gal/day				
112	93,035.72	93,035.72	2,394.28	95,429.99				
113								
114								
115	0.00%	0.00%	0.00%	0.00%				
116	0.00%	0.00%	0.00%	0.00%				
117	0.00%	0.00%	0.00%	0.00%				
118	0.00%	0.00%	0.00%	0.00%				
119	0.00%	0.00%	0.00%	0.00%				
120	100%	100%	100%	100%				

	BK	BL	BM	BN	BO	BP	BQ	BR
121	100%	100%	100%	100%	COD	0.0 mg/liter soln		
122	0.0%	0.0%	0.0%	0.0%	BOD	0.0 mg/liter soln		300
123	0.0%	0.0%	0.0%	0.0%		0.00000 lb/gal		0.00250
124								
125								
126	30	30	30	30				
127	5	5	5	5				
128								
129								
130	Waste H <sub>2</sub> O H <sub>2</sub> O * Perm. Cleaning Waste Total Waste							
131	52	53	54	55				
132	lbs/day	lbs/day	lbs/day	lbs/day				
133	0.00	0.00	0.00	0.00				
134	0.00	0.00	0.00	0.00				
135	0.00	0.00	0.00	0.00				
136	0.00	0.00	0.00	0.00				
137	0.00	0.00	0.00	0.00				
138	0.00	0.00	0.00	0.00				
139	833,443.78	833,443.78	20,480.73	853,924.51				
140	833,443.78	833,443.78	20,480.73	853,924.51				
141	0.00	0.00	0.00	0.00				
142								
143	gal/day	gal/day	gal/day	gal/day				
144	99,873.43	99,873.43	2,454.25	102,327.68				
145								
146								
147	0.00%	0.00%	0.00%	0.00%				
148	0.00%	0.00%	0.00%	0.00%				
149	0.00%	0.00%	0.00%	0.00%				
150	0.00%	0.00%	0.00%	0.00%				
151	0.00%	0.00%	0.00%	0.00%				
152	100%	100%	100%	0%				
153	100%	100%	100%	100%	COD	0.0 mg/liter soln		
154	0.0%	0.0%	0.0%	0.0%	BOD	0.0 mg/liter soln		300
155	0.0%	0.0%	0.0%	0.0%		0.00000 lb/gal		0.00250
156								
157								
158	30	30	30	30				
159	5	5	5	5				
160								
161								
162	Waste H <sub>2</sub> O H <sub>2</sub> O * Perm. Cleaning Waste Total Waste							
163	52	53	54	55				
164	lbs/day	lbs/day	lbs/day	lbs/day				
165	0.00	0.00	0.00	0.00				
166	0.00	126.38	0.00	126.38				
167	0.00	2,267.50	0.00	2,267.50				
168	0.00	366.75	0.00	366.75				
169	0.00	0.00	0.00	0.00				
170	830,484.51	878,024.09	21,195.73	899,219.81				
171	830,484.51	880,815.17	21,195.73	902,010.90				
172	0.00	2,790.09	0.00	2,790.09				
173								
174								
175	gal/day	gal/day	gal/day	gal/day				
176	99,518.81	105,440.07	2,539.93	108,089.98				
177								
178	0.00%	0.00%	0.00%	0.00%				
179	0.00%	0.01%	0.00%	0.01%				
180	0.00%	0.01%	0.00%	0.01%				

	BK	BL	BM	BN	BO	BP	BQ	BR
181	0.00%	0.26%	0.00%	0.25%				
182	0.00%	0.04%	0.00%	0.04%				
183	0.00%	0.00%	0.00%	0.00%				
184	100%	100%	100%	100%				
185	100%	100%	100%	100%	COD	2,872.6	mg/liter soln	300
186	0.0%	0.3%	0.0%	0.3%	BOD	1,723.6	mg/liter soln	
187	0.0%	5.6%	0.0%	0.0%		0.01438	lb/gal	0.00250
188								
189								
190	30	30	30	30				
191	5	5	5	5				
192								
193								
194	Waste H2O H2O Perm. Cleaning Waste Total Waste							
195	52	63	64	65				
196	lbs/day	lbs/day	lbs/day	lbs/day				
197	0.00	54.12	0.00	54.12				
198	0.00	225.89	0.00	225.89				
199	0.00	4,052.59	0.00	4,052.59				
200	0.00	655.48	0.00	655.48				
201	0.00	0.00	0.00	0.00				
202	837,805.45	922,022.09	21,563.23	943,575.31				
204	837,805.45	927,010.17	21,563.23	948,563.39				
205	0.00	4,987.08	0.00	0.00				
206								
207	gal/day	gal/day	gal/day	gal/day				
208	100,396.10	110,890.77	2,582.77	113,668.47				
209								
210								
211	0.00%	0.01%	0.00%	0.01%				
212	0.00%	0.02%	0.00%	0.02%				
213	0.00%	0.44%	0.00%	0.43%				
214	0.00%	0.07%	0.00%	0.07%				
215	0.00%	0.00%	0.00%	0.00%				
216	100%	99%	100%	99%				
217	100%	100%	100%	100%	COD	4,882.1	mg/liter soln	300
218	0.0%	0.5%	0.0%	0.5%	BOD	2,929.3	mg/liter soln	
219	0.0%	5.6%	0.0%	0.0%		0.02444	lb/gal	0.00250
220								
221								
222	30	30	30	30				
223	5	5	5	5				
224								
225								
226	Waste H2O H2O Perm. Cleaning Waste Total Waste							
227	62	63	64	65				
228	lbs/day	lbs/day	lbs/day	lbs/day				
229	0.00	86.84	0.00	86.84				
230	0.00	365.72	0.00	365.72				
231	0.00	6,563.35	0.00	6,563.35				
232	0.00	1,061.56	0.00	1,061.56				
233	0.00	0.00	0.00	0.00				
234	834,252.52	970,648.12	22,125.23	992,773.34				
235	834,252.52	978,725.58	22,125.23	1,000,850.80				
237	0.00	8,076.46	0.00	0.00				
238								
239	gal/day	gal/day	gal/day	gal/day				
240	99,970.34	116,967.17	2,651.32	119,934.19				

	BK	BL	BM	BN	BO	BP	BQ	BR
241								
242								
243	0.00%	0.01%	0.00%	0.01%				
244	0.00%	0.04%	0.00%	0.04%				
245	0.00%	0.67%	0.00%	0.66%				
246	0.00%	0.11%	0.00%	0.11%				
247	0.00%	0.00%	0.00%	0.00%				
248	100%	99%	100%	99%				
249	100%	100%	100%	100%				
250	0.0%	0.8%	0.0%	0.8%				300
251	0.0%	5.6%	0.0%	0.0%				0.00250
252								
253								
254	30	30	30	30				
255	5	5	5	5				
256								
257								
258	Waste H2O	H2O Perm.	Cleaning Waste	Total Waste				
259	62	63	64	65				
260	lbs/day	lbs/day	lbs/day	lbs/day				
261	0.00	123.38	0.00	123.38				
262	0.00	513.98	0.00	513.98				
263	0.00	9,221.24	0.00	9,221.24				
264	0.00	1,491.48	0.00	1,491.48				
265	0.00	0.00	0.00	0.00				
266	829,991.92	1,021,700.40	22,697.22	1,044,397.63				
267	829,991.92	1,033,050.48	22,697.22	1,055,747.70				
268	0.00	11,349.08	0.00	0.00				
269								
270								
271	gal/day	gal/day	gal/day	gal/day				
272	99,459.79	123,349.03	2,719.86	126,512.61				
273								
274	0.00%	0.01%	0.00%	0.01%				
275	0.00%	0.05%	0.00%	0.05%				
276	0.00%	0.89%	0.00%	0.87%				
277	0.00%	0.14%	0.00%	0.14%				
278	0.00%	0.00%	0.00%	0.00%				
279	100%	99%	100%	99%				
280	100%	100%	100%	100%				
281	0.0%	1.1%	0.0%	1.1%				300
282	0.0%	5.6%	0.0%	0.0%				0.00250
283								
284								
285								
286	30	30	30	30				
287	5	5	5	5				
288								
289								
290	Waste H2O	H2O Perm.	Cleaning Waste	Total Waste				
291	62	63	64	65				
292	lbs/day	lbs/day	lbs/day	lbs/day				
293	0.00	165.33	0.00	165.33				
294	0.00	685.96	0.00	685.96				
295	0.00	12,304.23	0.00	12,304.23				
296	0.00	1,980.17	0.00	1,980.17				
297	0.00	0.00	0.00	0.00				
298	818,983.71	1,076,983.24	23,412.22	1,099,495.46				
299	818,983.71	1,091,228.93	23,412.22	1,114,641.15				
300								

Appendix D

	BK	BL	BM	BN	BO	BP	BQ	BR
301	0.00	15,144.69	0.00	0.00				
302								
303	gal/day	gal/day	gal/day	gal/day				
304	98,140.65	130,169.50	2,805.54	131,910.20				
305								
306								
307	0.00%	0.02%	0.00%	0.01%				
308	0.00%	0.06%	0.00%	0.06%				
309	0.00%	1.13%	0.00%	1.10%				
310	0.00%	0.18%	0.00%	0.18%				
311	0.00%	0.00%	0.00%	0.00%				
312	100%	99%	100%	99%				
313	100%	100%	100%	100%	COD 12,614.3 mg/liter soln			
314	0.0%	1.4%	0.0%	1.4%	BOD 7,568.6 mg/liter soln			300
315	0.0%	5.6%	0.0%	0.0%	0.06316 lb/gal			0.00250
316								
317								
318	30	30	30	30				
319	5	5	5	5				

Appendix D

A	B	C	D	E	F	G	H
1							
2	Year						
3	Actual	Calc	Diff.	A	B	C	\$
3 1	=0.009*Givenil3	=(1/\$12)*0.35*E3+(1/(\$12)*\$M\$12)*0.75*F3+(1/(\$12)*\$M\$12*\$N\$12)*0.85	=B3-C3	14000	1163.46235938155	400	=0.65*E3+1.25*F3+2.5*G3
4	=0.009*Givenil4	=(1/\$12)*0.35*E4+(1/(\$12)*\$M\$12)*0.75*F4+(1/(\$12)*\$M\$12*\$N\$12)*0.85	=B4-C4	=E3*0.04+E3	1210.00085375682		=0.65*E4+1.25*F4+2.5*G4
5	=0.009*Givenil5	=(1/\$12)*0.35*E5+(1/(\$12)*\$M\$12)*0.75*F5+(1/(\$12)*\$M\$12*\$N\$12)*0.85	=B5-C5	=E4*0.04+E4	1258.40086790709		=0.65*E5+1.25*F5+2.5*G5
6	=0.009*Givenil6	=(1/\$12)*0.35*E6+(1/(\$12)*\$M\$12)*0.75*F6+(1/(\$12)*\$M\$12*\$N\$12)*0.85	=B6-C6	=E5*0.04+E5	1308.73662342337		=0.65*E6+1.25*F6+2.5*G6
7	=0.009*Givenil7	=(1/\$12)*0.35*E7+(1/(\$12)*\$M\$12)*0.75*F7+(1/(\$12)*\$M\$12*\$N\$12)*0.85	=B7-C7	=E6*0.04+E6	1361.08640036031		=0.65*E7+1.25*F7+2.5*G7
8	=0.009*Givenil8	=(1/\$12)*0.35*E8+(1/(\$12)*\$M\$12)*0.75*F8+(1/(\$12)*\$M\$12*\$N\$12)*0.85	=B8-C8	=E7*0.04+E7	1415.52985637472		=0.65*E8+1.25*F8+2.5*G8
9	=0.009*Givenil9	=(1/\$12)*0.35*E9+(1/(\$12)*\$M\$12)*0.75*F9+(1/(\$12)*\$M\$12*\$N\$12)*0.85	=B9-C9	=E8*0.04+E8	1472.15105062971		=0.65*E9+1.25*F9+2.5*G9
10	=0.009*Givenil10	=(1/\$12)*0.35*E10+(1/(\$12)*\$M\$12)*0.75*F10+(1/(\$12)*\$M\$12*\$N\$12)*0.85	=B10-C10	=E9*0.04+E9	1531.0370926549		=0.65*E10+1.25*F10+2.5*G10
11	=0.009*Givenil11	=(1/\$12)*0.35*E11+(1/(\$12)*\$M\$12)*0.75*F11+(1/(\$12)*\$M\$12*\$N\$12)*0.85	=B11-C11	=E10*0.04+E10	1592.27857636109		=0.65*E11+1.25*F11+2.5*G11
12	=0.009*Givenil12	=(1/\$12)*0.35*E12+(1/(\$12)*\$M\$12)*0.75*F12+(1/(\$12)*\$M\$12*\$N\$12)*0.85	=B12-C12	=E11*0.04+E11	1655.9695966627		=0.65*E12+1.25*F12+2.5*G12
13	Total Protein available			max		max	
14							
15		Total Soin In					
16	lb/day	=G16/0.009	=H16/0.009	=I16/0.009			lbs/day protein
17	gal/day	=C18/8.5	=D16/8.5	=E16/8.5		=I3/L3	=J3/(L3*M3)
18	lb/day	=G18/0.009	=H18/0.009	=I18/0.009			
19	gal/day	=C18/8.5	=D18/8.5	=E18/8.5		=I4/L4	=J4/(L4*M4)
20	lb/day	=G20/0.009	=H20/0.009	=I20/0.009			
21	gal/day	=C20/8.5	=D20/8.5	=E20/8.5		=I5/L5	=J5/(L5*M5)
22	lb/day	=G22/0.009	=H22/0.009	=I22/0.009			
23	gal/day	=C22/8.5	=D22/8.5	=E22/8.5		=I6/L6	=J6/(L6*M6)
24	lb/day	=G24/0.009	=H24/0.009	=I24/0.009			
25	gal/day	=C24/8.5	=D24/8.5	=E24/8.5		=I7/L7	=J7/(L7*M7)
26	lb/day	=G26/0.009	=H26/0.009	=I26/0.009			
27	gal/day	=C26/8.5	=D26/8.5	=E26/8.5		=I8/L8	=J8/(L8*M8)
28	lb/day	=G28/0.009	=H28/0.009	=I28/0.009			
29	gal/day	=C28/8.5	=D28/8.5	=E28/8.5		=I9/L9	=J9/(L9*M9)
30	lb/day	=G30/0.009	=H30/0.009	=I30/0.009			
31	gal/day	=C30/8.5	=D30/8.5	=E30/8.5		=I10/L10	=J10/(L10*M10)
32	lb/day	=G32/0.009	=H32/0.009	=I32/0.009			
33	gal/day	=C32/8.5	=D32/8.5	=E32/8.5		=I11/L11	=J11/(L11*M11)
34	lb/day	=G34/0.009	=H34/0.009	=I34/0.009			
35	gal/day	=C34/8.5	=D34/8.5	=E34/8.5		=I12/L12	=J12/(L12*M12)

	I	J	K	L	M	N
					Yield (incl.)	
1						
2	a	b	c	0.35	0.76	0.85
3	=0.35*E3	=0.75*F3	=0.85*G3	=10years*I\$73	=10.55%*J\$52	=10.85%*K\$517
4	=0.35*E4	=0.75*F4	=0.85*G4	=10years*I\$73	=10.55%*J\$52	=10.85%*K\$517
5	=0.35*E5	=0.75*F5	=0.85*G5	=10years*I\$73	=10.55%*J\$52	=10.85%*K\$517
6	=0.35*E6	=0.75*F6	=0.85*G6	=10years*I\$73	=10.55%*J\$52	=10.85%*K\$517
7	=0.35*E7	=0.75*F7	=0.85*G7	=10years*I\$73	=10.55%*J\$52	=10.85%*K\$517
8	=0.35*E8	=0.75*F8	=0.85*G8	=10years*I\$73	=10.55%*J\$52	=10.85%*K\$517
9	=0.35*E9	=0.75*F9	=0.85*G9	=10years*I\$73	=10.55%*J\$52	=10.85%*K\$517
10	=0.35*E10	=0.75*F10	=0.85*G10	=10years*I\$73	=10.55%*J\$52	=10.85%*K\$517
11	=0.35*E11	=0.75*F11	=0.85*G11	=10years*I\$73	=10.55%*J\$52	=10.85%*K\$517
12	=0.35*E12	=0.75*F12	=0.85*G12	=10years*I\$73	=10.55%*J\$52	=10.85%*K\$517
13						
14						
15						
16	=K3/(L3*M3*N3)					
17						
18	=K4/(L4*M4*N4)					
19						
20	=K5/(L5*M5*N5)					
21						
22	=K6/(L6*M6*N6)					
23						
24	=K7/(L7*M7*N7)					
25						
26	=K8/(L8*M8*N8)					
27						
28	=K9/(L9*M9*N9)					
29						
30	=K10/(L10*M10*N10)					
31						
32	=K11/(L11*M11*N11)					
33						
34	=K12/(L12*M12*N12)					
35						

Appendix D

	A	B	C	D	E	F	G	H	I
1									
2		1 Stage	2 Stages	3 Stages	4 Stages	5 Stages	6 Stages	7 Stages	8 Stages
3	Area	7491.74118398438	3177.1858107802	2031.18217670559	1493.60476614621	1181.29206922963	977.101354304381	832.295653142021	725.447417084212
4	F actual	=Given!\$J\$12	=Given!\$J\$12	=Given!\$J\$12	=Given!\$J\$12	=Given!\$J\$12	=F4	=G4	=H4
5	F calc	=B50	=C50	=D50	=E50	=F50			
6	CF <sub>1</sub>		=SC\$4/C60	=SD\$4/D60	=SE\$4/E60	=SF\$4/F60	=SG\$4/G60	=SH\$4/H60	
7	J <sub>1</sub>		=27.9-5.3*LN(C6)	=27.9-5.3*LN(D6)	=27.9-5.3*LN(E6)	=27.9-5.3*LN(F6)	=27.9-5.3*LN(G6)	=27.9-5.3*LN(H6)	=27.9-5.3*LN(I6)
8	P <sub>1</sub>		=C\$3*C7	=D\$3*D7	=E\$3*E7	=F\$3*F7	=G\$3*G7	=H\$3*H7	=I\$3*I7
9									
10	CF <sub>2</sub>			=SD\$4/D60	=SE\$4/E18	=SF\$4/F18	=SG\$4/G18	=SH\$4/H18	=SI\$4/I18
11	J <sub>2</sub>			=27.9-5.3*LN(D10)	=27.9-5.3*LN(E10)	=27.9-5.3*LN(F10)	=27.9-5.3*LN(G10)	=27.9-5.3*LN(H10)	=27.9-5.3*LN(I10)
12	P <sub>2</sub>			=D\$3*D11	=E\$3*E11	=F\$3*F11	=G\$3*G11	=H\$3*H11	=I\$3*I11
13	B <sub>1</sub>			=D12+D60	=E12+E18	=F12+F18	=G12+G18	=H12+H18	=I12+I18
14									
15	CF <sub>3</sub>				=SE\$4/E60	=SF\$4/F23	=SG\$4/G23	=SH\$4/H23	=SI\$4/I23
16	J <sub>3</sub>				=27.9-5.3*LN(E15)	=27.9-5.3*LN(F15)	=27.9-5.3*LN(G15)	=27.9-5.3*LN(H15)	=27.9-5.3*LN(I15)
17	P <sub>3</sub>				=E\$3*E16	=F\$3*F16	=G\$3*G16	=H\$3*H16	=I\$3*I16
18	B <sub>2</sub>				=E17+E60	=F17+F23	=G17+G23	=H17+H23	=I17+I23
19									
20	CF <sub>4</sub>					=SF\$4/F60	=SG\$4/G28	=SH\$4/H28	=SI\$4/I28
21	J <sub>4</sub>				=27.9-5.3*LN(F20)	=27.9-5.3*LN(G20)	=27.9-5.3*LN(H20)	=27.9-5.3*LN(I20)	
22	P <sub>4</sub>				=F\$3*F21	=G\$3*G21	=H\$3*H21	=I\$3*I21	
23	B <sub>3</sub>				=F22+F60	=G22+G28	=H22+H28	=I22+I28	
24									
25	CF <sub>5</sub>						=SG\$4/G60	=SH\$4/H33	=SI\$4/I33
26	J <sub>5</sub>						=27.9-5.3*LN(G25)	=27.9-5.3*LN(H25)	=27.9-5.3*LN(I25)
27	P <sub>5</sub>						=G\$3*G26	=H\$3*H26	=I\$3*I26
28	B <sub>4</sub>						=G27+G60	=H27+H33	=I27+I33
29									
30	CF <sub>6</sub>							=SH\$4/H60	=SI\$4/I38
31	J <sub>6</sub>							=27.9-5.3*LN(H30)	=27.9-5.3*LN(I30)
32	P <sub>6</sub>							=H\$3*H31	=I\$3*I31
33	B <sub>5</sub>							=H32+H60	=I32+I38
34									
35	CF <sub>7</sub>								
36	J <sub>7</sub>								
37	P <sub>7</sub>								
38	B <sub>6</sub>								
39									
40	CF <sub>8</sub>								
41	J <sub>8</sub>								
42	P <sub>8</sub>								
43	B <sub>7</sub>								
44									
45	CF <sub>9</sub>								
46	J <sub>9</sub>								
47	P <sub>9</sub>								
48	B <sub>8</sub>								
49									
50	CF <sub>10</sub>								



Appendix D

	A	B	C	D	E	F	G	H	I
51	J <sub>10</sub>								
52	P <sub>10</sub>								
53	B <sub>9</sub>								
54									
55	n <sub>F</sub>	1	2	3	4	5	6	7	8
56	CF <sub>n</sub>	=B4/B58	=C4/C58	=D4/D58	=E4/E58	=F4/F58	=G4/G58	=H4/H58	=I4/I58
57	J <sub>n</sub>	=27.9-5.3*LN(B56)	=27.9-5.3*LN(C56)	=27.9-5.3*LN(D56)	=27.9-5.3*LN(E56)	=27.9-5.3*LN(F56)	=27.9-5.3*LN(G56)	=27.9-5.3*LN(H56)	=27.9-5.3*LN(I56)
58	B <sub>n</sub>	28800	29700	29800	29800	29800	29800	29800	29800
59	P <sub>n</sub>	=B53*B67	=C53*C57	=D53*D57	=E53*E57	=F53*F57	=G53*G57	=H53*H57	=I53*I57
60	B <sub>n-1</sub>	=B59+B58	=C59+C58	=D59+D58	=E59+E58	=F59+F58	=G59+G58	=H59+H58	=I59+I58
61									
62									
63		1	2	3	4	5	6	7	8
64	Area/Stage	=B3	=C3	=D3	=E3	=F3	=G3	=H3	=I3
65	No. of Cart./Stage	=B64/26.5	=C64/26.5	=D64/26.5	=E64/26.5	=F64/26.5	=G64/26.5	=H64/26.5	=I64/26.5
66	Total Rec.	=B65*23	=C65*23	=D65*23	=E65*23	=F65*23	=G65*23	=H65*23	=I65*23
67	Max Flow	=B66+B4/(20*60)	=C66+C4/(20*60)	=D66+D4/(20*60)	=E66+E4/(20*60)	=F66+F4/(20*60)	=G66+G4/(20*60)	=H66+H4/(20*60)	=I66+I4/(20*60)
68	Final Stream								
70	C <sub>B,NFN</sub>	=P4	=Q13	=R22	=S31	=T40	=AE4	=AF13	=AG22
71	C <sub>A,TP</sub>	=P5	=Q14	=R23	=S32	=T41	=AE5	=AF14	=AG23
72	C <sub>B,Lentose</sub>	=P7	=Q16	=R25	=S34	=T43	=AE7	=AF16	=AG25
73	C <sub>B,Ash</sub>	=P8	=Q17	=R26	=S35	=T44	=AE8	=AF17	=AG26
74	C <sub>B,Butanr Fat</sub>	=P9	=Q18	=R27	=S36	=T45	=AE9	=AF18	=AG27
75	Yield	=S5	=T14	=U23	=V32	=W41	=AH5	=AI14	=AJ23
76									
77									
78	Flow Rates (gpm)	1	2	3	4	5	6	7	8
79	Cart/Stage	283	120	77	57	45	37	32	28
80	1	=B579*23+B4/(20*60)	=C579*23+C4/(20*60)	=D579*23+D4/(20*60)	=E579*23+E4/(20*60)	=F579*23+F4/(20*60)	=G579*23+G4/(20*60)	=H579*23+H4/(20*60)	=I579*23+I4/(20*60)
81	2		=C579*23+C13/(20*60)	=D579*23+D13/(20*60)	=E579*23+E13/(20*60)	=F579*23+F13/(20*60)	=G579*23+G13/(20*60)	=H579*23+H13/(20*60)	=I579*23+I13/(20*60)
82	3			=D579*23+D18/(20*60)	=E579*23+E18/(20*60)	=F579*23+F18/(20*60)	=G579*23+G18/(20*60)	=H579*23+H18/(20*60)	=I579*23+I18/(20*60)
83	4				=E579*23+E23/(20*60)	=F579*23+F23/(20*60)	=G579*23+G23/(20*60)	=H579*23+H23/(20*60)	=I579*23+I23/(20*60)
84	5					=F579*23+F28/(20*60)	=G579*23+G28/(20*60)	=H579*23+H28/(20*60)	=I579*23+I28/(20*60)
85	6						=G579*23+G33/(20*60)	=H579*23+H33/(20*60)	=I579*23+I33/(20*60)
86	7							=H579*23+H38/(20*60)	=I579*23+I38/(20*60)
87	8								
88	9								
89	10								

Appendix D

	J	K	L	M	N	O	P
1							
2	9 Stages	10 Stages	11 Stages	Unit		1 Stage	
3	642.923797863189	577.264589486707	523.772807500363	ft'		$f_n$	=B4/B58
4	=J4	=J4	=K4	gal/day		$C_{B,NPN}$	=Given $\$C5$ *(P $\$3$ /(P $\$3$ *(1-Given $\$F5$ )+Given $\$F5$ ))
5	=J4+J13	=K4+K13	=L4+L13	gal/day		$C_{B,TP}$	=Given $\$C6$ *(P $\$3$ /(P $\$3$ *(1-Given $\$F6$ )+Given $\$F6$ ))
6	=J4+J13	=K4+K13	=L4+L13	gal/day		$C_{B,Protein}$	=P4+P5
7	=J27.9-5.3*LN(J6)	=K27.9-5.3*LN(K6)	=L27.9-5.3*LN(L6)	gsfd		$C_{B,Lactose}$	=Given $\$C7$ *(P $\$3$ /(P $\$3$ *(1-Given $\$F7$ )+Given $\$F7$ ))
8	=J33*J7	=K33*K7	=L33*L7	gal/day		$C_{B,Ash}$	=Given $\$C8$ *(P $\$3$ /(P $\$3$ *(1-Given $\$F8$ )+Given $\$F8$ ))
9				gal/day		$C_{B,Burter Fat}$	=Given $\$C9$ *(P $\$3$ /(P $\$3$ *(1-Given $\$F9$ )+Given $\$F9$ ))
10	=G $\$4$ /J18	=G $\$4$ /K18	=G $\$4$ /L18	gsfd		2 Stages	1
11	=J27.9-5.3*LN(J10)	=K27.9-5.3*LN(K10)	=L27.9-5.3*LN(L10)	gsfd		$f_n$	=C4/C60
12	=J33*J11	=K33*K11	=L33*L11	gal/day		$C_{B,NPN}$	=Given $\$C5$ *(P $\$12$ /(P $\$12$ *(1-Given $\$F5$ )+Given $\$F5$ ))
13	=J12+J18	=K12+K18	=L12+L18	gal/day		$C_{B,TP}$	=Given $\$C6$ *(P $\$12$ /(P $\$12$ *(1-Given $\$F6$ )+Given $\$F6$ ))
14				gal/day		$C_{B,Protein}$	=P13+P14
15	=G $\$4$ /J23	=G $\$4$ /K23	=G $\$4$ /L23	gsfd		$C_{B,Lactose}$	=Given $\$C7$ *(P $\$12$ /(P $\$12$ *(1-Given $\$F7$ )+Given $\$F7$ ))
16	=J27.9-5.3*LN(J15)	=K27.9-5.3*LN(K15)	=L27.9-5.3*LN(L15)	gal/day		$C_{B,Ash}$	=Given $\$C8$ *(P $\$12$ /(P $\$12$ *(1-Given $\$F8$ )+Given $\$F8$ ))
17	=J33*J16	=K33*K16	=L33*L16	gal/day		$C_{B,Burter Fat}$	=Given $\$C9$ *(P $\$12$ /(P $\$12$ *(1-Given $\$F9$ )+Given $\$F9$ ))
18	=J17+J23	=K17+K23	=L17+L23	gal/day		3 Stages	1
19				gal/day		$f_n$	=D4/D13
20	=G $\$4$ /J28	=G $\$4$ /K28	=G $\$4$ /L28	gsfd		$C_{B,NPN}$	=Given $\$C5$ *(P $\$21$ /(P $\$21$ *(1-Given $\$F5$ )+Given $\$F5$ ))
21	=J27.9-5.3*LN(J20)	=K27.9-5.3*LN(K20)	=L27.9-5.3*LN(L20)	gal/day		$C_{B,TP}$	=Given $\$C6$ *(P $\$21$ /(P $\$21$ *(1-Given $\$F6$ )+Given $\$F6$ ))
22	=J33*J21	=K33*K21	=L33*L21	gal/day		$C_{B,Protein}$	=P22+P23
23	=J22+J28	=K22+K28	=L22+L28	gal/day		$C_{B,Lactose}$	=Given $\$C7$ *(P $\$21$ /(P $\$21$ *(1-Given $\$F7$ )+Given $\$F7$ ))
24				gal/day		$C_{B,Ash}$	=Given $\$C8$ *(P $\$21$ /(P $\$21$ *(1-Given $\$F8$ )+Given $\$F8$ ))
25	=G $\$4$ /J33	=G $\$4$ /K33	=G $\$4$ /L33	gsfd		$C_{B,Burter Fat}$	=Given $\$C9$ *(P $\$21$ /(P $\$21$ *(1-Given $\$F9$ )+Given $\$F9$ ))
26	=J27.9-5.3*LN(J25)	=K27.9-5.3*LN(K25)	=L27.9-5.3*LN(L25)	gal/day		4 Stages	1
27	=J33*J26	=K33*K26	=L33*L26	gal/day		$f_n$	=E4/E13
28	=J27+J33	=K27+K33	=L27+L33	gal/day		$C_{B,NPN}$	=Given $\$C5$ *(P $\$30$ /(P $\$30$ *(1-Given $\$F5$ )+Given $\$F5$ ))
29				gal/day		$C_{B,TP}$	=Given $\$C6$ *(P $\$30$ /(P $\$30$ *(1-Given $\$F6$ )+Given $\$F6$ ))
30	=G $\$4$ /J38	=G $\$4$ /K38	=G $\$4$ /L38	gsfd		$C_{B,Protein}$	=P31+P32
31	=J27.9-5.3*LN(J30)	=K27.9-5.3*LN(K30)	=L27.9-5.3*LN(L30)	gal/day		$C_{B,Lactose}$	=Given $\$C7$ *(P $\$30$ /(P $\$30$ *(1-Given $\$F7$ )+Given $\$F7$ ))
32	=J33*J31	=K33*K31	=L33*L31	gal/day		$C_{B,Ash}$	=Given $\$C8$ *(P $\$30$ /(P $\$30$ *(1-Given $\$F8$ )+Given $\$F8$ ))
33	=J32+J38	=K32+K38	=L32+L38	gal/day		$C_{B,Burter Fat}$	=Given $\$C9$ *(P $\$30$ /(P $\$30$ *(1-Given $\$F9$ )+Given $\$F9$ ))
34				gal/day		5 Stages	1
35	=G $\$4$ /J43	=G $\$4$ /K43	=G $\$4$ /L43	gsfd		$f_n$	=F4/F13
36	=J27.9-5.3*LN(J35)	=K27.9-5.3*LN(K35)	=L27.9-5.3*LN(L35)	gal/day		$C_{B,NPN}$	=Given $\$C5$ *(P $\$39$ /(P $\$39$ *(1-Given $\$F5$ )+Given $\$F5$ ))
37	=J33*J36	=K33*K36	=L33*L36	gal/day		$C_{B,TP}$	=Given $\$C6$ *(P $\$39$ /(P $\$39$ *(1-Given $\$F6$ )+Given $\$F6$ ))
38	=J37+J43	=K37+K43	=L37+L43	gal/day		$C_{B,Protein}$	=P40+P41
39				gal/day		$C_{B,Lactose}$	=Given $\$C7$ *(P $\$39$ /(P $\$39$ *(1-Given $\$F7$ )+Given $\$F7$ ))
40	=G $\$4$ /J60	=G $\$4$ /K48	=G $\$4$ /L48	gsfd		$C_{B,Ash}$	=Given $\$C8$ *(P $\$39$ /(P $\$39$ *(1-Given $\$F8$ )+Given $\$F8$ ))
41	=J27.9-5.3*LN(J40)	=K27.9-5.3*LN(K40)	=L27.9-5.3*LN(L40)	gal/day		$C_{B,Burter Fat}$	=Given $\$C9$ *(P $\$39$ /(P $\$39$ *(1-Given $\$F9$ )+Given $\$F9$ ))
42	=J33*J41	=K33*K41	=L33*L41	gal/day		6 Stages	1
43	=J42+J48	=K42+K48	=L42+L48	gal/day		$f_n$	=G4/G13
44				gal/day		$C_{B,NPN}$	=Given $\$C5$ *(P $\$39$ /(P $\$39$ *(1-Given $\$F5$ )+Given $\$F5$ ))
45	=G $\$4$ /K60	=G $\$4$ /L53	=G $\$4$ /L53	gsfd		$C_{B,TP}$	=Given $\$C6$ *(P $\$39$ /(P $\$39$ *(1-Given $\$F6$ )+Given $\$F6$ ))
46	=J27.9-5.3*LN(K45)	=L27.9-5.3*LN(L45)	=L27.9-5.3*LN(L45)	gal/day		$C_{B,Protein}$	=P40+P41
47	=K33*K46	=L33*L46	=L33*L46	gal/day		$C_{B,Lactose}$	=Given $\$C7$ *(P $\$39$ /(P $\$39$ *(1-Given $\$F7$ )+Given $\$F7$ ))
48	=K47+K60	=L47+L53	=L47+L53	gal/day		$C_{B,Ash}$	=Given $\$C8$ *(P $\$39$ /(P $\$39$ *(1-Given $\$F8$ )+Given $\$F8$ ))
49				gal/day		$C_{B,Burter Fat}$	=Given $\$C9$ *(P $\$39$ /(P $\$39$ *(1-Given $\$F9$ )+Given $\$F9$ ))
50			=G $\$4$ /L60	gsfd			

Appendix D

	J	K	L	M	N	O	P
51			=27.9-5.3*LN(L50)	gsfd			
52			=L83*L51	gal/day			
53			=L52+L60	gal/day			
54							
55	9		11				
56	=J4J58	=K4K58	=L4L58	CF total			
57	=27.9-5.3*LN(J56)	=27.9-5.3*LN(K56)	=27.9-5.3*LN(L56)	gsfd			
58	29900	29900	29901	gal/day			
59	=J83*J57	=K83*K57	=L83*L57	gal/day			
60	=J59+J58	=K59+K58	=L59+L58	gal/day			
61							
62							
63	9		11				
64	=J3	=K3	=L3	ft <sup>2</sup>			
65	=J64/26.5	=K64/26.5	=L64/26.5	26.5 ft <sup>2</sup> /cartridge			
66	=J65*23	=K65*23	=L65*23	gal/min			
67	=J66+J4/(20*60)	=K66+K4/(20*60)	=L66+L4/(20*60)	gal/min			
68		=K67*4*12*12/(7.48*4.026*2*P(I)*60)	=L67*4*12*12/(7.48*4.026*2*P(I)*60)				
69							
70	=AH31	=AI40	=AJ49				
71	=AH32	=AI41	=AJ50				
72	=AH34	=AI43	=AJ52				
73	=AH35	=AI44	=AJ53				
74	=AH36	=AI45	=AJ54				
75	=AK32	=AL41	=AM50				
76							
77							
78	9	10					
79	25	22					
80	=J879*23+J4/(20*60)	=K879*23+K4/(20*60)	=L879*23+L4/(20*60)				
81	=J879*23+J13/(20*60)	=K879*23+K13/(20*60)	=L879*23+L13/(20*60)				
82	=J879*23+J18/(20*60)	=K879*23+K18/(20*60)	=L879*23+L18/(20*60)				
83	=J879*23+J23/(20*60)	=K879*23+K23/(20*60)	=L879*23+L23/(20*60)				
84	=J879*23+J28/(20*60)	=K879*23+K28/(20*60)	=L879*23+L28/(20*60)				
85	=J879*23+J33/(20*60)	=K879*23+K33/(20*60)	=L879*23+L33/(20*60)				
86	=J879*23+J38/(20*60)	=K879*23+K38/(20*60)	=L879*23+L38/(20*60)				
87	=J879*23+J43/(20*60)	=K879*23+K43/(20*60)	=L879*23+L43/(20*60)				
88	=J879*23+J48/(20*60)	=K879*23+K48/(20*60)	=L879*23+L48/(20*60)				
89							

Appendix D

	Q	R	S	T
1				
2	Total Out gal/day			
3				
4	=P4*\$B\$58	Final Protein Concentration	=P6	
5	=P5*\$B\$58	Yield	=B58*S3/(B4*(Given(C5+Given(C6)))	
6	=P6*\$B\$58			
7	=P7*\$B\$58	Final Protein % (dry weight)		
8	=P8*\$B\$58	Total Area	=B3	
9	=P9*\$B\$58	Total Permeate	=B59	gal/day
10				
11		Total Out gal/day		
12	=C60/C58			
13	=P13*(Q\$12/(Q\$12*(1-Given(\$F5)+Given(\$F5)))		Final Protein Concentration	=Q15
14	=P14*(Q\$12/(Q\$12*(1-Given(\$F6)+Given(\$F6)))		Yield	=C58*T12/(C4*(Given(C5+Given(C6)))
15	=Q13+Q14			
16	=P16*(Q\$12/(Q\$12*(1-Given(\$F7)+Given(\$F7)))		Final Protein % (dry weight)	
17	=P17*(Q\$12/(Q\$12*(1-Given(\$F8)+Given(\$F8)))		Total Area	=2*C3
18	=P18*(Q\$12/(Q\$12*(1-Given(\$F9)+Given(\$F9)))		Total Permeate	=C8+C59
19				
20	3		Total Out gal/day	
21	=D13/D60			
22	=P22*(Q\$21/(Q\$21*(1-Given(\$F5)+Given(\$F5)))			Final Protein Concentration
23	=P23*(Q\$21/(Q\$21*(1-Given(\$F6)+Given(\$F6)))			Yield
24	=Q22+Q23			
25	=P25*(Q\$21/(Q\$21*(1-Given(\$F7)+Given(\$F7)))			Final Protein % (dry weight)
26	=P26*(Q\$21/(Q\$21*(1-Given(\$F8)+Given(\$F8)))			Total Area
27	=P27*(Q\$21/(Q\$21*(1-Given(\$F9)+Given(\$F9)))			Total Permeate
28				
29	3		Total Out gal/day	
30	=E13/E18			
31	=P31*(Q\$30/(Q\$30*(1-Given(\$F5)+Given(\$F5)))			
32	=P32*(Q\$30/(Q\$30*(1-Given(\$F6)+Given(\$F6)))			
33	=Q31+Q32			
34	=P34*(Q\$30/(Q\$30*(1-Given(\$F7)+Given(\$F7)))			
35	=P35*(Q\$30/(Q\$30*(1-Given(\$F8)+Given(\$F8)))			
36	=P36*(Q\$30/(Q\$30*(1-Given(\$F9)+Given(\$F9)))			
37				
38	3		Total Out gal/day	
39	=F13/F18			
40	=P40*(Q\$39/(Q\$39*(1-Given(\$F5)+Given(\$F5)))			
41	=P41*(Q\$39/(Q\$39*(1-Given(\$F6)+Given(\$F6)))			
42	=Q40+Q41			
43	=P43*(Q\$39/(Q\$39*(1-Given(\$F7)+Given(\$F7)))			
44	=P44*(Q\$39/(Q\$39*(1-Given(\$F8)+Given(\$F8)))			
45	=P45*(Q\$39/(Q\$39*(1-Given(\$F9)+Given(\$F9)))			
46				
47				
48				
49				
50				

Appendix D

	Q	R	S	T
51				
52				
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Appendix D

	U	V	W	X	Y	Z
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12						
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14						
15						
16						
17						
18	gal/day					
19						
20						
21						
22	=R24					
23	=D56*U21/(D4*(GivenC5+GivenC6))					
24						
25						
26	=3*D3					
27	=D8+D12+D59	gal/day				
28						
29						
30						
31	Final Protein Concentration	=S33				
32	Yield	=E58*Y30/(E4*(GivenC5+GivenC6))				
33						
34	Final Protein % (dry weight)					
35	Total Area	=4*E3				
36	Total Permeate	=E8+E12+E17+E59	gal/day			
37						
38	Total Out					
39	gal/day					
40	=T40*F58	Final Protein Concentration				
41	=T41*F58	Yield	=T42			
42	=T42*F58	Final Protein % (dry weight)	=F58*W39/(F4*(GivenC5+GivenC6))			
43	=T43*F58					
44	=T44*F58	Total Area				
45	=T45*F58	Total Permeate	=F58+F12+F17+F22+F59	gal/day		
46						
47						
48						
49						
50						

Appendix D

	U	V	W	X	Y	Z
51						=Z49+Z50
52					C <sub>8</sub> Protein	=Given\$C7*(Z\$48/(Z\$48*(1-Given\$F7)+Given\$F7))
53					C <sub>8</sub> Lactose	=Given\$C8*(Z\$48/(Z\$48*(1-Given\$F8)+Given\$F8))
54					C <sub>8</sub> Ash	=Given\$C9*(Z\$48/(Z\$48*(1-Given\$F9)+Given\$F9))
55					C <sub>8</sub> Butter Fat	
56						
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58						
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	AA	AB	AC	AD
1				
2				
3	=G13/G18			
4	=Z4*(AA\$3/(AA\$3*(1-Given)\$5)+Given)\$F5)	=G18/G23		
5	=Z5*(AA\$3/(AA\$3*(1-Given)\$6)+Given)\$F6)	=AA4*(AB\$3/(AB\$3*(1-Given)\$5)+Given)\$F5)	=G23/G28	=G28/G60
6	=AA+AA5	=AA5*(AB\$3/(AB\$3*(1-Given)\$6)+Given)\$F6)	=AB4*(AC\$3/(AC\$3*(1-Given)\$5)+Given)\$F5)	=AC4*(AD\$3/(AD\$3*(1-Given)\$5)+Given)\$F5)
7	=Z7*(AA\$3/(AA\$3*(1-Given)\$7)+Given)\$F7)	=AB4+AB5	=AB5*(AC\$3/(AC\$3*(1-Given)\$6)+Given)\$F6)	=AC5*(AD\$3/(AD\$3*(1-Given)\$6)+Given)\$F6)
8	=Z8*(AA\$3/(AA\$3*(1-Given)\$8)+Given)\$F8)	=AA7*(AB\$3/(AB\$3*(1-Given)\$7)+Given)\$F7)	=AC4+AC5	=AD4+AD5
9	=Z9*(AA\$3/(AA\$3*(1-Given)\$9)+Given)\$F9)	=AA8*(AB\$3/(AB\$3*(1-Given)\$8)+Given)\$F8)	=AB7*(AC\$3/(AC\$3*(1-Given)\$7)+Given)\$F7)	=AC7*(AD\$3/(AD\$3*(1-Given)\$7)+Given)\$F7)
10		=AA9*(AB\$3/(AB\$3*(1-Given)\$9)+Given)\$F9)	=AB8*(AC\$3/(AC\$3*(1-Given)\$8)+Given)\$F8)	=AC8*(AD\$3/(AD\$3*(1-Given)\$8)+Given)\$F8)
11				
12	=H13/H18			
13	=Z13*(AA\$12/(AA\$12*(1-Given)\$5)+Given)\$F5)	=H18/H23		
14	=Z14*(AA\$12/(AA\$12*(1-Given)\$6)+Given)\$F6)	=AA13*(AB\$12/(AB\$12*(1-Given)\$5)+Given)\$F5)	=H23/H28	=H28/H33
15	=AA13+AA14	=AA14*(AB\$12/(AB\$12*(1-Given)\$6)+Given)\$F6)	=AB13*(AC\$12/(AC\$12*(1-Given)\$5)+Given)\$F5)	=AC13*(AD\$12/(AD\$12*(1-Given)\$5)+Given)\$F5)
16	=Z16*(AA\$12/(AA\$12*(1-Given)\$7)+Given)\$F7)	=AB13+AB14	=AB14*(AC\$12/(AC\$12*(1-Given)\$6)+Given)\$F6)	=AC14*(AD\$12/(AD\$12*(1-Given)\$6)+Given)\$F6)
17	=Z17*(AA\$12/(AA\$12*(1-Given)\$8)+Given)\$F8)	=AA16*(AB\$12/(AB\$12*(1-Given)\$7)+Given)\$F7)	=AC13+AC14	=AD13+AD14
18	=Z18*(AA\$12/(AA\$12*(1-Given)\$9)+Given)\$F9)	=AA17*(AB\$12/(AB\$12*(1-Given)\$8)+Given)\$F8)	=AB16*(AC\$12/(AC\$12*(1-Given)\$7)+Given)\$F7)	=AC16*(AD\$12/(AD\$12*(1-Given)\$7)+Given)\$F7)
19		=AA18*(AB\$12/(AB\$12*(1-Given)\$9)+Given)\$F9)	=AB17*(AC\$12/(AC\$12*(1-Given)\$8)+Given)\$F8)	=AC17*(AD\$12/(AD\$12*(1-Given)\$8)+Given)\$F8)
20				
21	=I13/I18			
22	=Z22*(AA\$21/(AA\$21*(1-Given)\$5)+Given)\$F5)	=I18/I23		
23	=Z23*(AA\$21/(AA\$21*(1-Given)\$6)+Given)\$F6)	=AA22*(AB\$21/(AB\$21*(1-Given)\$5)+Given)\$F5)	=I23/I28	=I28/I33
24	=AA22+AA23	=AA23*(AB\$21/(AB\$21*(1-Given)\$6)+Given)\$F6)	=AB22*(AC\$21/(AC\$21*(1-Given)\$5)+Given)\$F5)	=AC22*(AD\$21/(AD\$21*(1-Given)\$5)+Given)\$F5)
25	=Z25*(AA\$21/(AA\$21*(1-Given)\$7)+Given)\$F7)	=AB22+AB23	=AB23*(AC\$21/(AC\$21*(1-Given)\$6)+Given)\$F6)	=AC23*(AD\$21/(AD\$21*(1-Given)\$6)+Given)\$F6)
26	=Z26*(AA\$21/(AA\$21*(1-Given)\$8)+Given)\$F8)	=AA25*(AB\$21/(AB\$21*(1-Given)\$7)+Given)\$F7)	=AC22+AC23	=AD22+AD23
27	=Z27*(AA\$21/(AA\$21*(1-Given)\$9)+Given)\$F9)	=AA26*(AB\$21/(AB\$21*(1-Given)\$8)+Given)\$F8)	=AB25*(AC\$21/(AC\$21*(1-Given)\$7)+Given)\$F7)	=AC25*(AD\$21/(AD\$21*(1-Given)\$7)+Given)\$F7)
28		=AA27*(AB\$21/(AB\$21*(1-Given)\$9)+Given)\$F9)	=AB26*(AC\$21/(AC\$21*(1-Given)\$8)+Given)\$F8)	=AC26*(AD\$21/(AD\$21*(1-Given)\$8)+Given)\$F8)
29				
30	=J13/J18			
31	=Z31*(AA\$30/(AA\$30*(1-Given)\$5)+Given)\$F5)	=J18/J23		
32	=Z32*(AA\$30/(AA\$30*(1-Given)\$6)+Given)\$F6)	=AA31*(AB\$30/(AB\$30*(1-Given)\$5)+Given)\$F5)	=J23/J28	=J28/J33
33	=AA31+AA32	=AA32*(AB\$30/(AB\$30*(1-Given)\$6)+Given)\$F6)	=AB31*(AC\$30/(AC\$30*(1-Given)\$5)+Given)\$F5)	=AC31*(AD\$30/(AD\$30*(1-Given)\$5)+Given)\$F5)
34	=Z34*(AA\$30/(AA\$30*(1-Given)\$7)+Given)\$F7)	=AB31+AB32	=AB32*(AC\$30/(AC\$30*(1-Given)\$6)+Given)\$F6)	=AC32*(AD\$30/(AD\$30*(1-Given)\$6)+Given)\$F6)
35	=Z35*(AA\$30/(AA\$30*(1-Given)\$8)+Given)\$F8)	=AA34*(AB\$30/(AB\$30*(1-Given)\$7)+Given)\$F7)	=AC31+AC32	=AD31+AD32
36	=Z36*(AA\$30/(AA\$30*(1-Given)\$9)+Given)\$F9)	=AA35*(AB\$30/(AB\$30*(1-Given)\$8)+Given)\$F8)	=AB34*(AC\$30/(AC\$30*(1-Given)\$7)+Given)\$F7)	=AC34*(AD\$30/(AD\$30*(1-Given)\$7)+Given)\$F7)
37		=AA36*(AB\$30/(AB\$30*(1-Given)\$9)+Given)\$F9)	=AB35*(AC\$30/(AC\$30*(1-Given)\$8)+Given)\$F8)	=AC35*(AD\$30/(AD\$30*(1-Given)\$8)+Given)\$F8)
38				
39	=K13/K18			
40	=Z40*(AA\$39/(AA\$39*(1-Given)\$5)+Given)\$F5)	=K18/K23		
41	=Z41*(AA\$39/(AA\$39*(1-Given)\$6)+Given)\$F6)	=AA40*(AB\$39/(AB\$39*(1-Given)\$5)+Given)\$F5)	=K23/K28	=K28/K33
42	=AA40+AA41	=AA41*(AB\$39/(AB\$39*(1-Given)\$6)+Given)\$F6)	=AB40*(AC\$39/(AC\$39*(1-Given)\$5)+Given)\$F5)	=AC40*(AD\$39/(AD\$39*(1-Given)\$5)+Given)\$F5)
43	=Z43*(AA\$39/(AA\$39*(1-Given)\$7)+Given)\$F7)	=AB40+AB41	=AB41*(AC\$39/(AC\$39*(1-Given)\$6)+Given)\$F6)	=AC41*(AD\$39/(AD\$39*(1-Given)\$6)+Given)\$F6)
44	=Z44*(AA\$39/(AA\$39*(1-Given)\$8)+Given)\$F8)	=AA43*(AB\$39/(AB\$39*(1-Given)\$7)+Given)\$F7)	=AC40+AC41	=AD40+AD41
45	=Z45*(AA\$39/(AA\$39*(1-Given)\$9)+Given)\$F9)	=AA44*(AB\$39/(AB\$39*(1-Given)\$8)+Given)\$F8)	=AB43*(AC\$39/(AC\$39*(1-Given)\$7)+Given)\$F7)	=AC43*(AD\$39/(AD\$39*(1-Given)\$7)+Given)\$F7)
46		=AA45*(AB\$39/(AB\$39*(1-Given)\$9)+Given)\$F9)	=AB44*(AC\$39/(AC\$39*(1-Given)\$8)+Given)\$F8)	=AC44*(AD\$39/(AD\$39*(1-Given)\$8)+Given)\$F8)
47				
48	=L13/L18			
49	=Z49*(AA\$48/(AA\$48*(1-Given)\$5)+Given)\$F5)	=L18/L23		
50	=Z50*(AA\$48/(AA\$48*(1-Given)\$6)+Given)\$F6)	=AA49*(AB\$48/(AB\$48*(1-Given)\$5)+Given)\$F5)	=L23/L28	=L28/L33
		=AA50*(AB\$48/(AB\$48*(1-Given)\$6)+Given)\$F6)	=AB49*(AC\$48/(AC\$48*(1-Given)\$5)+Given)\$F5)	=AC49*(AD\$48/(AD\$48*(1-Given)\$5)+Given)\$F5)
			=AB50*(AC\$48/(AC\$48*(1-Given)\$6)+Given)\$F6)	=AC50*(AD\$48/(AD\$48*(1-Given)\$6)+Given)\$F6)



Appendix D

	AA	AB	AC	AD
51	=AA49+AA50	=AB49+AB50	=AC49+AC50	=AD49+AD50
52	=Z52*(AA\$48/(AA\$48*(1-Given)\$F7)+Given)\$F7)	=AA52*(AB\$48/(AB\$48*(1-Given)\$F7)+Given)\$F7)	=AB52*(AC\$48/(AC\$48*(1-Given)\$F7)+Given)\$F7)	=AC52*(AD\$48/(AD\$48*(1-Given)\$F7)+Given)\$F7)
53	=Z53*(AA\$48/(AA\$48*(1-Given)\$F8)+Given)\$F8)	=AA53*(AB\$48/(AB\$48*(1-Given)\$F8)+Given)\$F8)	=AB53*(AC\$48/(AC\$48*(1-Given)\$F8)+Given)\$F8)	=AC53*(AD\$48/(AD\$48*(1-Given)\$F8)+Given)\$F8)
54	=Z54*(AA\$48/(AA\$48*(1-Given)\$F9)+Given)\$F9)	=AA54*(AB\$48/(AB\$48*(1-Given)\$F9)+Given)\$F9)	=AB54*(AC\$48/(AC\$48*(1-Given)\$F9)+Given)\$F9)	=AC54*(AD\$48/(AD\$48*(1-Given)\$F9)+Given)\$F9)
55				
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Appendix D

	AE	AF	AG	AH
1				
2				
3	=G60/G58	Total Out gal/day		
4	=AD4*(AE\$3/(AE\$3*(1-Given)\$F5)+Given)\$F5)	=AE4*\$G\$58	Final Protein Concentration	=AE6
5	=AD5*(AE\$3/(AE\$3*(1-Given)\$F6)+Given)\$F6)	=AE5*\$G\$58	Yield	=G58-AH3(G4*(Given)\$C\$55+Given)\$C\$66)
6	=AE4+AE5	=AE6*\$G\$58	Final Protein % (dry weight)	
7	=AD7*(AE\$3/(AE\$3*(1-Given)\$F7)+Given)\$F7)	=AE7*\$G\$58		
8	=AD8*(AE\$3/(AE\$3*(1-Given)\$F8)+Given)\$F8)	=AE8*\$G\$58	Total Area	=6*G3
9	=AD9*(AE\$3/(AE\$3*(1-Given)\$F9)+Given)\$F9)	=AE9*\$G\$58	Total Permeate	=G8+G12+G17+G22+G27+G59
10				
11				
12	=H33/H60	7	Total Out gal/day	
13	=AD13*(AE\$12/(AE\$12*(1-Given)\$F5)+Given)\$F5)	=AE13*(AF\$12/(AF\$12*(1-Given)\$F5)+Given)\$F5)	=AF13*\$H\$58	Final Protein Concentration
14	=AD14*(AE\$12/(AE\$12*(1-Given)\$F6)+Given)\$F6)	=AE14*(AF\$12/(AF\$12*(1-Given)\$F6)+Given)\$F6)	=AF14*\$H\$58	Yield
15	=AE13+AE14	=AF13+AF14	=AF15*\$H\$58	
16	=AD16*(AE\$12/(AE\$12*(1-Given)\$F7)+Given)\$F7)	=AE16*(AF\$12/(AF\$12*(1-Given)\$F7)+Given)\$F7)	=AF16*\$H\$58	Final Protein % (dry weight)
17	=AD17*(AE\$12/(AE\$12*(1-Given)\$F8)+Given)\$F8)	=AE17*(AF\$12/(AF\$12*(1-Given)\$F8)+Given)\$F8)	=AF17*\$H\$58	Total Area
18	=AD18*(AE\$12/(AE\$12*(1-Given)\$F9)+Given)\$F9)	=AE18*(AF\$12/(AF\$12*(1-Given)\$F9)+Given)\$F9)	=AF18*\$H\$58	Total Permeate
19				
20				
21	=I33/I38	7	Total Out gal/day	
22	=AD22*(AE\$21/(AE\$21*(1-Given)\$F5)+Given)\$F5)	=AE22*(AF\$21/(AF\$21*(1-Given)\$F5)+Given)\$F5)	=AF22*(AG\$21/(AG\$21*(1-Given)\$F5)+Given)\$F5)	=AG22*\$I\$58
23	=AD23*(AE\$21/(AE\$21*(1-Given)\$F6)+Given)\$F6)	=AE23*(AF\$21/(AF\$21*(1-Given)\$F6)+Given)\$F6)	=AF23*(AG\$21/(AG\$21*(1-Given)\$F6)+Given)\$F6)	=AG23*\$I\$58
24	=AE22+AE23	=AF22+AF23	=AG22+AG23	=AG24*\$I\$58
25	=AD25*(AE\$21/(AE\$21*(1-Given)\$F7)+Given)\$F7)	=AE25*(AF\$21/(AF\$21*(1-Given)\$F7)+Given)\$F7)	=AF25*(AG\$21/(AG\$21*(1-Given)\$F7)+Given)\$F7)	=AG25*\$I\$58
26	=AD26*(AE\$21/(AE\$21*(1-Given)\$F8)+Given)\$F8)	=AE26*(AF\$21/(AF\$21*(1-Given)\$F8)+Given)\$F8)	=AF26*(AG\$21/(AG\$21*(1-Given)\$F8)+Given)\$F8)	=AG26*\$I\$58
27	=AD27*(AE\$21/(AE\$21*(1-Given)\$F9)+Given)\$F9)	=AE27*(AF\$21/(AF\$21*(1-Given)\$F9)+Given)\$F9)	=AF27*(AG\$21/(AG\$21*(1-Given)\$F9)+Given)\$F9)	=AG27*\$I\$58
28				
29				
30	=J33/J38	7	Total Out gal/day	
31	=AD31*(AE\$30/(AE\$30*(1-Given)\$F5)+Given)\$F5)	=AE31*(AF\$30/(AF\$30*(1-Given)\$F5)+Given)\$F5)	=AF31*(AG\$30/(AG\$30*(1-Given)\$F5)+Given)\$F5)	=AG31*(AH\$30/(AH\$30*(1-Given)\$F5)+Given)\$F5)
32	=AD32*(AE\$30/(AE\$30*(1-Given)\$F6)+Given)\$F6)	=AE32*(AF\$30/(AF\$30*(1-Given)\$F6)+Given)\$F6)	=AF32*(AG\$30/(AG\$30*(1-Given)\$F6)+Given)\$F6)	=AG32*(AH\$30/(AH\$30*(1-Given)\$F6)+Given)\$F6)
33	=AE31+AE32	=AF31+AF32	=AG31+AG32	=AH31+AH32
34	=AD34*(AE\$30/(AE\$30*(1-Given)\$F7)+Given)\$F7)	=AE34*(AF\$30/(AF\$30*(1-Given)\$F7)+Given)\$F7)	=AF34*(AG\$30/(AG\$30*(1-Given)\$F7)+Given)\$F7)	=AG34*(AH\$30/(AH\$30*(1-Given)\$F7)+Given)\$F7)
35	=AD35*(AE\$30/(AE\$30*(1-Given)\$F8)+Given)\$F8)	=AE35*(AF\$30/(AF\$30*(1-Given)\$F8)+Given)\$F8)	=AF35*(AG\$30/(AG\$30*(1-Given)\$F8)+Given)\$F8)	=AG35*(AH\$30/(AH\$30*(1-Given)\$F8)+Given)\$F8)
36	=AD36*(AE\$30/(AE\$30*(1-Given)\$F9)+Given)\$F9)	=AE36*(AF\$30/(AF\$30*(1-Given)\$F9)+Given)\$F9)	=AF36*(AG\$30/(AG\$30*(1-Given)\$F9)+Given)\$F9)	=AG36*(AH\$30/(AH\$30*(1-Given)\$F9)+Given)\$F9)
37				
38				
39	=K33/K38	7	Total Out gal/day	
40	=AD40*(AE\$39/(AE\$39*(1-Given)\$F5)+Given)\$F5)	=AE40*(AF\$39/(AF\$39*(1-Given)\$F5)+Given)\$F5)	=AF40*(AG\$39/(AG\$39*(1-Given)\$F5)+Given)\$F5)	=AG40*(AH\$39/(AH\$39*(1-Given)\$F5)+Given)\$F5)
41	=AD41*(AE\$39/(AE\$39*(1-Given)\$F6)+Given)\$F6)	=AE41*(AF\$39/(AF\$39*(1-Given)\$F6)+Given)\$F6)	=AF41*(AG\$39/(AG\$39*(1-Given)\$F6)+Given)\$F6)	=AG41*(AH\$39/(AH\$39*(1-Given)\$F6)+Given)\$F6)
42	=AE40+AE41	=AF40+AF41	=AG40+AG41	=AH40+AH41
43	=AD43*(AE\$39/(AE\$39*(1-Given)\$F7)+Given)\$F7)	=AE43*(AF\$39/(AF\$39*(1-Given)\$F7)+Given)\$F7)	=AF43*(AG\$39/(AG\$39*(1-Given)\$F7)+Given)\$F7)	=AG43*(AH\$39/(AH\$39*(1-Given)\$F7)+Given)\$F7)
44	=AD44*(AE\$39/(AE\$39*(1-Given)\$F8)+Given)\$F8)	=AE44*(AF\$39/(AF\$39*(1-Given)\$F8)+Given)\$F8)	=AF44*(AG\$39/(AG\$39*(1-Given)\$F8)+Given)\$F8)	=AG44*(AH\$39/(AH\$39*(1-Given)\$F8)+Given)\$F8)
45	=AD45*(AE\$39/(AE\$39*(1-Given)\$F9)+Given)\$F9)	=AE45*(AF\$39/(AF\$39*(1-Given)\$F9)+Given)\$F9)	=AF45*(AG\$39/(AG\$39*(1-Given)\$F9)+Given)\$F9)	=AG45*(AH\$39/(AH\$39*(1-Given)\$F9)+Given)\$F9)
46				
47				
48	=L33/L38	7	Total Out gal/day	
49	=AD49*(AE\$48/(AE\$48*(1-Given)\$F5)+Given)\$F5)	=AE49*(AF\$48/(AF\$48*(1-Given)\$F5)+Given)\$F5)	=AF49*(AG\$48/(AG\$48*(1-Given)\$F5)+Given)\$F5)	=AG49*(AH\$48/(AH\$48*(1-Given)\$F5)+Given)\$F5)
50	=AD50*(AE\$48/(AE\$48*(1-Given)\$F6)+Given)\$F6)	=AE50*(AF\$48/(AF\$48*(1-Given)\$F6)+Given)\$F6)	=AF50*(AG\$48/(AG\$48*(1-Given)\$F6)+Given)\$F6)	=AG50*(AH\$48/(AH\$48*(1-Given)\$F6)+Given)\$F6)

Appendix D

	AE	AF	AG	AH
51	=AE49+AE50	=AF49+AF50	=AG49+AG50	=AH49+AH50
52	=AD52*(AE\$48/(AE\$48*(1-Given\$F7)+Given\$F7))	=AE52*(AF\$48/(AF\$48*(1-Given\$F7)+Given\$F7))	=AF52*(AG\$48/(AG\$48*(1-Given\$F7)+Given\$F7))	=AG52*(AH\$48/(AH\$48*(1-Given\$F7)+Given\$F7))
53	=AD53*(AE\$48/(AE\$48*(1-Given\$F8)+Given\$F8))	=AE53*(AF\$48/(AF\$48*(1-Given\$F8)+Given\$F8))	=AF53*(AG\$48/(AG\$48*(1-Given\$F8)+Given\$F8))	=AG53*(AH\$48/(AH\$48*(1-Given\$F8)+Given\$F8))
54	=AD54*(AE\$48/(AE\$48*(1-Given\$F9)+Given\$F9))	=AE54*(AF\$48/(AF\$48*(1-Given\$F9)+Given\$F9))	=AF54*(AG\$48/(AG\$48*(1-Given\$F9)+Given\$F9))	=AG54*(AH\$48/(AH\$48*(1-Given\$F9)+Given\$F9))
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Appendix D

	AI	AJ	AK	AL
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8				
9	gal/day			
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12				
13	=AF15			
14	=I58*AI12/(H4*(Given!\$C\$5+Given!\$C\$6))			
15				
16				
17	=7*H3			
18	=I8+H12+H17+H22+H27+H32+H59	gal/day		
19				
20				
21				
22	Final Protein Concentration	=AG24		
23	Yield	=I58*AJ2/(I4*(Given!\$C\$5+Given!\$C\$6))		
24	Final Protein % (dry weight)			
25		=8*J3		
26	Total Area	=I8+I12+I17+I25+I27+I32+I37+I59	gal/day	
27	Total Permeate			
28				
29	Total Out			
30	gal/day			
31	=AH31*\$J\$58	Final Protein Concentration	=AH33	
32	=AH32*\$J\$58	Yield	=K56*AK30/(J4*(Given!\$C\$5+Given!\$C\$6))	
33	=AH33*\$J\$58			
34	=AH34*\$J\$58	Final Protein % (dry weight)		
35	=AH35*\$J\$58	Total Area	=9*J3	
36	=AH36*\$J\$58	Total Permeate	=J8+J12+J17+J22+J27+J32+J37+J42+J59	gal/day
37				
38	10	Total Out		
39	=\$K60/\$K58	gal/day		
40	=AH40*(AI\$39/(AI\$39*(1-Given!\$F5)+Given!\$F5))		Final Protein Concentration	=AI42
41	=AH41*(AI\$39/(AI\$39*(1-Given!\$F6)+Given!\$F6))		Yield	=K58*AL39/(K4*(Given!\$C\$5+Given!\$C\$6))
42	=AH40+AI41			
43	=AH43*(AI\$39/(AI\$39*(1-Given!\$F7)+Given!\$F7))		Final Protein % (dry weight)	
44	=AH44*(AI\$39/(AI\$39*(1-Given!\$F8)+Given!\$F8))		Total Area	=10*K3
45	=AH45*(AI\$39/(AI\$39*(1-Given!\$F9)+Given!\$F9))		Total Permeate	=K8+K12+K17+K22+K27+K32+K37+K42+K47+K59
46				
47	10	Total Out		
48	=L53/L58	gal/day		
49	=AH48*(AI\$48/(AI\$48*(1-Given!\$F5)+Given!\$F5))		Final Protein Concentration	
50	=AH50*(AI\$48/(AI\$48*(1-Given!\$F6)+Given!\$F6))		Yield	

Appendix D

	AI	AJ	AK	AL
51	=AI49+AI50	=AJ49+AJ50	=AI51*\$K\$58	Final Protein % (dry weight)
52	=AI52*(AI\$48/(AI\$48*(1-Given)\$F7)+Given)\$F7)	=AI52*(AJ\$48/(AJ\$48*(1-Given)\$F7)+Given)\$F7)	=AI52*\$K\$58	
53	=AI53*(AI\$48/(AI\$48*(1-Given)\$F8)+Given)\$F8)	=AI53*(AJ\$48/(AJ\$48*(1-Given)\$F8)+Given)\$F8)	=AI53*\$K\$58	Total Area
54	=AI54*(AI\$48/(AI\$48*(1-Given)\$F9)+Given)\$F9)	=AI54*(AJ\$48/(AJ\$48*(1-Given)\$F9)+Given)\$F9)	=AI54*\$K\$58	Total Permeate
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Appendix D

	AM	AN
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45	gal/day	
46		
47		
48		
49	=A151	
50	=L58*AM48/(L4*(Given(C\$5+Given(C\$6)))	

Appendix D

	AM	AN
51		
52		
53	=10*K12	
54	=K17+K21+K26+K31+K36+K41+K46+K56+K61+K68	gal/day
55		
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Appendix D

	A	B	C	D
1	Based on 35%, 10 stages		Total Soln into 35% (gal/day)	
2		1 Stage	2 Stages	3 Stages
3	Area	339.816363609668	152.639507743806	98.5448352186055
4	F actual	=1maxA11\$F\$23	=1maxA11\$F\$23	=1maxA11\$F\$23
5	F calc	=B55	=C6+C55	=D6+D13
6	CF <sub>1</sub>		=\$F\$1/C55	=\$F\$1/D13
7	J <sub>1</sub>		=27.9-5.3*LN(C6)	=27.9-5.3*LN(D6)
8	P <sub>1</sub>		=C\$3*C7	=D\$3*D7
9		=B4-B5	=C4-C5	=D4-D5
10	CF <sub>2</sub>			=\$F\$1/D55
11	J <sub>2</sub>			=27.9-5.3*LN(D10)
12	P <sub>2</sub>			=D\$3*D11
13	B <sub>1</sub>			=D12+D55
14				
15	CF <sub>3</sub>			
16	J <sub>3</sub>			
17	P <sub>3</sub>			
18	B <sub>2</sub>			
19				
20	CF <sub>4</sub>			
21	J <sub>4</sub>			
22	P <sub>4</sub>			
23	B <sub>3</sub>			
24				
25	CF <sub>5</sub>			
26	J <sub>5</sub>			
27	P <sub>5</sub>			
28	B <sub>4</sub>			
29				
30	CF <sub>6</sub>			
31	J <sub>6</sub>			
32	P <sub>6</sub>			
33	B <sub>5</sub>			
34				
35	CF <sub>7</sub>			
36	J <sub>7</sub>			
37	P <sub>7</sub>			
38	B <sub>6</sub>			
39				
40	CF <sub>8</sub>			
41	J <sub>8</sub>			
42	P <sub>8</sub>			
43	B <sub>7</sub>			
44				
45	CF <sub>9</sub>			
46	J <sub>9</sub>			
47	P <sub>9</sub>			
48	B <sub>8</sub>			
49				
50	n <sup>n</sup>	1	2	3
51	CF <sub>n</sub>	=\$F\$1/B53	=\$F\$1/C53	=\$F\$1/D53
52	J <sub>n</sub>	=27.9-5.3*LN(B51)	=27.9-5.3*LN(C51)	=27.9-5.3*LN(D51)
53	B <sub>n</sub>	2561.02087016954	2561.12315254324	2561.1578768609



A	B			C			D		
	P <sub>n</sub>	B	C	D	E	F	G	H	I
54	=B53*B62	=C53*C52	=D53*D52						
55	=B54+B53	=C54+C53							
56									
57									
58									
59	Area/Stage	=B3	=C3						
60	No. of Cartridges/Stage	=B59/26.5	=C59/26.5						
61	Total Recirculation	=B60*23	=C60*23						
62	Max Flow	=B61+B4/(20*60)	=C61+C4/(20*60)						
63									
64	Final Stream								
65	C <sub>5-NPN</sub>	=O4	=P13						
66	C <sub>5-TP</sub>	=O5	=P14						
67	C <sub>5-Lactose</sub>	=O7	=P16						
68	C <sub>5-Ash</sub>	=O8	=P17						
69	C <sub>5-Butter Fat</sub>	=O9	=P18						
70	Yield <small>(dry part)</small>	=R5	=S14						
71									
72									
73	1 Diafiltration								
74	Soin Feed (gpd)	=B53	=C53						
75	Water Added (gpd)	7076.58602278368	7076.58602278368						
76	Total Feed (gpd)	=B75+B74	=C75+C74						
77	CF, DT	=B76/B74	=C76/C74						
78	Concentrations								
79	True Protein	=B65*1/((B576/B574)*(1-Given(\$F5)+Given(\$F5))*(\$B\$73)	=C65*1/((C576/C574)*(1-Given(\$F5)+Given(\$F5))*(\$B\$73)						
80	Non-Protein Nitrogen	=B66*1/((B576/B574)*(1-Given(\$F6)+Given(\$F6))*(\$B\$73)	=C66*1/((C576/C574)*(1-Given(\$F6)+Given(\$F6))*(\$B\$73)						
81	Lactose	=B67*1/((B576/B574)*(1-Given(\$F7)+Given(\$F7))*(\$B\$73)	=C67*1/((C576/C574)*(1-Given(\$F7)+Given(\$F7))*(\$B\$73)						
82	Ash	=B68*1/((B576/B574)*(1-Given(\$F8)+Given(\$F8))*(\$B\$73)	=C68*1/((C576/C574)*(1-Given(\$F8)+Given(\$F8))*(\$B\$73)						
83	Butter Fat	=B69*1/((B576/B574)*(1-Given(\$F9)+Given(\$F9))*(\$B\$73)	=C69*1/((C576/C574)*(1-Given(\$F9)+Given(\$F9))*(\$B\$73)						
84	Total Protein <small>(dry weight)</small>	=B79+B80/SUM(B79:B83)	=C79+C80/SUM(C79:C83)						
85	Yield <small>(dry part)</small>	=B79+B80*B74/((B65+B66)*B74)	=C79+C80*C74/((C65+C66)*C74)						
86	CF overall	=B75/B74	=C75/C74						
87	Area/stage	=B75/(27.9-5.3)*LN(\$F1/B74)/\$B73	=C75/(27.9-5.3)*LN(\$F1/C74)/\$B73						
88	Cartridges/stage	=B87/26.5	=C87/26.5						
89	Max Flow Rate (gpm)	=23*B88+B76/(20*60)	=23*C88+C76/(20*60)						
90	Overall Yield	=B79+B80*B74/((1*maxAll!\$F\$27+1*maxAll!\$F\$28)*1*maxAll!\$F\$23)	=C79+C80*C74/((1*maxAll!\$F\$27+1*maxAll!\$F\$28)*1*maxAll!\$F\$23)						
91	2 Diafiltration								
92	Water Added/Stage (gpd)	2362.78105748553	2345.40753147464						
93	Total Feed (gpd)	=B92+B74	=C92+C74						
94	CF, DT	=B74+B92/B74	=C74+C92/C74						
95	Concentrations								
96	True Protein	=B65*1/((B593/B574)*(1-Given(\$F5)+Given(\$F5))*(\$B\$91)	=C65*1/((C593/C574)*(1-Given(\$F5)+Given(\$F5))*(\$B\$91)						
97	Non-Protein Nitrogen	=B66*1/((B593/B574)*(1-Given(\$F6)+Given(\$F6))*(\$B\$91)	=C66*1/((C593/C574)*(1-Given(\$F6)+Given(\$F6))*(\$B\$91)						
98	Lactose	=B67*1/((B593/B574)*(1-Given(\$F7)+Given(\$F7))*(\$B\$91)	=C67*1/((C593/C574)*(1-Given(\$F7)+Given(\$F7))*(\$B\$91)						
99	Ash	=B68*1/((B593/B574)*(1-Given(\$F8)+Given(\$F8))*(\$B\$91)	=C68*1/((C593/C574)*(1-Given(\$F8)+Given(\$F8))*(\$B\$91)						
100	Butter Fat	=B69*1/((B593/B574)*(1-Given(\$F9)+Given(\$F9))*(\$B\$91)	=C69*1/((C593/C574)*(1-Given(\$F9)+Given(\$F9))*(\$B\$91)						
101	Total Protein <small>(dry weight)</small>	=B96+B97/SUM(B96:B100)	=C96+C97/SUM(C96:C100)						
102	Yield <small>(dry part)</small>	=B96+B97*B74/((B65+B66)*B74)	=C96+C97*C74/((C65+C66)*C74)						
103	CF overall	=B92/(27.9-5.3)*LN(\$F1/B74)/\$B91	=C92/(27.9-5.3)*LN(\$F1/C74)/\$B91						
104	Area/stage	=B104/26.5	=C104/26.5						
105	Cartridges/stage	=23*B105+B93/(20*60)	=23*C105+C93/(20*60)						
106	Max Flow Rate (gpm)	=B96+B97*B74/((1*maxAll!\$F\$27+1*maxAll!\$F\$28)*1*maxAll!\$F\$23)	=C96+C97*C74/((1*maxAll!\$F\$27+1*maxAll!\$F\$28)*1*maxAll!\$F\$23)						
107	Overall Yield								
108									
109									
110	Flow Rates (gpm)								
111	Cart/Stage	=B60	=C60						
112	Actual	13	16						

Appendix D

	A	B	C	D
113 1		=B\$74*23+B4/(20*60)		
114 2			=C\$74*23+C4/(20*60)	=D\$74*23+D4/(20*60)
115 3			=C\$74*23+C13/(20*60)	=D\$74*23+D13/(20*60)
116 4				=D\$74*23+D18/(20*60)
117 5				
118 6				
119 7				
120 8				
121 9				
122 10				
123	Cart/Stage	=B88		
124	Actual	18	=C88	=D88
125	D1			18
126	Cart/Stage	=B76/(20*60)+23*B124	=C76/(20*60)+23*C124	=D76/(20*60)+23*D124
127	Actual	=B105	=C105	=D105
128	D2	=B83/(20*60)+23*B127	=C83/(20*60)+23*C127	=D83/(20*60)+23*D127

Appendix D

	E	F	G
1			
2	29949.04		
3	4 Stages	6 Stages	6 Stages
4	74.375135807628	50.1614929413273	50.6761891211226
5	=1maxAll!\$F\$23	=1maxAll!\$F\$23	=1maxAll!\$F\$23
6	=E13	=F13	=G13
7	=\$F\$1/E13	=\$F\$1/F13	=\$F\$1/G13
8	=E3*E7	=F3*F7	=G3*G7
9	=E4+E5	=F4+F5	=G4+G5
10	=\$F\$1/E55	=\$F\$1/F55	=\$F\$1/G55
11	=27.9-5.3*LN(E10)	=27.9-5.3*LN(F10)	=27.9-5.3*LN(G10)
12	=E3*E11	=F3*F11	=G3*G11
13	=E12+E18	=F12+F18	=G12+G18
14			
15	=\$F\$1/E55	=\$F\$1/F55	=\$F\$1/G55
16	=27.9-5.3*LN(E15)	=27.9-5.3*LN(F15)	=27.9-5.3*LN(G15)
17	=E3*E16	=F3*F16	=G3*G16
18	=E17+E55	=F17+F23	=G17+G23
19			
20	=\$F\$1/F55	=\$F\$1/F55	=\$F\$1/G55
21			
22	=27.9-5.3*LN(F20)	=27.9-5.3*LN(F20)	=27.9-5.3*LN(G20)
23	=F3*F21	=F3*F21	=G3*G21
24			
25	=F22+F55	=F22+F55	=G22+G28
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			
38			
39			
40			
41			
42			
43			
44			
45			
46			
47			
48			
49			
50	4	5	6
51	=\$F\$1/E53	=\$F\$1/F53	=\$F\$1/G53
52	=27.9-5.3*LN(E51)	=27.9-5.3*LN(F51)	=27.9-5.3*LN(G51)
53	2561.09805838236	2561.09805838236	2561.09805838236

Appendix D

	E	F	G
54	=E53*E52	=F53*F52	=G53*G52
55	=E54+E53	=F54+F53	=G54+G53
56			
57			
58			
59			
60	=E59/E26.5	=F59/F26.5	=G59/G26.5
61	=E60*23	=F60*23	=G60*23
62	=E61+E4/(20^60)	=F61+F4/(20^60)	=G61+G4/(20^60)
63			
64			
65	=R31	=S40	=AD4
66	=R32	=S41	=AD5
67	=R34	=S43	=AD7
68	=R35	=S44	=AD8
69	=R36	=S45	=AD9
70	=U32	=V41	=AG5
71			
72			
73			
74	=E53	=F53	=G53
75	6930.9989969051	6930.9989969051	6935.19546004236
76	=E75+E74	=F75+F74	=G75+G74
77	=E76/E74	=F76/F74	=G76/G74
78			
79	=E65*1/((E57/E54)*(1-Given(\$F5)+Given(\$F5))*(\$B\$73)	=F65*1/((F57/F54)*(1-Given(\$F5)+Given(\$F5))*(\$B\$73)	=G65*1/((G57/G54)*(1-Given(\$F5)+Given(\$F5))*(\$B\$73)
80	=E66*1/((E58/E54)*(1-Given(\$F6)+Given(\$F6))*(\$B\$73)	=F66*1/((F58/F54)*(1-Given(\$F6)+Given(\$F6))*(\$B\$73)	=G66*1/((G58/G54)*(1-Given(\$F6)+Given(\$F6))*(\$B\$73)
81	=E67*1/((E59/E54)*(1-Given(\$F7)+Given(\$F7))*(\$B\$73)	=F67*1/((F59/F54)*(1-Given(\$F7)+Given(\$F7))*(\$B\$73)	=G67*1/((G59/G54)*(1-Given(\$F7)+Given(\$F7))*(\$B\$73)
82	=E68*1/((E60/E54)*(1-Given(\$F8)+Given(\$F8))*(\$B\$73)	=F68*1/((F60/F54)*(1-Given(\$F8)+Given(\$F8))*(\$B\$73)	=G68*1/((G60/G54)*(1-Given(\$F8)+Given(\$F8))*(\$B\$73)
83	=E69*1/((E61/E54)*(1-Given(\$F9)+Given(\$F9))*(\$B\$73)	=F69*1/((F61/F54)*(1-Given(\$F9)+Given(\$F9))*(\$B\$73)	=G69*1/((G61/G54)*(1-Given(\$F9)+Given(\$F9))*(\$B\$73)
84	=E79+E80/SUM(E79:E83)	=F79+F80/SUM(F79:F83)	=G79+G80/SUM(G79:G83)
85	=E79+E80/E74/((E65+E66)*E74)	=F79+F80/F74/((F65+F66)*F74)	=G79+G80/G74/((G65+G66)*G74)
86	=F\$1/E74	=F\$1/F74	=G\$1/G74
87	=E75/(27.9-5.3*LN(\$F3/E74))/B73	=F75/(27.9-5.3*LN(\$F3/F74))/B73	=G75/(27.9-5.3*LN(\$G3/G74))/B73
88	=E87/E26.5	=F87/F26.5	=G87/G26.5
89	=23^E88+E76/(20^60)	=23^F88+F76/(20^60)	=23^G88+G76/(20^60)
90	=E79+E80/E74/((1+maxAll(\$F\$27+1*maxAll(\$F\$28)*1*maxAll(\$F\$29)+1*maxAll(\$F\$20)*1*maxAll(\$F\$23)	=F79+F80/F74/((1+maxAll(\$F\$27+1*maxAll(\$F\$28)*1*maxAll(\$F\$29)+1*maxAll(\$F\$20)*1*maxAll(\$F\$23)	=G79+G80/G74/((1+maxAll(\$G\$27+1*maxAll(\$G\$28)*1*maxAll(\$G\$29)+1*maxAll(\$G\$20)*1*maxAll(\$G\$23)
91			
92	2347.2536439585	2348.6114872013	2349.72405779777
93	=E92+E74	=F92+F74	=G92+G74
94	=E74+E92/E74	=F74+F92/F74	=G74+G92/G74
95			
96	=E65*1/((E59/E54)*(1-Given(\$F5)+Given(\$F5))*(\$B\$91)	=F65*1/((F59/F54)*(1-Given(\$F5)+Given(\$F5))*(\$B\$91)	=G65*1/((G59/G54)*(1-Given(\$F5)+Given(\$F5))*(\$B\$91)
97	=E66*1/((E60/E54)*(1-Given(\$F6)+Given(\$F6))*(\$B\$91)	=F66*1/((F60/F54)*(1-Given(\$F6)+Given(\$F6))*(\$B\$91)	=G66*1/((G60/G54)*(1-Given(\$F6)+Given(\$F6))*(\$B\$91)
98	=E67*1/((E61/E54)*(1-Given(\$F7)+Given(\$F7))*(\$B\$91)	=F67*1/((F61/F54)*(1-Given(\$F7)+Given(\$F7))*(\$B\$91)	=G67*1/((G61/G54)*(1-Given(\$F7)+Given(\$F7))*(\$B\$91)
99	=E68*1/((E62/E54)*(1-Given(\$F8)+Given(\$F8))*(\$B\$91)	=F68*1/((F62/F54)*(1-Given(\$F8)+Given(\$F8))*(\$B\$91)	=G68*1/((G62/G54)*(1-Given(\$F8)+Given(\$F8))*(\$B\$91)
100	=E69*1/((E63/E54)*(1-Given(\$F9)+Given(\$F9))*(\$B\$91)	=F69*1/((F63/F54)*(1-Given(\$F9)+Given(\$F9))*(\$B\$91)	=G69*1/((G63/G54)*(1-Given(\$F9)+Given(\$F9))*(\$B\$91)
101	=E96+E97/SUM(E96:E100)	=F96+F97/SUM(F96:F100)	=G96+G97/SUM(G96:G100)
102	=E96+E97/E74/((E65+E66)*E74)	=F96+F97/F74/((F65+F66)*F74)	=G96+G97/G74/((G65+G66)*G74)
103	=F\$1/E74	=F\$1/F74	=G\$1/G74
104	=E92/(27.9-5.3*LN(\$F3/E74))/B91	=F92/(27.9-5.3*LN(\$F3/F74))/B91	=G92/(27.9-5.3*LN(\$G3/G74))/B91
105	=E104/E26.5	=F104/F26.5	=G104/G26.5
106	=23^E105+E93/(20^60)	=23^F105+F93/(20^60)	=23^G105+G93/(20^60)
107	=E96+E97/E74/((1+maxAll(\$F\$27+1*maxAll(\$F\$28)*1*maxAll(\$F\$29)+1*maxAll(\$F\$20)*1*maxAll(\$F\$23)	=F96+F97/F74/((1+maxAll(\$F\$27+1*maxAll(\$F\$28)*1*maxAll(\$F\$29)+1*maxAll(\$F\$20)*1*maxAll(\$F\$23)	=G96+G97/G74/((1+maxAll(\$G\$27+1*maxAll(\$G\$28)*1*maxAll(\$G\$29)+1*maxAll(\$G\$20)*1*maxAll(\$G\$23)
108			
109			
110			
111	=E60	=F60	=G60
112			
113			

Flow Rates: Feed + Recycle

Appendix D

	E	F	G
113	=E\$74*23+E4/(20*60)	=F\$74*23+F4/(20*60)	=G\$74*23+G4/(20*60)
114	=E\$74*23+E13/(20*60)	=F\$74*23+F13/(20*60)	=G\$74*23+G13/(20*60)
115	=E\$74*23+E18/(20*60)	=F\$74*23+F18/(20*60)	=G\$74*23+G18/(20*60)
116	=E\$74*23+E23/(20*60)	=F\$74*23+F23/(20*60)	=G\$74*23+G23/(20*60)
117	=E\$74*23+E28/(20*60)	=F\$74*23+F28/(20*60)	=G\$74*23+G28/(20*60)
118			
119			
120			
121			
122			
123	=E88	=F88	=G88
124	18	18	18
125	=E76/(20*60)+23*E124	=F76/(20*60)+23*F124	=G76/(20*60)+23*G124
126	=E105	=F105	=G105
127	=E105	=F105	=G105
128	=E93/(20*60)+23*E127	=F93/(20*60)+23*F127	=G93/(20*60)+23*G127

Appendix D

	H	I	J
1			
2			
3	43.6541038159139	38.668038431676	34.634338421518
4	=1*max(A11:\$F\$23	=1*max(A11:\$F\$23	=1*max(A11:\$F\$23
5	=I8*H13	=I8*H13	=I8*H13
6	=\$F\$1/H13	=\$F\$1/H13	=\$F\$1/H13
7	=27.9-5.3*L(N(H6)	=27.9-5.3*L(N(I6)	=27.9-5.3*L(N(J6)
8	=H\$3*H7	=I\$3*H7	=J\$3*H7
9	=H4-H5	=I4-I5	=J4-J5
10	=\$F\$1/H55	=\$F\$1/I55	=\$F\$1/J55
11	=27.9-5.3*L(N(H10)	=27.9-5.3*L(N(I10)	=27.9-5.3*L(N(J10)
12	=H\$3*H11	=I\$3*H11	=J\$3*H11
13	=H12+H18	=I12+I18	=J12+J18
14			
15	=\$F\$1/H55	=\$F\$1/I55	=\$F\$1/J55
16	=27.9-5.3*L(N(H15)	=27.9-5.3*L(N(I15)	=27.9-5.3*L(N(J15)
17	=H\$3*H16	=I\$3*H16	=J\$3*H16
18	=H17+H23	=I17+I23	=J17+J23
19			
20	=\$F\$1/H55	=\$F\$1/I55	=\$F\$1/J55
21	=27.9-5.3*L(N(H20)	=27.9-5.3*L(N(I20)	=27.9-5.3*L(N(J20)
22	=H\$3*H21	=I\$3*H21	=J\$3*H21
23	=H22+H28	=I22+I28	=J22+J28
24			
25	=\$F\$1/H55	=\$F\$1/I55	=\$F\$1/J55
26	=27.9-5.3*L(N(H25)	=27.9-5.3*L(N(I25)	=27.9-5.3*L(N(J25)
27	=H\$3*H26	=I\$3*H26	=J\$3*H26
28	=H27+H33	=I27+I33	=J27+J33
29			
30	=\$F\$1/H55	=\$F\$1/I55	=\$F\$1/J55
31	=27.9-5.3*L(N(H30)	=27.9-5.3*L(N(I30)	=27.9-5.3*L(N(J30)
32	=H\$3*H31	=I\$3*H31	=J\$3*H31
33	=H32+H55	=I32+I38	=J32+J38
34			
35	=\$F\$1/H55	=\$F\$1/I55	=\$F\$1/J55
36	=27.9-5.3*L(N(H35)	=27.9-5.3*L(N(I35)	=27.9-5.3*L(N(J35)
37	=H\$3*H36	=I\$3*H36	=J\$3*H36
38	=H37+H55	=I37+I43	=J37+J43
39			
40			
41			
42			
43			
44			
45			
46			
47			
48			
49			
50			
51	=\$F\$1/H53	=\$F\$1/I53	=\$F\$1/J53
52	=27.9-5.3*L(N(H51)	=27.9-5.3*L(N(I51)	=27.9-5.3*L(N(J51)
53	2560.9155628173	2561.17015414092	2561.09805638236

Appendix D

	H	I	J
54	=I\$3*H52	=I\$3*H52	=J\$3*J52
55	=H54+H53	=I54+I53	=J54+J53
56			
57			
58	7	8	9
59	=H3	=I3	=J3
60	=H59/26.5	=I59/26.5	=J59/26.5
61	=H60*23	=I60*23	=J60*23
62	=H61+H4/(20*60)	=I61+I4/(20*60)	=J61+J4/(20*60)
63			
64			
65	=AE13	=AF22	=AG31
66	=AE14	=AF23	=AG32
67	=AE16	=AF25	=AG34
68	=AE17	=AF26	=AG35
69	=AE18	=AF27	=AG36
70	=AH14	=AI32	=AJ32
71			
72			
73			
74	=H63	=I63	=J63
75	7022.31523256075	7028.96589130456	7028.94809126074
76	=H73+H74	=I75+I74	=J75+J74
77	=H76/H74	=I76/I74	=J76/J74
78			
79	=H65*1/((H\$76/H\$74)*(1-Given(\$F5)+Given(\$F6))*(\$B\$73))	=I65*1/((I\$76/I\$74)*(1-Given(\$F5)+Given(\$F6))*(\$B\$73))	=J65*1/((J\$76/J\$74)*(1-Given(\$F5)+Given(\$F6))*(\$B\$73))
80	=H66*1/((H\$76/H\$74)*(1-Given(\$F6)+Given(\$F7))*(\$B\$73))	=I66*1/((I\$76/I\$74)*(1-Given(\$F6)+Given(\$F7))*(\$B\$73))	=J66*1/((J\$76/J\$74)*(1-Given(\$F6)+Given(\$F7))*(\$B\$73))
81	=H67*1/((H\$76/H\$74)*(1-Given(\$F7)+Given(\$F8))*(\$B\$73))	=I67*1/((I\$76/I\$74)*(1-Given(\$F7)+Given(\$F8))*(\$B\$73))	=J67*1/((J\$76/J\$74)*(1-Given(\$F7)+Given(\$F8))*(\$B\$73))
82	=H68*1/((H\$76/H\$74)*(1-Given(\$F8)+Given(\$F9))*(\$B\$73))	=I68*1/((I\$76/I\$74)*(1-Given(\$F8)+Given(\$F9))*(\$B\$73))	=J68*1/((J\$76/J\$74)*(1-Given(\$F8)+Given(\$F9))*(\$B\$73))
83	=H69*1/((H\$76/H\$74)*(1-Given(\$F9)+Given(\$F9))*(\$B\$73))	=I69*1/((I\$76/I\$74)*(1-Given(\$F9)+Given(\$F9))*(\$B\$73))	=J69*1/((J\$76/J\$74)*(1-Given(\$F9)+Given(\$F9))*(\$B\$73))
84	=(H79+H80)/SUM(H79:H83)	=(I79+I80)/SUM(I79:I83)	=(J79+J80)/SUM(J79:J83)
85	=(H79+H80)*H74/((H65+H66)*H74)	=(I79+I80)*I74/((I65+I66)*I74)	=(J79+J80)*J74/((J65+J66)*J74)
86	=F\$1/H74	=F\$1/I74	=F\$1/J74
87	=H75/(27.9-5.3*LN(\$F\$1/H74))/B73	=I75/(27.9-5.3*LN(I\$F\$1/I74))/B73	=J75/(27.9-5.3*LN(J\$F\$1/J74))/B73
88	=H87/26.5	=I87/26.5	=J87/26.5
89	=23*H88+H76/(20*60)	=23*I88+I76/(20*60)	=23*J88+J76/(20*60)
90	=(H79+H80)*H74/((I\$F\$27+I\$F\$28)*I\$F\$23)	=(I79+I80)*I74/((I\$F\$27+I\$F\$28)*I\$F\$23)	=(J79+J80)*J74/((J\$F\$27+J\$F\$28)*J\$F\$23)
91			
92	2350.27593016291	2351.47607211928	2351.93706210809
93	=H92+H74	=I92+I74	=J92+J74
94	=(H74+H92)/H74	=(I74+I92)/I74	=(J74+J92)/J74
95			
96	=H65*1/((H\$93/H\$74)*(1-Given(\$F5)+Given(\$F5))*(\$B\$91))	=I65*1/((I\$93/I\$74)*(1-Given(\$F5)+Given(\$F5))*(\$B\$91))	=J65*1/((J\$93/J\$74)*(1-Given(\$F5)+Given(\$F5))*(\$B\$91))
97	=H66*1/((H\$93/H\$74)*(1-Given(\$F6)+Given(\$F6))*(\$B\$91))	=I66*1/((I\$93/I\$74)*(1-Given(\$F6)+Given(\$F6))*(\$B\$91))	=J66*1/((J\$93/J\$74)*(1-Given(\$F6)+Given(\$F6))*(\$B\$91))
98	=H67*1/((H\$93/H\$74)*(1-Given(\$F7)+Given(\$F7))*(\$B\$91))	=I67*1/((I\$93/I\$74)*(1-Given(\$F7)+Given(\$F7))*(\$B\$91))	=J67*1/((J\$93/J\$74)*(1-Given(\$F7)+Given(\$F7))*(\$B\$91))
99	=H68*1/((H\$93/H\$74)*(1-Given(\$F8)+Given(\$F8))*(\$B\$91))	=I68*1/((I\$93/I\$74)*(1-Given(\$F8)+Given(\$F8))*(\$B\$91))	=J68*1/((J\$93/J\$74)*(1-Given(\$F8)+Given(\$F8))*(\$B\$91))
100	=H69*1/((H\$93/H\$74)*(1-Given(\$F9)+Given(\$F9))*(\$B\$91))	=I69*1/((I\$93/I\$74)*(1-Given(\$F9)+Given(\$F9))*(\$B\$91))	=J69*1/((J\$93/J\$74)*(1-Given(\$F9)+Given(\$F9))*(\$B\$91))
101	=(H96+H97)/SUM(H96:H100)	=(I96+I97)/SUM(I96:I100)	=(J96+J97)/SUM(J96:J100)
102	=(H96+H97)*H74/((H65+H66)*H74)	=(I96+I97)*I74/((I65+I66)*I74)	=(J96+J97)*J74/((J65+J66)*J74)
103	=F\$1/H74	=F\$1/I74	=F\$1/J74
104	=H92/(27.9-5.3*LN(\$F\$1/H74))/B91	=I92/(27.9-5.3*LN(I\$F\$1/I74))/B91	=J92/(27.9-5.3*LN(J\$F\$1/J74))/B91
105	=H104/26.5	=I104/26.5	=J104/26.5
106	=23*H105+H93/(20*60)	=23*I105+I93/(20*60)	=23*J105+J93/(20*60)
107	=(H96+H97)*H74/((I\$F\$27+I\$F\$28)*I\$F\$23)	=(I96+I97)*I74/((I\$F\$27+I\$F\$28)*I\$F\$23)	=(J96+J97)*J74/((J\$F\$27+J\$F\$28)*J\$F\$23)
108			
109			
110	7	8	9
111	=H60	=I60	=J60
112			

Appendix D

	H	I	J
113	=H\$74*23+H4/(20*60)	=I\$74*23+I4/(20*60)	=J\$74*23+J4/(20*60)
114	=H\$74*23+H13/(20*60)	=I\$74*23+I13/(20*60)	=J\$74*23+J13/(20*60)
115	=H\$74*23+H18/(20*60)	=I\$74*23+I18/(20*60)	=J\$74*23+J18/(20*60)
116	=H\$74*23+H23/(20*60)	=I\$74*23+I23/(20*60)	=J\$74*23+J23/(20*60)
117	=H\$74*23+H28/(20*60)	=I\$74*23+I28/(20*60)	=J\$74*23+J28/(20*60)
118	=H\$74*23+H33/(20*60)	=I\$74*23+I33/(20*60)	=J\$74*23+J33/(20*60)
119	=H\$74*23+H38/(20*60)	=I\$74*23+I38/(20*60)	=J\$74*23+J38/(20*60)
120		=I\$74*23+I43/(20*60)	=J\$74*23+J43/(20*60)
121			=J\$74*23+J48/(20*60)
122			
123	=H88	=I88	=J88
124	18	18	18
125	=H76/(20*60)+23*1124	=I76/(20*60)+23*1124	=J76/(20*60)+23*1124
126	=H105	=I105	=J105
127	=H105	=I105	=J105
128	=H93/(20*60)+23*1127	=I93/(20*60)+23*1127	=J93/(20*60)+23*1127



	K	L	M	N	O	P
1						
2	10 Stages			1 Stage		
3	31, 3636077441951	ft		$f_n$	=B4/B53	Total Out gal/day
4	=1maxA11F27	gal/day		$C_{B,NPN}$	=1maxA11F27*(O\$3*(1-Given(\$F5)+Given(\$F5))	=O4*\$B\$53
5		gal/day		$C_{B,TP}$	=1maxA11F28*(O\$3*(1-Given(\$F6)+Given(\$F6))	=O5*\$B\$53
6	=F\$1/K13			$C_{B,Protein}$	=O4+O5	=O6*\$B\$53
7	=27.9-5.3*LN(K6)	gsfd		$C_{B,Lactose}$	=1maxA11F29*(O\$3*(1-Given(\$F7)+Given(\$F7))	=O7*\$B\$53
8	=K\$3*K7	gal/day		$C_{B,Ash}$	=1maxA11F30*(O\$3*(1-Given(\$F8)+Given(\$F8))	=O8*\$B\$53
9	=K4-K5	gal/day		$C_{B,Batter Fat}$	=1maxA11F31*(O\$3*(1-Given(\$F9)+Given(\$F9))	=O9*\$B\$53
10	=F\$1/K55			2 Stages	2	
11	=27.9-5.3*LN(K10)	gsfd		$f_n$	=C4/C55	
12	=K\$3*K11	gal/day		$C_{B,NPN}$	=1maxA11F27*(O\$12*(O\$12*(1-Given(\$F5)+Given(\$F5))	=O13*(P\$12/(P\$12*(1-Given(\$F5)+Given(\$F5))
13	=K12+K18	gal/day		$C_{B,TP}$	=1maxA11F28*(O\$12*(O\$12*(1-Given(\$F6)+Given(\$F6))	=O14*(P\$12/(P\$12*(1-Given(\$F6)+Given(\$F6))
14				$C_{B,Protein}$	=O13+O14	=P13+P14
15	=F\$1/K65			$C_{B,Lactose}$	=1maxA11F29*(O\$12*(O\$12*(1-Given(\$F7)+Given(\$F7))	=O16*(P\$12/(P\$12*(1-Given(\$F7)+Given(\$F7))
16	=27.9-5.3*LN(K15)	gsfd		$C_{B,Ash}$	=1maxA11F30*(O\$12*(O\$12*(1-Given(\$F8)+Given(\$F8))	=O17*(P\$12/(P\$12*(1-Given(\$F8)+Given(\$F8))
17	=K\$3*K16	gal/day		$C_{B,Batter Fat}$	=1maxA11F31*(O\$12*(O\$12*(1-Given(\$F9)+Given(\$F9))	=O18*(P\$12/(P\$12*(1-Given(\$F9)+Given(\$F9))
18	=K17+K23	gal/day		3 Stages	2	
19		gal/day		$f_n$	=D4/D13	=O13/D55
20	=F\$1/K65			$C_{B,NPN}$	=1maxA11F27*(O\$21*(O\$21*(1-Given(\$F5)+Given(\$F5))	=O22*(P\$21/(P\$21*(1-Given(\$F5)+Given(\$F5))
21	=27.9-5.3*LN(K20)	gsfd		$C_{B,TP}$	=1maxA11F28*(O\$21*(O\$21*(1-Given(\$F6)+Given(\$F6))	=O23*(P\$21/(P\$21*(1-Given(\$F6)+Given(\$F6))
22	=K\$3*K21	gal/day		$C_{B,Protein}$	=O22+O23	=P22+P23
23	=K24+K28	gal/day		$C_{B,Lactose}$	=1maxA11F29*(O\$21*(O\$21*(1-Given(\$F7)+Given(\$F7))	=O25*(P\$21/(P\$21*(1-Given(\$F7)+Given(\$F7))
24				$C_{B,Ash}$	=1maxA11F30*(O\$21*(O\$21*(1-Given(\$F8)+Given(\$F8))	=O26*(P\$21/(P\$21*(1-Given(\$F8)+Given(\$F8))
25	=F\$1/K65			$C_{B,Batter Fat}$	=1maxA11F31*(O\$21*(O\$21*(1-Given(\$F9)+Given(\$F9))	=O27*(P\$21/(P\$21*(1-Given(\$F9)+Given(\$F9))
26	=27.9-5.3*LN(K25)	gsfd		4 Stages	2	
27	=K\$3*K26	gal/day		$f_n$	=E4/E13	=E13/E18
28	=K27+K33	gal/day		$C_{B,NPN}$	=1maxA11F27*(O\$30*(O\$30*(1-Given(\$F5)+Given(\$F5))	=O31*(P\$30/(P\$30*(1-Given(\$F5)+Given(\$F5))
29				$C_{B,TP}$	=1maxA11F28*(O\$30*(O\$30*(1-Given(\$F6)+Given(\$F6))	=O32*(P\$30/(P\$30*(1-Given(\$F6)+Given(\$F6))
30	=F\$1/K65			$C_{B,Protein}$	=O31+O32	=P31+P32
31	=27.9-5.3*LN(K30)	gsfd		$C_{B,Lactose}$	=1maxA11F29*(O\$30*(O\$30*(1-Given(\$F7)+Given(\$F7))	=O34*(P\$30/(P\$30*(1-Given(\$F7)+Given(\$F7))
32	=K\$3*K31	gal/day		$C_{B,Ash}$	=1maxA11F30*(O\$30*(O\$30*(1-Given(\$F8)+Given(\$F8))	=O35*(P\$30/(P\$30*(1-Given(\$F8)+Given(\$F8))
33	=K32+K38	gal/day		$C_{B,Batter Fat}$	=1maxA11F31*(O\$30*(O\$30*(1-Given(\$F9)+Given(\$F9))	=O36*(P\$30/(P\$30*(1-Given(\$F9)+Given(\$F9))
34				5 Stages	2	
35	=F\$1/K65			$f_n$	=F4/F13	=F13/F18
36	=27.9-5.3*LN(K35)	gsfd		$C_{B,NPN}$	=1maxA11F27*(O\$39*(O\$39*(1-Given(\$F5)+Given(\$F5))	=O40*(P\$39/(P\$39*(1-Given(\$F5)+Given(\$F5))
37	=K\$3*K36	gal/day		$C_{B,TP}$	=1maxA11F28*(O\$39*(O\$39*(1-Given(\$F6)+Given(\$F6))	=O41*(P\$39/(P\$39*(1-Given(\$F6)+Given(\$F6))
38	=K37+K43	gal/day		$C_{B,Protein}$	=O40+O41	=P40+P41
39				$C_{B,Lactose}$	=1maxA11F29*(O\$39*(O\$39*(1-Given(\$F7)+Given(\$F7))	=O43*(P\$39/(P\$39*(1-Given(\$F7)+Given(\$F7))
40	=F\$1/K65			$C_{B,Ash}$	=1maxA11F30*(O\$39*(O\$39*(1-Given(\$F8)+Given(\$F8))	=O44*(P\$39/(P\$39*(1-Given(\$F8)+Given(\$F8))
41	=27.9-5.3*LN(K40)	gsfd		$C_{B,Batter Fat}$	=1maxA11F31*(O\$39*(O\$39*(1-Given(\$F9)+Given(\$F9))	=O45*(P\$39/(P\$39*(1-Given(\$F9)+Given(\$F9))
42	=K\$3*K41	gal/day				
43	=K42+K48	gal/day				
44						
45	=F\$1/K65					
46	=27.9-5.3*LN(K45)	gsfd				
47	=K\$3*K46	gal/day				
48	=K47+K55	gal/day				
49						
50	10					
51	=F\$1/K63	CF total				
52	=27.9-5.3*LN(K51)	gsfd				
53	2561.0980583236	gal/day				

Appendix D

	K	L	M	N	O	P
54	=K53*K62	gal/day				
55	=K54+K63	gal/day				
56						
57						
58	10					
59	=K3	ft <sup>2</sup>				
60	=K59/26.5	26.5 ft <sup>2</sup> /cartridge				
61	=K60*23	gal/min				
62	=K61+K4/(20*60)	gal/min				
63	=K62*4*12*(7.48*4.028*2*P)/(60)	gal/min				
64						
65	=AH40					
66	=AH41					
67	=AH43					
68	=AH44					
69	=AH45					
70	=AK41					
71						
72						
73						
74	=K53					
75	7030.98949014563					
76	=K75+K74					
77	=K76/K74					
78						
79	=K65*(1/((K\$76/K\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7))^(BB\$73)))					
80	=K66*(1/((K\$76/K\$74)*(1-Given(\$F6)+Given(\$F7))^(BB\$73)))					
81	=K67*(1/((K\$76/K\$74)*(1-Given(\$F7)+Given(\$F8))^(BB\$73)))					
82	=K68*(1/((K\$76/K\$74)*(1-Given(\$F8)+Given(\$F9))^(BB\$73)))					
83	=K69*(1/((K\$76/K\$74)*(1-Given(\$F9)+Given(\$F5))^(BB\$73)))					
84	=K79+K60)/SUM(K79:K83)					
85	=((K79+K60)*K74)/((K65+K66)*K74)					
86	=K75/K74					
87	=K75/(27.9-5.3*LN(\$F\$1/K74))/BB73					
88	=K87/26.5					
89	=23*(K68+K76)/(20*60)					
90	=((K79+K60)*K74)/((1+maxAll (\$F\$27+1*maxAll (\$F\$28)*1*maxAll (\$F\$29)))					
91						
92	2362.43428109631					
93	=K92+K74					
94	=K74+K92)/K74					
95						
96	=K65*(1/((K\$93/K\$74)*(1-Given(\$F5)+Given(\$F6))^(BB\$91)))					
97	=K66*(1/((K\$93/K\$74)*(1-Given(\$F6)+Given(\$F7))^(BB\$91)))					
98	=K67*(1/((K\$93/K\$74)*(1-Given(\$F7)+Given(\$F8))^(BB\$91)))					
99	=K68*(1/((K\$93/K\$74)*(1-Given(\$F8)+Given(\$F9))^(BB\$91)))					
100	=K69*(1/((K\$93/K\$74)*(1-Given(\$F9)+Given(\$F5))^(BB\$91)))					
101	=K96+K97)/SUM(K96:K100)					
102	=((K96+K97)*K74)/((K65+K66)*K74)					
103	=K75/K74					
104	=K92/(27.9-5.3*LN(\$F\$1/K74))/BB91					
105	=K104/26.5					
106	=23*(K105+K93)/(20*60)					
107	=((K96+K97)*K74)/((1+maxAll (\$F\$27+1*maxAll (\$F\$28)*1*maxAll (\$F\$29)))					
108						
109						
110	10					
111	=K60					
112	12					

Appendix D

	K	L	M	N	O	P
113	=K\$74*23+K4/(20*60)					
114	=K\$74*23+K13/(20*60)					
115	=K\$74*23+K18/(20*60)					
116	=K\$74*23+K23/(20*60)					
117	=K\$74*23+K28/(20*60)					
118	=K\$74*23+K33/(20*60)					
119	=K\$74*23+K38/(20*60)					
120	=K\$74*23+K43/(20*60)					
121	=K\$74*23+K48/(20*60)					
122	=K\$74*23+K53/(20*60)					
123	=K88					
124	18					
125	=K76/(20*60)+23*K124					
126	=K105					
127	=K105					
128	=K93/(20*60)+23*K127					

Appendix D

	Q	R	S	T	U
1					
2					
3					
4	Final Protein Concentration	=O6			
5	Yield	=B53*R3/(B4*(1maxA  \$F\$27+1maxA  \$F\$28))			
6					
7	Final Protein % (dry weight)				
8	Total Area	=B3	gal/day		
9	Total Permeate	=B54			
10					
11	Total Out				
12	gal/day				
13	Final Protein Concentration				
14	Yield	=P15			
15					
16	Final Protein % (dry weight)				
17	Total Area	=2*C3			
18	Total Permeate	=C8+C54	gal/day		
19					
20	Total Out				
21	gal/day				
22	Final Protein Concentration				
23	Yield	=Q24			
24					
25	Final Protein % (dry weight)				
26	Total Area	=S*D3			
27	Total Permeate	=D8+D12+D54	gal/day		
28					
29	Total Out				
30	gal/day				
31	Final Protein Concentration				
32	Yield	=R33			
33					
34	Final Protein % (dry weight)				
35	Total Area	=4*E3			
36	Total Permeate	=E6+E12+E17+E54			
37					
38	Total Out				
39	gal/day				
40	Final Protein Concentration				
41	Yield				
42					
43	Final Protein % (dry weight)				
44	Total Area				
45	Total Permeate				
46					
47	Total Out				
48	gal/day				
49	Final Protein Concentration				
50	Yield				
51					
52	Final Protein % (dry weight)				
53	Total Area				
	Total Permeate				

Appendix D

	Q	R	S	T	U
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Appendix D

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	V	W	X	Y	Z	AA
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35						
36	gal/day					
37						
38						
39						
40	=S42					
41	=F53*V39/(F4*(1+maxAll(\$F\$27*(1+maxAll(\$F\$28)))					
42						
43						
44	=F3					
45	=F8+F12+F17+F22+F54					
46						
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Appendix D

	V	W	X	Y	Z	AA
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Appendix D

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	AB	AC	AD	AE	AF
1					
2					
3	=G28/G28				
4	=AA4*(AB\$3/(AB\$3*(1-Given)\$F5)+Given)\$F5)				
5	=AA5*(AB\$3/(AB\$3*(1-Given)\$F6)+Given)\$F6)				
6	=AA6*(AB\$3/(AB\$3*(1-Given)\$F7)+Given)\$F7)				
7	=AA7*(AB\$3/(AB\$3*(1-Given)\$F8)+Given)\$F8)				
8	=AA8*(AB\$3/(AB\$3*(1-Given)\$F9)+Given)\$F9)				
9					
10					
11					
12	=H23/H28				
13	=AA13*(AB\$12/(AB\$12*(1-Given)\$F5)+Given)\$F5)				
14	=AA14*(AB\$12/(AB\$12*(1-Given)\$F6)+Given)\$F6)				
15	=AA15*(AB\$12/(AB\$12*(1-Given)\$F7)+Given)\$F7)				
16	=AA16*(AB\$12/(AB\$12*(1-Given)\$F8)+Given)\$F8)				
17	=AA17*(AB\$12/(AB\$12*(1-Given)\$F9)+Given)\$F9)				
18					
19					
20					
21	=I23/I28				
22	=AA22*(AB\$21/(AB\$21*(1-Given)\$F5)+Given)\$F5)				
23	=AA23*(AB\$21/(AB\$21*(1-Given)\$F6)+Given)\$F6)				
24	=AA24*(AB\$21/(AB\$21*(1-Given)\$F7)+Given)\$F7)				
25	=AA25*(AB\$21/(AB\$21*(1-Given)\$F8)+Given)\$F8)				
26	=AA26*(AB\$21/(AB\$21*(1-Given)\$F9)+Given)\$F9)				
27					
28					
29					
30	=J23/J28				
31	=AA31*(AB\$30/(AB\$30*(1-Given)\$F5)+Given)\$F5)				
32	=AA32*(AB\$30/(AB\$30*(1-Given)\$F6)+Given)\$F6)				
33	=AA33*(AB\$30/(AB\$30*(1-Given)\$F7)+Given)\$F7)				
34	=AA34*(AB\$30/(AB\$30*(1-Given)\$F8)+Given)\$F8)				
35	=AA35*(AB\$30/(AB\$30*(1-Given)\$F9)+Given)\$F9)				
36					
37					
38					
39	=K23/K28				
40	=AA40*(AB\$39/(AB\$39*(1-Given)\$F5)+Given)\$F5)				
41	=AA41*(AB\$39/(AB\$39*(1-Given)\$F6)+Given)\$F6)				
42	=AA42*(AB\$39/(AB\$39*(1-Given)\$F7)+Given)\$F7)				
43	=AA43*(AB\$39/(AB\$39*(1-Given)\$F8)+Given)\$F8)				
44	=AA44*(AB\$39/(AB\$39*(1-Given)\$F9)+Given)\$F9)				
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Appendix D

	AB	AC	AD	AE	AF
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Appendix D

	AB	AC	AD	AE	AF
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Appendix D

	AG	AH	AI	AJ	AK	AL
1						
2						
3						
4	=AD6					
5	=G53*AG3/(G4*(1+max(AI))\$F\$27+1*max(AI))\$F\$28))					
6						
7						
8	=6*G3					
9	=G8*G12+G17+G22+G27+G54	gal/day				
10						
11						
12						
13	Final Protein Concentration	=AE15				
14	Yield	=H53*AH12/(H4*(1+max(AI))\$F\$27+1*max(AI))\$F\$28))				
15	Final Protein % (dry weight)					
16						
17	Total Area	=7*H3				
18	Total Permeate	=H8+H12+H17+H22+H27+H32+H35	gal/day			
19						
20	Total Out					
21	gal/day					
22	=AF22*\$J\$53	Final Protein Concentration	=AF24			
23	=AF23*\$J\$53	Yield	=I53*AI21/(I4*(1+max(AI))\$F\$27+1*max(AI))\$F\$28))			
24	=AF24*\$J\$53	Final Protein % (dry weight)				
25	=AF25*\$J\$53					
26	=AF26*\$J\$53	Total Area	=8*H3			
27	=AF27*\$J\$53	Total Permeate	=I8+H12+H17+H22+H27+H32+H37+H54	gal/day		
28						
29		Total Out				
30	=J\$55*\$J\$53	gal/day				
31	=AF31*(AG\$30/(AG\$30*(1-Given)\$F5)+Given)\$F5))					
32	=AF32*(AG\$30/(AG\$30*(1-Given)\$F6)+Given)\$F6))					
33	=AG31+AG32					
34	=AF34*(AG\$30/(AG\$30*(1-Given)\$F7)+Given)\$F7))					
35	=AF35*(AG\$30/(AG\$30*(1-Given)\$F8)+Given)\$F8))					
36	=AF36*(AG\$30/(AG\$30*(1-Given)\$F9)+Given)\$F9))					
37						
38						
39	=K\$55*\$K\$53					
40	=AF40*(AG\$39/(AG\$39*(1-Given)\$F5)+Given)\$F5))					
41	=AF41*(AG\$39/(AG\$39*(1-Given)\$F6)+Given)\$F6))					
42	=AG40+AG41					
43	=AF43*(AG\$39/(AG\$39*(1-Given)\$F7)+Given)\$F7))					
44	=AF44*(AG\$39/(AG\$39*(1-Given)\$F8)+Given)\$F8))					
45	=AF45*(AG\$39/(AG\$39*(1-Given)\$F9)+Given)\$F9))					
46						
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Appendix D

	AG	AH	AI	AJ	AK	AL
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Appendix D

	AG	AH	AI	AJ	AK	AL
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A		B	C
1	Total Soln into 35% (gal/day)		
2	From 75% (One Dia. Stage)	1 Stage	2 Stages
3	1 Diafiltration		
4	Soln Feed (gpd)	=1max55%IB74-1maxAllI\$M\$23	=1max55%IC74-1maxAllI\$M\$23
5	Water Added (gpd)	2436.61447661109	2350.06255369232
6	Total Feed (gpd)	=B5+B4	=C5+C4
7	CF, D1	=B6/B4	=C6/C4
8	Concentrations		
9	True Protein	=1max55%IB79-1/((B\$6/B\$4)*(1-GivenI\$F5)+GivenI\$F5)/\$B\$3	=1max55%IC79-1/((C\$6/C\$4)*(1-GivenI\$F5)+GivenI\$F5)/\$B\$3
10	Non-Protein Nitrogen	=1max55%IB80-1/((B\$6/B\$4)*(1-GivenI\$F6)+GivenI\$F6)/\$B\$3	=1max55%IC80-1/((C\$6/C\$4)*(1-GivenI\$F6)+GivenI\$F6)/\$B\$3
11	Lactose	=1max55%IB81-1/((B\$6/B\$4)*(1-GivenI\$F7)+GivenI\$F7)/\$B\$3	=1max55%IC81-1/((C\$6/C\$4)*(1-GivenI\$F7)+GivenI\$F7)/\$B\$3
12	Ash	=1max55%IB82-1/((B\$6/B\$4)*(1-GivenI\$F8)+GivenI\$F8)/\$B\$3	=1max55%IC82-1/((C\$6/C\$4)*(1-GivenI\$F8)+GivenI\$F8)/\$B\$3
13	Butter Fat	=1max55%IB83-1/((B\$6/B\$4)*(1-GivenI\$F9)+GivenI\$F9)/\$B\$3	=1max55%IC83-1/((C\$6/C\$4)*(1-GivenI\$F9)+GivenI\$F9)/\$B\$3
14	Total Protein (dry weight)	=((B9+B10)/SUM(B9:B13))	=((C9+C10)/SUM(C9:C13))
15	Yield (dry part)	=((B9+B10)*B4)/((1max55%IB79+1max55%IB80)*B\$4)	=((C9+C10)*C4)/((1max55%IC79+1max55%IC80)*C\$4)
16	CF overall	=B\$1/B4	=C\$1/C4
17	Area/stage	=B5/(27.9-5.3*LN(\$E\$1/B4))/\$B3	=C5/(27.9-5.3*LN(\$E\$1/C4))/\$B3
18	Cartridges/stage	=B17/26.5	=C17/26.5
19	Max Flow Rate (gpm)	=23*B18+B6/(20*60)	=23*C18+C6/(20*60)
20	2 Diafiltration		
21	Water Added/Stage (gpd)	747.240953716152	731.412787518192
22	Total Feed (gpd)	=B21+B4	=C21+C4
23	CF, D1	=((B4+B21)/B\$4)	=((C4+C21)/C\$4)
24	Concentrations		
25	True Protein	=1max55%IB79-1/((B\$4+B\$21)/B\$4*(1-GivenI\$F5)+GivenI\$F5)/\$B\$20	=1max55%IC79-1/((C\$4+C\$21)/C\$4*(1-GivenI\$F5)+GivenI\$F5)/\$B\$20
26	Non-Protein Nitrogen	=1max55%IB80-1/((B\$4+B\$21)/B\$4*(1-GivenI\$F6)+GivenI\$F6)/\$B\$20	=1max55%IC80-1/((C\$4+C\$21)/C\$4*(1-GivenI\$F6)+GivenI\$F6)/\$B\$20
27	Lactose	=1max55%IB81-1/((B\$4+B\$21)/B\$4*(1-GivenI\$F7)+GivenI\$F7)/\$B\$20	=1max55%IC81-1/((C\$4+C\$21)/C\$4*(1-GivenI\$F7)+GivenI\$F7)/\$B\$20
28	Ash	=1max55%IB82-1/((B\$4+B\$21)/B\$4*(1-GivenI\$F8)+GivenI\$F8)/\$B\$20	=1max55%IC82-1/((C\$4+C\$21)/C\$4*(1-GivenI\$F8)+GivenI\$F8)/\$B\$20
29	Butter Fat	=1max55%IB83-1/((B\$4+B\$21)/B\$4*(1-GivenI\$F9)+GivenI\$F9)/\$B\$20	=1max55%IC83-1/((C\$4+C\$21)/C\$4*(1-GivenI\$F9)+GivenI\$F9)/\$B\$20
30	Total Protein (dry weight)	=((B25+B26)/SUM(B25:B29))	=((C25+C26)/SUM(C25:C29))
31	Yield (dry part)	=((B25+B26)*B4)/((1max55%IB79+1max55%IB80)*B\$4)	=((C25+C26)*C4)/((1max55%IC79+1max55%IC80)*C\$4)
32	CF overall	=B\$1/B4	=C\$1/C4
33	Area/stage	=B21/(27.9-5.3*LN(\$E\$1/B4))/\$B20	=C21/(27.9-5.3*LN(\$E\$1/C4))/\$B20
34	Cartridges/stage	=B32/26.5	=C32/26.5
35	Max Flow Rate (gpm)	=23*B34+B22/(20*60)	=23*C34+C22/(20*60)
36	From 75% (Two Dia. Stage)	1 Stage	2 Stages
37	1 Diafiltration		
38	Soln Feed (gpd)	=1max55%IB74-1maxAllI\$M\$23	=1max55%IC74-1maxAllI\$M\$23
39	Water Added (gpd)	2312.1523978619	2247.59078303463
40	Total Feed (gpd)	=B39+B38	=C39+C38
41	CF, D1	=B40/B38	=C40/C38
42	Concentrations		
43	True Protein	=1max55%IB96-1/((B\$40/B\$38)*(1-GivenI\$F5)+GivenI\$F5)/\$B\$37	=1max55%IC96-1/((C\$40/C\$38)*(1-GivenI\$F5)+GivenI\$F5)/\$B\$37
44	Non-Protein Nitrogen	=1max55%IB97-1/((B\$40/B\$38)*(1-GivenI\$F6)+GivenI\$F6)/\$B\$37	=1max55%IC97-1/((C\$40/C\$38)*(1-GivenI\$F6)+GivenI\$F6)/\$B\$37
45	Lactose	=1max55%IB98-1/((B\$40/B\$38)*(1-GivenI\$F7)+GivenI\$F7)/\$B\$37	=1max55%IC98-1/((C\$40/C\$38)*(1-GivenI\$F7)+GivenI\$F7)/\$B\$37
46	Ash	=1max55%IB99-1/((B\$40/B\$38)*(1-GivenI\$F8)+GivenI\$F8)/\$B\$37	=1max55%IC99-1/((C\$40/C\$38)*(1-GivenI\$F8)+GivenI\$F8)/\$B\$37
47	Butter Fat	=1max55%IB100-1/((B\$40/B\$38)*(1-GivenI\$F9)+GivenI\$F9)/\$B\$37	=1max55%IC100-1/((C\$40/C\$38)*(1-GivenI\$F9)+GivenI\$F9)/\$B\$37
48	Total Protein (dry weight)	=((B43+B44)/SUM(B43:B47))	=((C43+C44)/SUM(C43:C47))
49	Yield (dry part)	=((B43+B44)*B38)/((1max55%IB96+1max55%IB97)*B\$38)	=((C43+C44)*C38)/((1max55%IC96+1max55%IC97)*C\$38)
50	CF overall	=B\$1/B38	=C\$1/C38
51	Area/stage	=B39/(27.9-5.3*LN(\$E\$1/B38))/\$B37	=C39/(27.9-5.3*LN(\$E\$1/C38))/\$B37
52	Cartridges/stage	=B51/26.5	=C51/26.5
53	Max Flow Rate (gpm)	=23*B52+B40/(20*60)	=23*C52+C40/(20*60)
54	2 Diafiltration		
55	Water Added/Stage (gpd)	724.606323693601	712.412282878419
56	Total Feed (gpd)	=B55+B38	=C55+C38
57	CF, D1	=((B38+B55)/B\$38)	=((C38+C55)/C\$4)
58	Concentrations		
59	True Protein	=1max55%IB96-1/((B\$38+B\$55)/B\$38*(1-GivenI\$F5)+GivenI\$F5)/\$B\$54	=1max55%IC96-1/((C\$38+C\$55)/C\$38*(1-GivenI\$F5)+GivenI\$F5)/\$B\$54



Appendix D

	A	B	C
60	Non-Protein Nitrogen	$=1\text{max}55\% \cdot \text{B}97 \cdot \frac{1}{1 + ((\text{B}338 + \text{B}355) / \text{B}338) \cdot (1 - \text{Given}\{\$F6\}) + \text{Given}\{\$F6\}} \cdot (\$B554)$	$=1\text{max}55\% \cdot \text{C}97 \cdot \frac{1}{1 + ((\text{C}338 + \text{C}355) / \text{C}338) \cdot (1 - \text{Given}\{\$F6\}) + \text{Given}\{\$F6\}} \cdot (\$B554)$
61	Lactose	$=1\text{max}55\% \cdot \text{B}98 \cdot \frac{1}{1 + ((\text{B}338 + \text{B}355) / \text{B}338) \cdot (1 - \text{Given}\{\$F7\}) + \text{Given}\{\$F7\}} \cdot (\$B554)$	$=1\text{max}55\% \cdot \text{C}98 \cdot \frac{1}{1 + ((\text{C}338 + \text{C}355) / \text{C}338) \cdot (1 - \text{Given}\{\$F7\}) + \text{Given}\{\$F7\}} \cdot (\$B554)$
62	Ash	$=1\text{max}55\% \cdot \text{B}99 \cdot \frac{1}{1 + ((\text{B}338 + \text{B}355) / \text{B}338) \cdot (1 - \text{Given}\{\$F8\}) + \text{Given}\{\$F8\}} \cdot (\$B554)$	$=1\text{max}55\% \cdot \text{C}99 \cdot \frac{1}{1 + ((\text{C}338 + \text{C}355) / \text{C}338) \cdot (1 - \text{Given}\{\$F8\}) + \text{Given}\{\$F8\}} \cdot (\$B554)$
63	Buffer Fat	$=1\text{max}55\% \cdot \text{B}100 \cdot \frac{1}{1 + ((\text{B}338 + \text{B}355) / \text{B}338) \cdot (1 - \text{Given}\{\$F9\}) + \text{Given}\{\$F9\}} \cdot (\$B554)$	$=1\text{max}55\% \cdot \text{C}100 \cdot \frac{1}{1 + ((\text{C}338 + \text{C}355) / \text{C}338) \cdot (1 - \text{Given}\{\$F9\}) + \text{Given}\{\$F9\}} \cdot (\$B554)$
64	Total Protein (dry weight)	$= (\text{B}59 + \text{B}60) / \text{SUM}(\text{B}59 : \text{B}63)$	$= (\text{C}59 + \text{C}60) / \text{SUM}(\text{C}59 : \text{C}63)$
65	Yield this part	$= (\text{B}59 + \text{B}60) \cdot \text{B}38 / ((1\text{max}55\% \cdot \text{B}96 + 1\text{max}55\% \cdot \text{B}97) \cdot \text{B}34)$	$= (\text{C}59 + \text{C}60) \cdot \text{C}38 / ((1\text{max}55\% \cdot \text{C}96 + 1\text{max}55\% \cdot \text{C}97) \cdot \text{C}34)$
66	CF overall	$= \$E\$1 / \text{B}38$	$= \$E\$1 / \text{C}38$
67	Area/stage	$= 865 / (27.9 - 5.3 \cdot \text{LN}(\$E\$1 / \text{B}38)) / \$B54$	$= 855 / (27.9 - 5.3 \cdot \text{LN}(\$E\$1 / \text{C}38)) / \$B54$
68	Cartridges/stage	$= 867 / 26.5$	$= 867 / 26.5$
69	Max Flow Rate (gpm)	$= 23 \cdot \text{B}66 + \text{B}56 / (20 \cdot 60)$	$= 23 \cdot \text{C}66 + \text{C}56 / (20 \cdot 60)$
70			
71			
72	Flow Rates (gpm)	1	2
73			
74	Cartr/Stage	$= \text{B}18$	$= \text{C}18$
75	Actual	8	7
76	D1	$= \text{B}6 / (20 \cdot 60) + 23 \cdot \text{B}75$	$= \text{C}6 / (20 \cdot 60) + 23 \cdot \text{C}75$
77	Cartr/Stage	$= \text{B}34$	$= \text{C}34$
78	Actual	2	2
79	D2	$= \text{B}22 / (20 \cdot 60) + 23 \cdot \text{B}78$	$= \text{C}22 / (20 \cdot 60) + 23 \cdot \text{C}78$
80			
81	Cartr/Stage	$= \text{B}52$	$= \text{C}52$
82	Actual	7	7
83	D1	$= \text{B}40 / (20 \cdot 60) + 23 \cdot \text{B}81$	$= \text{C}40 / (20 \cdot 60) + 23 \cdot \text{C}81$
84	Cartr/Stage	$= \text{B}68$	$= \text{C}68$
85	Actual	2	2
86	D2	$= \text{B}56 / (20 \cdot 60) + 23 \cdot \text{B}84$	$= \text{C}56 / (20 \cdot 60) + 23 \cdot \text{C}84$

	D	E	F
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	D	E	F
60	=1max55%*ID97*(1/((D\$38+D\$55)/D\$38))*(1-Given\$F6)+Given\$F6)^(\$B\$54)	=1max55%*IE97*(1/((E\$38+E\$55)/E\$38))*(1-Given\$E6)+Given\$E6)^(\$B\$54)	=1max55%*IF97*(1/((F\$38+F\$55)/F\$38))*(1-Given\$F6)+Given\$F6)^(\$B\$54)
61	=1max55%*ID98*(1/((D\$38+D\$55)/D\$38))*(1-Given\$F7)+Given\$F7)^(\$B\$54)	=1max55%*IE98*(1/((E\$38+E\$55)/E\$38))*(1-Given\$F7)+Given\$F7)^(\$B\$54)	=1max55%*IF98*(1/((F\$38+F\$55)/F\$38))*(1-Given\$F7)+Given\$F7)^(\$B\$54)
62	=1max55%*ID99*(1/((D\$38+D\$55)/D\$38))*(1-Given\$F8)+Given\$F8)^(\$B\$54)	=1max55%*IE99*(1/((E\$38+E\$55)/E\$38))*(1-Given\$F8)+Given\$F8)^(\$B\$54)	=1max55%*IF99*(1/((F\$38+F\$55)/F\$38))*(1-Given\$F8)+Given\$F8)^(\$B\$54)
63	=1max55%*ID100*(1/((D\$38+D\$55)/D\$38))*(1-Given\$F9)+Given\$F9)^(\$B\$54)	=1max55%*IE100*(1/((E\$38+E\$55)/E\$38))*(1-Given\$F9)+Given\$F9)^(\$B\$54)	=1max55%*IF100*(1/((F\$38+F\$55)/F\$38))*(1-Given\$F9)+Given\$F9)^(\$B\$54)
64	=(D59+D60)/SUM(D59:D63)	=(E59+E60)/SUM(E59:E63)	=(F59+F60)/SUM(F59:F63)
65	=(D59+D60)*D38/((1max55%*ID96+1max55%*ID97)*D\$4)	=(E59+E60)*E38/((1max55%*IE96+1max55%*IE97)*E\$4)	=(F59+F60)*F38/((1max55%*IF96+1max55%*IF97)*F\$4)
66	=\$E\$1/D38	=\$E\$1/E38	=\$E\$1/F38
67	=D55/(27.9-5.3*LN(\$E\$1/D38))/\$B54	=E55/(27.9-5.3*LN(\$E\$1/E38))/\$B54	=F55/(27.9-5.3*LN(\$E\$1/F38))/\$B54
68	=D67/26.5	=E67/26.5	=F67/26.5
69	=23*D68+D56/(20*60)	=23*E68+E56/(20*60)	=23*F68+F56/(20*60)
70			
71			
72	3	4	5
73			
74	=D18	=E18	=F18
75	=D18	7	7
76	=D6/(20*60)+23*D75	=E6/(20*60)+23*E75	=F6/(20*60)+23*F75
77	=D34	=E34	=F34
78	2	2	2
79	=D22/(20*60)+23*D78	=E22/(20*60)+23*E78	=F22/(20*60)+23*F78
80			
81	=D52	=E52	=F52
82	7	7	7
83	=D40/(20*60)+23*D81	=E40/(20*60)+23*E81	=F40/(20*60)+23*F81
84	=D68	=E68	=F68
85	2	2	2
86	=D56/(20*60)+23*D84	=E56/(20*60)+23*E84	=F56/(20*60)+23*F84

Flow Rates: Feed + Recycle

1 Diafiltration  
2 Diafiltration

	G	H	8 Stages
1			
2			
3			
4	=1*max55%*G74-1*maxAll*\$M\$23		=1*max55%*H74-1*maxAll*\$M\$23
5	=G5+G4		=H5+H4
6	=G6/G4		=H6/H4
7			
8			
9	=1*max55%*G79*(1/((G\$6/G\$4)*(1-Given)\$F5)+Given)\$F5)*(\$B\$3)		=1*max55%*H79*(1/((H\$6/H\$4)*(1-Given)\$F5)+Given)\$F5)*(\$B\$3)
10	=1*max55%*G80*(1/((G\$6/G\$4)*(1-Given)\$F6)+Given)\$F6)*(\$B\$3)		=1*max55%*H80*(1/((H\$6/H\$4)*(1-Given)\$F6)+Given)\$F6)*(\$B\$3)
11	=1*max55%*G81*(1/((G\$6/G\$4)*(1-Given)\$F7)+Given)\$F7)*(\$B\$3)		=1*max55%*H81*(1/((H\$6/H\$4)*(1-Given)\$F7)+Given)\$F7)*(\$B\$3)
12	=1*max55%*G82*(1/((G\$6/G\$4)*(1-Given)\$F8)+Given)\$F8)*(\$B\$3)		=1*max55%*H82*(1/((H\$6/H\$4)*(1-Given)\$F8)+Given)\$F8)*(\$B\$3)
13	=1*max55%*G83*(1/((G\$6/G\$4)*(1-Given)\$F9)+Given)\$F9)*(\$B\$3)		=1*max55%*H83*(1/((H\$6/H\$4)*(1-Given)\$F9)+Given)\$F9)*(\$B\$3)
14	=(G9+G10)/SUM(G9:G13)		=(H9+H10)/SUM(H9:H13)
15	=(G9+G10)*G4/((1*max55%*G79+1*max55%*G80)*G\$4)		=(H9+H10)*H4/((1*max55%*H79+1*max55%*H80)*H\$4)
16	=E\$1/G4		=E\$1/H4
17	=G5/(27.9-5.3*LN(E\$1/G4))/B3		=H5/(27.9-5.3*LN(E\$1/H4))/B3
18	=G17/26.5		=H17/26.5
19	=23*G18+G6/(20*60)		=23*H18+H6/(20*60)
20			
21	726.669788501505		726.638183913758
22	=G21+G4		=H21+H4
23	=(G4+G21)/G\$4		=(H4+H21)/H\$4
24			
25	=1*max55%*G79*(1/((G\$4+G\$21)/G\$4)*(1-Given)\$F5)+Given)\$F5)*(\$B\$20)		=1*max55%*H79*(1/((H\$4+H\$21)/H\$4)*(1-Given)\$F5)+Given)\$F5)*(\$B\$20)
26	=1*max55%*G80*(1/((G\$4+G\$21)/G\$4)*(1-Given)\$F6)+Given)\$F6)*(\$B\$20)		=1*max55%*H80*(1/((H\$4+H\$21)/H\$4)*(1-Given)\$F6)+Given)\$F6)*(\$B\$20)
27	=1*max55%*G81*(1/((G\$4+G\$21)/G\$4)*(1-Given)\$F7)+Given)\$F7)*(\$B\$20)		=1*max55%*H81*(1/((H\$4+H\$21)/H\$4)*(1-Given)\$F7)+Given)\$F7)*(\$B\$20)
28	=1*max55%*G82*(1/((G\$4+G\$21)/G\$4)*(1-Given)\$F8)+Given)\$F8)*(\$B\$20)		=1*max55%*H82*(1/((H\$4+H\$21)/H\$4)*(1-Given)\$F8)+Given)\$F8)*(\$B\$20)
29	=1*max55%*G83*(1/((G\$4+G\$21)/G\$4)*(1-Given)\$F9)+Given)\$F9)*(\$B\$20)		=1*max55%*H83*(1/((H\$4+H\$21)/H\$4)*(1-Given)\$F9)+Given)\$F9)*(\$B\$20)
30	=(G25+G26)/SUM(G25:G29)		=(H25+H26)/SUM(H25:H29)
31	=(G25+G26)*G4/((1*max55%*G79+1*max55%*G80)*G\$4)		=(H25+H26)*H4/((1*max55%*H79+1*max55%*H80)*H\$4)
32	=E\$1/G4		=E\$1/H4
33	=G21/(27.9-5.3*LN(E\$1/G4))/B20		=H21/(27.9-5.3*LN(E\$1/H4))/B20
34	=G38/26.5		=H33/26.5
35	=23*G34+G22/(20*60)		=23*H34+H22/(20*60)
36			
37			
38	=1*max55%*G74-1*maxAll*\$M\$23		=1*max55%*H74-1*maxAll*\$M\$23
39	=G39+G38		=H39+H38
40	=G40/G38		=H40/H38
41			
42			
43	=1*max55%*G96*(1/((G\$40/G\$38)*(1-Given)\$F5)+Given)\$F5)*(\$B\$37)		=1*max55%*H96*(1/((H\$40/H\$38)*(1-Given)\$F5)+Given)\$F5)*(\$B\$37)
44	=1*max55%*G97*(1/((G\$40/G\$38)*(1-Given)\$F6)+Given)\$F6)*(\$B\$37)		=1*max55%*H97*(1/((H\$40/H\$38)*(1-Given)\$F6)+Given)\$F6)*(\$B\$37)
45	=1*max55%*G98*(1/((G\$40/G\$38)*(1-Given)\$F7)+Given)\$F7)*(\$B\$37)		=1*max55%*H98*(1/((H\$40/H\$38)*(1-Given)\$F7)+Given)\$F7)*(\$B\$37)
46	=1*max55%*G99*(1/((G\$40/G\$38)*(1-Given)\$F8)+Given)\$F8)*(\$B\$37)		=1*max55%*H99*(1/((H\$40/H\$38)*(1-Given)\$F8)+Given)\$F8)*(\$B\$37)
47	=1*max55%*G100*(1/((G\$40/G\$38)*(1-Given)\$F9)+Given)\$F9)*(\$B\$37)		=1*max55%*H100*(1/((H\$40/H\$38)*(1-Given)\$F9)+Given)\$F9)*(\$B\$37)
48	=(G43+G44)/SUM(G43:G47)		=(H43+H44)/SUM(H43:H47)
49	=(G43+G44)*G38/((1*max55%*G96+1*max55%*G97)*G\$38)		=(H43+H44)*H38/((1*max55%*H96+1*max55%*H97)*H\$38)
50	=E\$1/G38		=E\$1/H38
51	=G39/(27.9-5.3*LN(E\$1/G38))/B37		=H39/(27.9-5.3*LN(E\$1/H38))/B37
52	=G17/26.5		=H17/26.5
53	=23*G52+G40/(20*60)		=23*H52+H40/(20*60)
54			
55	706.61776463005		706.123873305168
56	=G55+G38		=H55+H38
57	=(G38+G55)/G\$4		=(H38+H55)/H\$4
58			
59	=1*max55%*G66*(1/((G\$38+G\$55)/G\$38)*(1-Given)\$F5)+Given)\$F5)*(\$B\$54)		=1*max55%*H66*(1/((H\$38+H\$55)/H\$38)*(1-Given)\$F5)+Given)\$F5)*(\$B\$54)

Appendix D

	G	H	I
60	$=1\text{max}55\% \cdot G97 \cdot 1 / (((G338 + G355) / G338) \cdot (1 - \text{Given}\{F6\}) + \text{Given}\{F6\}) \cdot (\$B\$54))$	$=1\text{max}55\% \cdot H97 \cdot 1 / (((H338 + H355) / H338) \cdot (1 - \text{Given}\{F6\}) + \text{Given}\{F6\}) \cdot (\$B\$54))$	$=1\text{max}55\% \cdot I97 \cdot 1 / (((I338 + I355) / I338) \cdot (1 - \text{Given}\{F6\}) + \text{Given}\{F6\}) \cdot (\$B\$54))$
61	$=1\text{max}55\% \cdot G98 \cdot 1 / (((G338 + G355) / G338) \cdot (1 - \text{Given}\{F7\}) + \text{Given}\{F7\}) \cdot (\$B\$54))$	$=1\text{max}55\% \cdot H98 \cdot 1 / (((H338 + H355) / H338) \cdot (1 - \text{Given}\{F7\}) + \text{Given}\{F7\}) \cdot (\$B\$54))$	$=1\text{max}55\% \cdot I98 \cdot 1 / (((I338 + I355) / I338) \cdot (1 - \text{Given}\{F7\}) + \text{Given}\{F7\}) \cdot (\$B\$54))$
62	$=1\text{max}55\% \cdot G99 \cdot 1 / (((G338 + G355) / G338) \cdot (1 - \text{Given}\{F8\}) + \text{Given}\{F8\}) \cdot (\$B\$54))$	$=1\text{max}55\% \cdot H99 \cdot 1 / (((H338 + H355) / H338) \cdot (1 - \text{Given}\{F8\}) + \text{Given}\{F8\}) \cdot (\$B\$54))$	$=1\text{max}55\% \cdot I99 \cdot 1 / (((I338 + I355) / I338) \cdot (1 - \text{Given}\{F8\}) + \text{Given}\{F8\}) \cdot (\$B\$54))$
63	$=1\text{max}55\% \cdot G100 \cdot 1 / (((G338 + G355) / G338) \cdot (1 - \text{Given}\{F9\}) + \text{Given}\{F9\}) \cdot (\$B\$54))$	$=1\text{max}55\% \cdot H100 \cdot 1 / (((H338 + H355) / H338) \cdot (1 - \text{Given}\{F9\}) + \text{Given}\{F9\}) \cdot (\$B\$54))$	$=1\text{max}55\% \cdot I100 \cdot 1 / (((I338 + I355) / I338) \cdot (1 - \text{Given}\{F9\}) + \text{Given}\{F9\}) \cdot (\$B\$54))$
64	$= (G59 + G60) \cdot \text{SUM}(G59:G63)$	$= (H59 + H60) \cdot \text{SUM}(H59:H63)$	$= (I59 + I60) \cdot \text{SUM}(I59:I63)$
65	$= (\$E\$1 / G38) \cdot G38 / ((1\text{max}55\% \cdot G96 + 1\text{max}55\% \cdot G97) \cdot G34)$	$= (\$E\$1 / H38) \cdot H38 / ((1\text{max}55\% \cdot H96 + 1\text{max}55\% \cdot H97) \cdot H34)$	$= (\$E\$1 / I38) \cdot I38 / ((1\text{max}55\% \cdot I96 + 1\text{max}55\% \cdot I97) \cdot I34)$
66	$= \$E\$1 / G38$	$= \$E\$1 / H38$	$= \$E\$1 / I38$
67	$= G55 / (27.9 \cdot 5.3 \cdot \text{LN}(\$E\$1 / G38)) \cdot \$B54$	$= H55 / (27.9 \cdot 5.3 \cdot \text{LN}(\$E\$1 / H38)) \cdot \$B54$	$= I55 / (27.9 \cdot 5.3 \cdot \text{LN}(\$E\$1 / I38)) \cdot \$B54$
68	$= G67 / 26.5$	$= H67 / 26.5$	$= I67 / 26.5$
69	$= 23 \cdot G68 + G56 / (20 \cdot 60)$	$= 23 \cdot H68 + H56 / (20 \cdot 60)$	$= 23 \cdot I68 + I56 / (20 \cdot 60)$
70			
71			
72	6	7	8
73			
74	$= G18$	$= H18$	$= I18$
75	7	7	7
76	$= G6 / (20 \cdot 60) + 23 \cdot G75$	$= H6 / (20 \cdot 60) + 23 \cdot H75$	$= I6 / (20 \cdot 60) + 23 \cdot I75$
77	$= G34$	$= H34$	$= I34$
78	2	2	2
79	$= G22 / (20 \cdot 60) + 23 \cdot G78$	$= H22 / (20 \cdot 60) + 23 \cdot H78$	$= I22 / (20 \cdot 60) + 23 \cdot I78$
80			
81	$= G52$	$= H52$	$= I52$
82	7	7	7
83	$= G40 / (20 \cdot 60) + 23 \cdot G81$	$= H40 / (20 \cdot 60) + 23 \cdot H81$	$= I40 / (20 \cdot 60) + 23 \cdot I81$
84	$= G68$	$= H68$	$= I68$
85	2	2	2
86	$= G56 / (20 \cdot 60) + 23 \cdot G84$	$= H56 / (20 \cdot 60) + 23 \cdot H84$	$= I56 / (20 \cdot 60) + 23 \cdot I84$

J		K	
1			
2			
3			
4	=1*max55% J74-1*maxA  \$M\$23		
5	2320.53803834058		
6	=J5+J4		
7	=J6/J4		
8	=1*max55% J79*(1/((K\$6/K\$4)*(1-Given)\$F5)+Given)\$F5)^*(B\$3)		
9	=1*max55% J80*(1/((K\$6/K\$4)*(1-Given)\$F6)+Given)\$F6)^*(B\$3)		
10	=1*max55% J81*(1/((K\$6/K\$4)*(1-Given)\$F7)+Given)\$F7)^*(B\$3)		
11	=1*max55% J82*(1/((K\$6/K\$4)*(1-Given)\$F8)+Given)\$F8)^*(B\$3)		
12	=1*max55% J83*(1/((K\$6/K\$4)*(1-Given)\$F9)+Given)\$F9)^*(B\$3)		
13	=1*max55% J84*(1/((K\$6/K\$4)*(1-Given)\$F5)+Given)\$F5)^*(B\$3)		
14	=1*max55% J85*(1/((K\$6/K\$4)*(1-Given)\$F6)+Given)\$F6)^*(B\$3)		
15	=1*max55% J86*(1/((K\$6/K\$4)*(1-Given)\$F7)+Given)\$F7)^*(B\$3)		
16	=1*max55% J87*(1/((K\$6/K\$4)*(1-Given)\$F8)+Given)\$F8)^*(B\$3)		
17	=1*max55% J88*(1/((K\$6/K\$4)*(1-Given)\$F9)+Given)\$F9)^*(B\$3)		
18	=K5+K4		
19	=K6/K4		
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Appendix D

	J	K
60	$=1\text{max}55\% \cdot J97 \cdot 1 / (1 / ((J38 + J55) / J38) \cdot (1 - \text{Given}\$F6) + \text{Given}\$F6) \cdot (\$B\$54)$	$=1\text{max}55\% \cdot K97 \cdot 1 / (1 / ((K38 + K55) / K38) \cdot (1 - \text{Given}\$F6) + \text{Given}\$F6) \cdot (\$B\$54)$
61	$=1\text{max}55\% \cdot J98 \cdot 1 / (1 / ((J38 + J55) / J38) \cdot (1 - \text{Given}\$F7) + \text{Given}\$F7) \cdot (\$B\$54)$	$=1\text{max}55\% \cdot K98 \cdot 1 / (1 / ((K38 + K55) / K38) \cdot (1 - \text{Given}\$F7) + \text{Given}\$F7) \cdot (\$B\$54)$
62	$=1\text{max}55\% \cdot J99 \cdot 1 / (1 / ((J38 + J55) / J38) \cdot (1 - \text{Given}\$F8) + \text{Given}\$F8) \cdot (\$B\$54)$	$=1\text{max}55\% \cdot K99 \cdot 1 / (1 / ((K38 + K55) / K38) \cdot (1 - \text{Given}\$F8) + \text{Given}\$F8) \cdot (\$B\$54)$
63	$=1\text{max}55\% \cdot J100 \cdot 1 / (1 / ((J38 + J55) / J38) \cdot (1 - \text{Given}\$F9) + \text{Given}\$F9) \cdot (\$B\$54)$	$=1\text{max}55\% \cdot K100 \cdot 1 / (1 / ((K38 + K55) / K38) \cdot (1 - \text{Given}\$F9) + \text{Given}\$F9) \cdot (\$B\$54)$
64	$= (J59 + J60) / \text{SUM}(J59:J63)$	$= (K59 + K60) / \text{SUM}(K59:K63)$
65	$= (J59 + J60) \cdot J38 / ((1\text{max}55\% \cdot J96 + 1\text{max}55\% \cdot J97) \cdot J54)$	$= ((K59 + K60) \cdot K38) / ((1\text{max}55\% \cdot K96 + 1\text{max}55\% \cdot K97) \cdot K54)$
66	$= \$E\$1 / J38$	$= \$E\$1 / K38$
67	$= J55 / (27.9 - 5.3 \cdot \text{LN}(\$E\$1 / J38)) / \$B54$	$= K55 / (27.9 - 5.3 \cdot \text{LN}(\$E\$1 / K38)) / \$B54$
68	$= J67 / 26.5$	$= K67 / 26.5$
69	$= 23 \cdot J68 + J56 / (20 \cdot 60)$	$= 23 \cdot K68 + K56 / (20 \cdot 60)$
70		
71		
72	9	10
73		
74	$= J18$	$= K18$
75	7	7
76	$= J6 / (20 \cdot 60) + 23 \cdot J75$	$= K6 / (20 \cdot 60) + 23 \cdot K75$
77	$= J34$	$= K34$
78	2	2
79	$= J22 / (20 \cdot 60) + 23 \cdot J78$	$= K22 / (20 \cdot 60) + 23 \cdot K78$
80		
81	$= J52$	$= K52$
82	7	7
83	$= J40 / (20 \cdot 60) + 23 \cdot J81$	$= K40 / (20 \cdot 60) + 23 \cdot K81$
84	$= J68$	$= K68$
85	2	2
86	$= J56 / (20 \cdot 60) + 23 \cdot J84$	$= K56 / (20 \cdot 60) + 23 \cdot K84$

Appendix D

	A	B	C	D
	Based on 35%, 10 stages	1 Stage	Total SoIn into 35% (gal/day)	3 Stages
1	Area	340.662058081807	152.983402730653	98.7600381349884
2	F actual	=2maxA   F\$23	=2maxA   F\$23	=2maxA   F\$23
3	F calc	=B5	=C3+C5	=D3+D5
4	CF <sub>1</sub>		=F\$1/C55	=F\$1/D13
5	J <sub>1</sub>		=27.9-5.3*LN(C6)	=27.9-5.3*LN(D6)
6	P <sub>1</sub>		=C6/C7	=D6/D7
7			=C4-C5	=D4-D5
8		=B4-B5		=F\$1/D55
9	CF <sub>2</sub>			=27.9-5.3*LN(D10)
10	J <sub>2</sub>			=D\$3*D11
11	P <sub>2</sub>			=D12+D55
12	B <sub>1</sub>			
13				
14				
15	CF <sub>3</sub>			
16	J <sub>3</sub>			
17	P <sub>3</sub>			
18	B <sub>2</sub>			
19				
20	CF <sub>4</sub>			
21	J <sub>4</sub>			
22	P <sub>4</sub>			
23	B <sub>3</sub>			
24				
25	CF <sub>5</sub>			
26	J <sub>5</sub>			
27	P <sub>5</sub>			
28	B <sub>4</sub>			
29				
30	CF <sub>6</sub>			
31	J <sub>6</sub>			
32	P <sub>6</sub>			
33	B <sub>5</sub>			
34				
35	CF <sub>7</sub>			
36	J <sub>7</sub>			
37	P <sub>7</sub>			
38	B <sub>6</sub>			
39				
40	CF <sub>8</sub>			
41	J <sub>8</sub>			
42	P <sub>8</sub>			
43	B <sub>7</sub>			
44				
45	CF <sub>9</sub>			
46	J <sub>9</sub>			
47	P <sub>9</sub>			
48	B <sub>8</sub>			
49				
50	n <sup>*</sup>	1	2	3
51	CF <sub>n</sub>	=F\$1/B53	=F\$1/C53	=F\$1/D53
52	J <sub>n</sub>	=27.9-5.3*LN(B51)	=27.9-5.3*LN(C51)	=27.9-5.3*LN(D51)
53	B <sub>n</sub>	2561.02087015954	2561.12316254324	2561.1578768609



	A	B	C	D
54	P <sub>n</sub>	=B\$3*B52	=C\$3*D52	=D\$3*D52
55	B <sub>n-1</sub>	=B54+B53	=C54+D53	=D54+D53
56				
57				
58	Area/Stage	1	2	3
59	No. of Cartridges/Stage	=B3	=C3	=D3
60	Total Recirculation	=B60*23	=C59/26.5	=D59/26.5
61	Max Flow	=B61+B4/(20*60)	=C60*23	=D60*23
62				
63	Final Stream			
64	C <sub>B,NFN</sub>	=O4	=P13	=Q22
65	C <sub>B,LP</sub>	=O5	=P14	=Q23
66	C <sub>B,Lactose</sub>	=O7	=P16	=Q25
67	C <sub>B,Ash</sub>	=O8	=P17	=Q26
68	C <sub>B,Butter Fat</sub>	=O9	=P18	=Q27
69	Yield this part	=R5	=S14	=T23
70				
71				
72				
73	1 Diafiltration			
74	Solin Feed (gpd)	=B53	=C53	=D53
75	Water Added (gpd)	7076.58603931989	7093.85602218368	6920.1300401268
76	Total Feed (gpd)	=B75+B74	=C75+C74	=D75+D74
77	CF, D1	=B76/B74	=C76/C74	=D76/D74
78	Concentrations			
79	True Protein	=B65*(1/(B\$76/B\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))	=C65*(1/(C\$76/C\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))	=D65*(1/(D\$76/D\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))
80	Non-Protein Nitrogen	=B66*(1/(B\$76/B\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))	=C66*(1/(C\$76/C\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))	=D66*(1/(D\$76/D\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))
81	Lactose	=B67*(1/(B\$76/B\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))	=C67*(1/(C\$76/C\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))	=D67*(1/(D\$76/D\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))
82	Butter Fat	=B68*(1/(B\$76/B\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))	=C68*(1/(C\$76/C\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))	=D68*(1/(D\$76/D\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))
83	Ash	=B69*(1/(B\$76/B\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))	=C69*(1/(C\$76/C\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))	=D69*(1/(D\$76/D\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))
84	Total Protein (dry weight)	=B79+B80/SUM(B79:B83)	=C79+C80/SUM(C79:C83)	=D79+D80/SUM(D79:D83)
85	Yield distribution	=B79+B80/SUM(B79:B83)	=C79+C80/SUM(C79:C83)	=D79+D80/SUM(D79:D83)
86	CF overall	=B75/B74	=C75/C74	=D75/D74
87	Area/stage	=B75/(27.9-5.3)*LN(\$F1/B74))\$B73	=C75/(27.9-5.3)*LN(\$F1/C74))\$C73	=D75/(27.9-5.3)*LN(\$F1/D74))\$D73
88	Cartridges/stage	=B87/26.5	=C87/26.5	=D87/26.5
89	Max Flow Rate (gpm)	=23*B88+B76/(20*60)	=23*C88+C76/(20*60)	=23*D88+D76/(20*60)
90	Overall Yield % <sub>50-75%</sub>	=B79+B80/B74/((2*maxAll(\$F\$27+2*maxAll(\$F\$28))*2*maxAll(\$F\$23)	=C79+C80/C74/((2*maxAll(\$F\$27+2*maxAll(\$F\$28))*2*maxAll(\$F\$23)	=D79+D80/D74/((2*maxAll(\$F\$27+2*maxAll(\$F\$28))*2*maxAll(\$F\$23)
91	2 Diafiltration			
92	Water Added/Stage (gpd)	2362.78105746553	2345.40755147464	2345.625553061523
93	Total Feed (gpd)	=B92+B74	=C92+C74	=D92+D74
94	CF, D1	=B74+B92/B74	=C74+C92/C74	=D74+D92/D74
95	Concentrations			
96	True Protein	=B65*(1/(B\$93/B\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))	=C65*(1/(C\$93/C\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))	=D65*(1/(D\$93/D\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))
97	Non-Protein Nitrogen	=B66*(1/(B\$93/B\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))	=C66*(1/(C\$93/C\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))	=D66*(1/(D\$93/D\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))
98	Lactose	=B67*(1/(B\$93/B\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))	=C67*(1/(C\$93/C\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))	=D67*(1/(D\$93/D\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))
99	Ash	=B68*(1/(B\$93/B\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))	=C68*(1/(C\$93/C\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))	=D68*(1/(D\$93/D\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))
100	Butter Fat	=B69*(1/(B\$93/B\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))	=C69*(1/(C\$93/C\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))	=D69*(1/(D\$93/D\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9))
101	Total Protein (dry weight)	=B96+B97/SUM(B96:B100)	=C96+C97/SUM(C96:C100)	=D96+D97/SUM(D96:D100)
102	Yield this part	=B96+B97/SUM(B96:B100)	=C96+C97/SUM(C96:C100)	=D96+D97/SUM(D96:D100)
103	CF overall	=B75/B74	=C75/C74	=D75/D74
104	Area/stage	=B92/(27.9-5.3)*LN(\$F1/B74))\$B91	=C92/(27.9-5.3)*LN(\$F1/C74))\$C91	=D92/(27.9-5.3)*LN(\$F1/D74))\$D91
105	Cartridges/stage	=B104/26.5	=C104/26.5	=D104/26.5
106	Max Flow Rate (gpm)	=23*B105+B93/(20*60)	=23*C105+C93/(20*60)	=23*D105+D93/(20*60)
107	Overall Yield	=B96+B97/B74/((2*maxAll(\$F\$27+2*maxAll(\$F\$28))*2*maxAll(\$F\$23)	=C96+C97/C74/((2*maxAll(\$F\$27+2*maxAll(\$F\$28))*2*maxAll(\$F\$23)	=D96+D97/D74/((2*maxAll(\$F\$27+2*maxAll(\$F\$28))*2*maxAll(\$F\$23)
108				
109	Flow Rates (gpm)	1	2	3
110	Card/Stage	=B60	=C60	=D60
111	Actual	13	6	4
112				

Appendix D

	A	B	C	D
113.1		=B\$74*23+B4/(20*60)		
114.2			=C\$74*23+C4/(20*60)	=D\$74*23+D4/(20*60)
115.3			=C\$74*23+C13/(20*60)	=D\$74*23+D13/(20*60)
116.4				=D\$74*23+D18/(20*60)
117.5				
118.6				
119.7				
120.8				
121.9				
122.10	Cart/Stage	=B88	=C88	=D88
123	Actual	18	18	18
124	D1	=B76/(20*60)+23*B124	=C76/(20*60)+23*C124	=D76/(20*60)+23*D124
125	Cart/Stage	=B105	=C105	=D105
126	Actual	=B105	=C105	=D105
127	D2	=B93/(20*60)+23*B127	=C93/(20*60)+23*C127	=D93/(20*60)+23*D127
128				

Appendix D

	E	F	G
1			
2			
3	4 Stages	6 Stages	6 Stages
4	74.538547251688	60.295020013934	50.789769126608
5	=2maxAll!F\$23	=2maxAll!F\$23	=2maxAll!F\$23
6	=E3*E13	=F3*F13	=G3*G13
7	=F\$1/E13	=F\$1/F13	=F\$1/G13
8	=E3*E7	=F3*F7	=G3*G7
9	=E4-E5	=F4-F5	=G4-G5
10	=F\$1/E55	=F\$1/F55	=F\$1/G55
11	=27.9-5.3*LN(E10)	=27.9-5.3*LN(F10)	=27.9-5.3*LN(G10)
12	=E3*E11	=F3*F11	=G3*G11
13	=E12+E18	=F12+F18	=G12+G18
14			
15	=F\$1/E55	=F\$1/F55	=F\$1/G55
16	=27.9-5.3*LN(E15)	=27.9-5.3*LN(F15)	=27.9-5.3*LN(G15)
17	=E3*E16	=F3*F16	=G3*G16
18	=E17+E55	=F17+F23	=G17+G23
19			
20			
21			
22			
23			
24			
25			
26			
27			
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53			

E		F	G
54	=E\$3*E\$2	=F\$3*F\$2	=G\$3*G\$2
55	=E\$4+E\$3	=F\$4+F\$3	=G\$4+G\$3
56			
57	No. of Stages	6	6
58	=E3	=F3	=G3
59	=E\$9/26.5	=F\$9/26.5	=G\$9/26.5
60	=E\$0*23	=F\$0*23	=G\$0*23
61	=E\$1+E/4(20*60)	=F\$1+F/4(20*60)	=G\$1+G/4(20*60)
62			
63			
64			
65	=R31	=S40	=AD4
66	=R32	=S41	=AD5
67	=R33	=S43	=AD7
68	=R35	=S44	=AD8
69	=R36	=S46	=AD9
70	=U32	=V41	=AG5
71			
<b>4 Stages</b>			
72			
73			
74	=E53	=F53	=G53
75	6825.68317307684	6830.89898980551	6835.19545004236
76	=E75+E74	=F75+F74	=G75+G74
77	=E76/E74	=F76/F74	=G76/G74
78			
79	=E65*1/((E\$76/E\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$73)	=F65*1/((F\$76/F\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$73)	=G65*1/((G\$76/G\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$73)
80	=E66*1/((E\$76/E\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$73)	=F66*1/((F\$76/F\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$73)	=G66*1/((G\$76/G\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$73)
81	=E67*1/((E\$76/E\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$73)	=F67*1/((F\$76/F\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$73)	=G67*1/((G\$76/G\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$73)
82	=E68*1/((E\$76/E\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$73)	=F68*1/((F\$76/F\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$73)	=G68*1/((G\$76/G\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$73)
83	=E69*1/((E\$76/E\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$73)	=F69*1/((F\$76/F\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$73)	=G69*1/((G\$76/G\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$73)
84	=E79+E80/SUM(E79:E83)	=F79+F80/SUM(F79:F83)	=G79+G80/SUM(G79:G83)
85	=(E79+E80)*E74/((E65+E66)*E74)	=(F79+F80)*F74/((F65+F66)*F74)	=(G79+G80)*G74/((G65+G66)*G74)
86	=\$F1/E74	=\$F1/F74	=\$F1/G74
87	=E75/(27.9-5.3*LN(\$F1/E74))/B73	=F75/(27.9-5.3*LN(\$F1/F74))/B73	=G75/(27.9-5.3*LN(\$F1/G74))/B73
88	=E87/26.5	=F87/26.5	=G87/26.5
89	=23*E88-E76/(20*60)	=23*F88-F76/(20*60)	=23*G88-G76/(20*60)
90	=(E79+E80)*E74/((2*maxAll(\$F\$27+2*maxAll(\$F\$28)+2*maxAll(\$F\$29)+2*maxAll(\$F\$30)+2*maxAll(\$F\$31)+2*maxAll(\$F\$32)))*(\$B\$23)	=(F79+F80)*F74/((2*maxAll(\$F\$27+2*maxAll(\$F\$28)+2*maxAll(\$F\$29)+2*maxAll(\$F\$30)+2*maxAll(\$F\$31)+2*maxAll(\$F\$32)))*(\$B\$23)	=(G79+G80)*G74/((2*maxAll(\$F\$27+2*maxAll(\$F\$28)+2*maxAll(\$F\$29)+2*maxAll(\$F\$30)+2*maxAll(\$F\$31)+2*maxAll(\$F\$32)))*(\$B\$23)
91			
92	2347.2536439585	2348.6114872013	2349.72405779777
93	=E92+E74	=F92+F74	=G92+G74
94	=(E74+E92)/E74	=(F74+F92)/F74	=(G74+G92)/G74
95			
96	=E65*1/((E\$93/E\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$91)	=F65*1/((F\$93/F\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$91)	=G65*1/((G\$93/G\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$91)
97	=E66*1/((E\$93/E\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$91)	=F66*1/((F\$93/F\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$91)	=G66*1/((G\$93/G\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$91)
98	=E67*1/((E\$93/E\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$91)	=F67*1/((F\$93/F\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$91)	=G67*1/((G\$93/G\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$91)
99	=E68*1/((E\$93/E\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$91)	=F68*1/((F\$93/F\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$91)	=G68*1/((G\$93/G\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$91)
100	=E69*1/((E\$93/E\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$91)	=F69*1/((F\$93/F\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$91)	=G69*1/((G\$93/G\$74)*(1-Given(\$F5)+Given(\$F6)+Given(\$F7)+Given(\$F8)+Given(\$F9)+Given(\$F10)))*(\$B\$91)
101	=(E96+E97)/SUM(E96:E100)	=(F96+F97)/SUM(F96:F100)	=(G96+G97)/SUM(G96:G100)
102	=(E96+E97)*E74/((E65+E66)*E74)	=(F96+F97)*F74/((F65+F66)*F74)	=(G96+G97)*G74/((G65+G66)*G74)
103	=\$F1/E74	=\$F1/F74	=\$F1/G74
104	=E92/(27.9-5.3*LN(\$F1/E74))/B91	=F92/(27.9-5.3*LN(\$F1/F74))/B91	=G92/(27.9-5.3*LN(\$F1/G74))/B91
105	=E104/26.5	=F104/26.5	=G104/26.5
106	=23*E105+E93/(20*60)	=23*F105+F93/(20*60)	=23*G105+G93/(20*60)
107	=(E96+E97)*E74/((2*maxAll(\$F\$27+2*maxAll(\$F\$28)+2*maxAll(\$F\$29)+2*maxAll(\$F\$30)+2*maxAll(\$F\$31)+2*maxAll(\$F\$32)))*(\$B\$23)	=(F96+F97)*F74/((2*maxAll(\$F\$27+2*maxAll(\$F\$28)+2*maxAll(\$F\$29)+2*maxAll(\$F\$30)+2*maxAll(\$F\$31)+2*maxAll(\$F\$32)))*(\$B\$23)	=(G96+G97)*G74/((2*maxAll(\$F\$27+2*maxAll(\$F\$28)+2*maxAll(\$F\$29)+2*maxAll(\$F\$30)+2*maxAll(\$F\$31)+2*maxAll(\$F\$32)))*(\$B\$23)
108			
109			
110	=E60	=F60	=G60
111			
112			
113			
<b>6 Stages</b>			
114			
115			
116			
117			
118			
119			
120			
121			
122			
123			
<b>Flow Rates: Feed + Recycle</b>			
124			
125			
126			
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193			
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195			
196			
197			
198			
199			
200			

Appendix D

	E	F	G
113	=E\$7'4'23+E4/(20*60)	=F\$7'4'23+F4/(20*60)	=G\$7'4'23+G4/(20*60)
114	=E\$7'4'23+E13/(20*60)	=F\$7'4'23+F13/(20*60)	=G\$7'4'23+G13/(20*60)
115	=E\$7'4'23+E18/(20*60)	=F\$7'4'23+F18/(20*60)	=G\$7'4'23+G18/(20*60)
116	=E\$7'4'23+E23/(20*60)	=F\$7'4'23+F23/(20*60)	=G\$7'4'23+G23/(20*60)
117		=F\$7'4'23+F28/(20*60)	=G\$7'4'23+G28/(20*60)
118			=G\$7'4'23+G33/(20*60)
119			
120			
121			
122			
123	=E88	=F88	=G88
124	18	18	18
125	=E76/(20*60)+23'E124	=F76/(20*60)+23'F124	=G76/(20*60)+23'G124
126	=E105	=F105	=G105
127	=E105	=F105	=G105
128	=E93/(20*60)+23'E127	=F93/(20*60)+23'F127	=G93/(20*60)+23'G127

Appendix D

H			I			J		
7 Stages			8 Stages			9 Stages		
1								
2								
3	43.953242898376	38.7749160320288	34.7137341977757					
4	=2*max(A11:\$F\$23	=2*max(A11:\$F\$23	=2*max(A11:\$F\$23					
5	#H\$1:H13	#I\$1:I13	#J\$1:J13					
6	=\$F\$1/H13	=\$F\$1/I13	=\$F\$1/J13					
7	=27.9-5.3*L(N(H6)	=27.9-5.3*L(N(I6)	=27.9-5.3*L(N(J6)					
8	=H\$3*H7	=I\$3*I7	=J\$3*J7					
9	=H4-H5	=I4-I5	=J4-J5					
10	=\$F\$1/H55	=\$F\$1/I55	=\$F\$1/J55					
11	=27.9-5.3*L(N(H10)	=27.9-5.3*L(N(I10)	=27.9-5.3*L(N(J10)					
12	=H\$3*H11	=I\$3*I11	=J\$3*J11					
13	=H12+H18	=I12+I18	=J12+J18					
14								
15	=\$F\$1/H55	=\$F\$1/I55	=\$F\$1/J55					
16	=27.9-5.3*L(N(H15)	=27.9-5.3*L(N(I15)	=27.9-5.3*L(N(J15)					
17	=H\$3*H16	=I\$3*I16	=J\$3*J16					
18	=H17+H23	=I17+I23	=J17+J23					
19								
20	=\$F\$1/H55	=\$F\$1/I55	=\$F\$1/J55					
21	=27.9-5.3*L(N(H20)	=27.9-5.3*L(N(I20)	=27.9-5.3*L(N(J20)					
22	=H\$3*H21	=I\$3*I21	=J\$3*J21					
23	=H22+H28	=I22+I28	=J22+J28					
24								
25	=\$F\$1/H55	=\$F\$1/I55	=\$F\$1/J55					
26	=27.9-5.3*L(N(H25)	=27.9-5.3*L(N(I25)	=27.9-5.3*L(N(J25)					
27	=H\$3*H26	=I\$3*I26	=J\$3*J26					
28	=H27+H33	=I27+I33	=J27+J33					
29								
30	=\$F\$1/H55	=\$F\$1/I55	=\$F\$1/J55					
31	=27.9-5.3*L(N(H30)	=27.9-5.3*L(N(I30)	=27.9-5.3*L(N(J30)					
32	=H\$3*H31	=I\$3*I31	=J\$3*J31					
33	=H32+H55	=I32+I38	=J32+J38					
34								
35	=\$F\$1/H55	=\$F\$1/I55	=\$F\$1/J55					
36	=27.9-5.3*L(N(H35)	=27.9-5.3*L(N(I35)	=27.9-5.3*L(N(J35)					
37	=H\$3*H36	=I\$3*I36	=J\$3*J36					
38	=H37+H55	=I37+I55	=J37+J43					
39								
40	=\$F\$1/H55	=\$F\$1/I55	=\$F\$1/J55					
41	=27.9-5.3*L(N(H40)	=27.9-5.3*L(N(I40)	=27.9-5.3*L(N(J40)					
42	=H\$3*H41	=I\$3*I41	=J\$3*J41					
43	=H42+H55	=I42+I55	=J42+J55					
44								
45								
46								
47								
48								
49								
50								
51	=\$F\$1/H53	=\$F\$1/I53	=\$F\$1/J53					
52	=27.9-5.3*L(N(H51)	=27.9-5.3*L(N(I51)	=27.9-5.3*L(N(J51)					
53	2560.9155628173	2561.17015414092	2561.09805688236					

	H	I	J
54	=H\$3*H52	=I\$3*J52	
55	=H54+H63	=I54+J53	
56			
57			
58	8	9	
59	=H3	=I3	
60	=H59/26.5	=I59/26.5	
61	=H60*23	=I60*23	
62	=H61+H4/(20*60)	=I61+J4/(20*60)	
63			
64			
65	=AE13	=AG31	
66	=AE14	=AG32	
67	=AE16	=AG34	
68	=AE17	=AG35	
69	=AE18	=AG36	
70	=AH14	=AJ32	
71			
72			
73			
74	=H53	=I53	
75	7022.31623255075	7028.94809125074	
76	=H75+H74	=I75+J74	
77	=H76/H74	=I76/J74	
78			
79	=H65*1/((H\$76/H\$74)*(1-Given(\$F5)+Given(\$F5))*(\$B\$73)	=I65*1/((I\$76/I\$74)*(1-Given(\$F5)+Given(\$F5))*(\$B\$73)	
80	=H66*1/((H\$76/H\$74)*(1-Given(\$F6)+Given(\$F6))*(\$B\$73)	=I66*1/((I\$76/I\$74)*(1-Given(\$F6)+Given(\$F6))*(\$B\$73)	
81	=H67*1/((H\$76/H\$74)*(1-Given(\$F7)+Given(\$F7))*(\$B\$73)	=I67*1/((I\$76/I\$74)*(1-Given(\$F7)+Given(\$F7))*(\$B\$73)	
82	=H68*1/((H\$76/H\$74)*(1-Given(\$F8)+Given(\$F8))*(\$B\$73)	=I68*1/((I\$76/I\$74)*(1-Given(\$F8)+Given(\$F8))*(\$B\$73)	
83	=H69*1/((H\$76/H\$74)*(1-Given(\$F9)+Given(\$F9))*(\$B\$73)	=I69*1/((I\$76/I\$74)*(1-Given(\$F9)+Given(\$F9))*(\$B\$73)	
84	=(H79+H80)/SUM(H79:H83)	=(J79+J80)/SUM(J79:J83)	
85	=(H79+H80)*H74/((H65+H66)*H74)	=(J79+J80)*J74/((I65+I66)*J74)	
86	=H\$3*H74	=I\$3*J74	
87	=H75/(27.9-5.3*L.N(\$F\$1/H74))/\$B73	=I75/(27.9-5.3*L.N(\$F\$1/J74))/\$B73	
88	=H87/26.5	=I87/26.5	
89	=23*H88+H76/(20*60)	=23*I88+J76/(20*60)	
90	=(H79+H80)*H74/((2*maxAll!(\$F\$28)+2*maxAll!(\$F\$23))	=(J79+J80)*J74/((2*maxAll!(\$F\$28)+2*maxAll!(\$F\$23))	
91			
92	2351.47607211928	2351.93706210809	
93	=H92+H74	=I92+J74	
94	=(H74+H92)/H74	=(I74+I92)/J74	
95			
96	=H65*1/((H\$93/H\$74)*(1-Given(\$F5)+Given(\$F5))*(\$B\$91)	=I65*1/((I\$93/I\$74)*(1-Given(\$F5)+Given(\$F5))*(\$B\$91)	
97	=H66*1/((H\$93/H\$74)*(1-Given(\$F6)+Given(\$F6))*(\$B\$91)	=I66*1/((I\$93/I\$74)*(1-Given(\$F6)+Given(\$F6))*(\$B\$91)	
98	=H67*1/((H\$93/H\$74)*(1-Given(\$F7)+Given(\$F7))*(\$B\$91)	=I67*1/((I\$93/I\$74)*(1-Given(\$F7)+Given(\$F7))*(\$B\$91)	
99	=H68*1/((H\$93/H\$74)*(1-Given(\$F8)+Given(\$F8))*(\$B\$91)	=I68*1/((I\$93/I\$74)*(1-Given(\$F8)+Given(\$F8))*(\$B\$91)	
100	=H69*1/((H\$93/H\$74)*(1-Given(\$F9)+Given(\$F9))*(\$B\$91)	=I69*1/((I\$93/I\$74)*(1-Given(\$F9)+Given(\$F9))*(\$B\$91)	
101	=(H96+H97)/SUM(H96:H100)	=(J96+J97)/SUM(J96:J100)	
102	=(H96+H97)*H74/((H65+H66)*H74)	=(J96+J97)*J74/((I65+I66)*J74)	
103	=H\$3*H74	=I\$3*J74	
104	=H92/(27.9-5.3*L.N(\$F\$1/H74))/\$B91	=I92/(27.9-5.3*L.N(\$F\$1/J74))/\$B91	
105	=H104/26.5	=I104/26.5	
106	=23*H105+H93/(20*60)	=23*I105+J93/(20*60)	
107	=(H96+H97)*H74/((2*maxAll!(\$F\$28)+2*maxAll!(\$F\$23))	=(J96+J97)*J74/((2*maxAll!(\$F\$28)+2*maxAll!(\$F\$23))	
108			
109			
110	8	9	
111	=H60	=I60	
112	2	2	

Appendix D

	H	I	J
113	=H74*23+H4/(20*60)	=I74*23+I4/(20*60)	=J74*23+J4/(20*60)
114	=H74*23+H13/(20*60)	=I74*23+I13/(20*60)	=J74*23+J13/(20*60)
115	=H74*23+H18/(20*60)	=I74*23+I18/(20*60)	=J74*23+J18/(20*60)
116	=H74*23+H23/(20*60)	=I74*23+I23/(20*60)	=J74*23+J23/(20*60)
117	=H74*23+H28/(20*60)	=I74*23+I28/(20*60)	=J74*23+J28/(20*60)
118	=H74*23+H33/(20*60)	=I74*23+I33/(20*60)	=J74*23+J33/(20*60)
119	=H74*23+H38/(20*60)	=I74*23+I38/(20*60)	=J74*23+J38/(20*60)
120			
121			
122			
123	=H88	=I88	=J88
124	18	18	18
125	=H76/(20*60)+23*H124	=I76/(20*60)+23*I124	=J76/(20*60)+23*J124
126	=H105	=I105	=J105
127	=H105	=I105	=J105
128	=H93/(20*60)+23*H127	=I93/(20*60)+23*I127	=J93/(20*60)+23*J127



	K	L	M	N	O	P
1						
2	10 Stages					
3	31.4359124742647	ft		1 Stage		
4	=2maxA  F27*(O\$3*(O\$3*(1-Given)\$F5)+Given)\$F5)	gal/day	$f_n$			Total Out gal/day
5	=K\$3*K13	gal/day	$C_{B,NPN}$			=O4*\$B\$53
6	=F\$1/K13	gal/day	$C_{B,TP}$			=O5*\$B\$53
7	=27.9-5.3*L N(K6)	gsfd	$C_{B,Protein}$			=O6*\$B\$53
8	=K\$3*K7	gal/day	$C_{B,Lactose}$			=O7*\$B\$53
9	=K4+K5	gal/day	$C_{B,Ash}$			=O8*\$B\$53
10	=F\$1/K55	gal/day	$C_{B,Butter Fat}$			=O9*\$B\$53
11	=27.9-5.3*L N(K10)	gsfd		2 Stages		2
12	=K\$3*K11	gal/day	$f_n$			=C55/C53
13	=K12+K18	gal/day	$C_{B,NPN}$			=O13*(P\$12/(P\$12*(1-Given)\$F5)+Given)\$F5)
14	=F\$1/K55	gal/day	$C_{B,TP}$			=O14*(P\$12/(P\$12*(1-Given)\$F6)+Given)\$F6)
15	=27.9-5.3*L N(K15)	gsfd	$C_{B,Protein}$			=P13+P14
16	=K\$3*K16	gal/day	$C_{B,Lactose}$			=O16*(P\$12/(P\$12*(1-Given)\$F7)+Given)\$F7)
17	=K17+K23	gal/day	$C_{B,Ash}$			=O17*(P\$12/(P\$12*(1-Given)\$F8)+Given)\$F8)
18	=F\$1/K55	gal/day	$C_{B,Butter Fat}$			=O18*(P\$12/(P\$12*(1-Given)\$F9)+Given)\$F9)
19						
20	=27.9-5.3*L N(K20)	gsfd	$f_n$	3 Stages		2
21	=K\$3*K21	gal/day	$C_{B,NPN}$			=D13/D55
22	=K22+K28	gal/day	$C_{B,TP}$			=O22*(P\$21/(P\$21*(1-Given)\$F5)+Given)\$F5)
23	=F\$1/K55	gal/day	$C_{B,Protein}$			=O23*(P\$21/(P\$21*(1-Given)\$F6)+Given)\$F6)
24	=27.9-5.3*L N(K25)	gsfd	$C_{B,Lactose}$			=P22+P23
25	=K\$3*K26	gal/day	$C_{B,Ash}$			=O25*(P\$21/(P\$21*(1-Given)\$F7)+Given)\$F7)
26	=K27+K33	gal/day	$C_{B,Butter Fat}$			=O26*(P\$21/(P\$21*(1-Given)\$F8)+Given)\$F8)
27						=O27*(P\$21/(P\$21*(1-Given)\$F9)+Given)\$F9)
28						
29						
30	=27.9-5.3*L N(K30)	gsfd	$f_n$	4 Stages		2
31	=K\$3*K31	gal/day	$C_{B,NPN}$			=E13/E18
32	=K32+K38	gal/day	$C_{B,TP}$			=O31*(P\$30/(P\$30*(1-Given)\$F5)+Given)\$F5)
33	=F\$1/K55	gal/day	$C_{B,Protein}$			=O32*(P\$30/(P\$30*(1-Given)\$F6)+Given)\$F6)
34	=27.9-5.3*L N(K35)	gsfd	$C_{B,Lactose}$			=P31+P32
35	=K\$3*K36	gal/day	$C_{B,Ash}$			=O34*(P\$30/(P\$30*(1-Given)\$F7)+Given)\$F7)
36	=K37+K43	gal/day	$C_{B,Butter Fat}$			=O35*(P\$30/(P\$30*(1-Given)\$F8)+Given)\$F8)
37						=O36*(P\$30/(P\$30*(1-Given)\$F9)+Given)\$F9)
38						
39						
40	=27.9-5.3*L N(K40)	gsfd	$f_n$	5 Stages		2
41	=K\$3*K41	gal/day	$C_{B,NPN}$			=F13/F18
42	=K42+K48	gal/day	$C_{B,TP}$			=O40*(P\$39/(P\$39*(1-Given)\$F5)+Given)\$F5)
43	=F\$1/K55	gal/day	$C_{B,Protein}$			=O41*(P\$39/(P\$39*(1-Given)\$F6)+Given)\$F6)
44	=27.9-5.3*L N(K45)	gsfd	$C_{B,Lactose}$			=P40+P41
45	=K\$3*K46	gal/day	$C_{B,Ash}$			=O43*(P\$39/(P\$39*(1-Given)\$F7)+Given)\$F7)
46	=K47+K55	gal/day	$C_{B,Butter Fat}$			=O44*(P\$39/(P\$39*(1-Given)\$F8)+Given)\$F8)
47						=O45*(P\$39/(P\$39*(1-Given)\$F9)+Given)\$F9)
48						
49						
50						
51		CF total				
52		gsfd				
53		gal/day				

Appendix D

	K	L	M	N	O	P
54	=K\$3*K\$2	gal/day				
55	=K\$4+K\$3	gal/day				
56						
57						
58	10					
59	=K3	ft <sup>2</sup>				
60	=K\$9/26.5	26.5 ft <sup>3</sup> /cartridge				
61	=K\$0*23	gal/min				
62	=K\$1+K4/(20*60)	gall/min				
63	=K\$2*4*12*12/(7.48*4.026*2*P1)*60					
64						
65	=AH40					
66	=AH41					
67	=AH43					
68	=AH44					
69	=AH45					
70	=AK41					
71						
72						
73						
74	=K\$3					
75	7030.98949014563					
76	=K7\$+K74					
77	=K76/K74					
78						
79	=K\$5*1/((K\$76/K\$74)*(1-Given1\$F5)+Given1\$F5)*(\$B\$73)					
80	=K\$6*1/((K\$76/K\$74)*(1-Given1\$F6)+Given1\$F6)*(\$B\$73)					
81	=K\$7*1/((K\$76/K\$74)*(1-Given1\$F7)+Given1\$F7)*(\$B\$73)					
82	=K\$8*1/((K\$76/K\$74)*(1-Given1\$F8)+Given1\$F8)*(\$B\$73)					
83	=K\$9*1/((K\$76/K\$74)*(1-Given1\$F9)+Given1\$F9)*(\$B\$73)					
84	=K79+K80)/SUM(K79;K83)					
85	=((K79+K80)*K74)/((K65+K66)*K74)					
86	=K\$1/K74					
87	=K75/(27.9-5.3*LN(\$F1/K74))/(\$B73)					
88	=K87/26.5					
89	=23*K88+K76/(20*60)					
90	=((K79+K80)*K74)/((2*maxAll1\$F\$27+2*maxAll1\$F\$28)*2*maxAll1\$F\$23)					
91						
92	2362.43428109631					
93	=K92+K74					
94	=K74+K92)/K74					
95						
96	=K\$5*1/((K\$93/K\$74)*(1-Given1\$F5)+Given1\$F5)*(\$B\$91)					
97	=K\$6*1/((K\$93/K\$74)*(1-Given1\$F6)+Given1\$F6)*(\$B\$91)					
98	=K\$7*1/((K\$93/K\$74)*(1-Given1\$F7)+Given1\$F7)*(\$B\$91)					
99	=K\$8*1/((K\$93/K\$74)*(1-Given1\$F8)+Given1\$F8)*(\$B\$91)					
100	=K\$9*1/((K\$93/K\$74)*(1-Given1\$F9)+Given1\$F9)*(\$B\$91)					
101	=K96+K97)/SUM(K96;K100)					
102	=((K96+K97)*K74)/((K65+K66)*K74)					
103	=K\$1/K74					
104	=K92/(27.9-5.3*LN(\$F1/K74))/(\$B91)					
105	=K104/26.5					
106	=23*K105+K93/(20*60)					
107	=((K96+K97)*K74)/((2*maxAll1\$F\$27+2*maxAll1\$F\$28)*2*maxAll1\$F\$23)					
108						
109						
110	10					
111	=K60					
112						

Appendix D

	K	L	M	N	O	P
113	=K874*23+K4/(20*60)					
114	=K874*23+K13/(20*60)					
115	=K874*23+K18/(20*60)					
116	=K874*23+K23/(20*60)					
117	=K874*23+K28/(20*60)					
118	=K874*23+K33/(20*60)					
119	=K874*23+K38/(20*60)					
120	=K874*23+K43/(20*60)					
121	=K874*23+K48/(20*60)					
122	=K874*23+K55/(20*60)					
123	=K68					
124	18					
125	=K76/(20*60)+23*K124					
126	=K105					
127	=K105					
128	=K93/(20*60)+23*K127					

Appendix D

	Q	R	S	T	U
1					
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4					
5		=O6			
6		=B53*(R3/(B4*(2*maxAll ) \$F\$27+2*maxAll ) \$F\$28))			
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Appendix D

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Appendix D

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Appendix D

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Appendix D

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	AG	AH	AI	AJ	AK	AL
1						
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4	=AD6					
5	=G53*AG3/(G4*(2*maxA  (\$F\$27+2*maxA  (\$F\$28)))					
6						
7						
8	=6*G3					
9	=G8+G12+G17+G22+G27+G54	gal/day				
10						
11						
12						
13	Final Protein Concentration	=AE15				
14	Yield	=H53*AH12/(H4*(2*maxA  (\$F\$27+2*maxA  (\$F\$28)))				
15	Final Protein % (dry weight)					
16						
17	Total Area	=7*H3				
18	Total Permeate	=H8+H12+H17+H22+H27+H32+H54	gal/day			
19						
20	Total Out					
21	gal/day					
22	=AF22*\$I\$53	Final Protein Concentration	=AF24			
23	=AF23*\$I\$53	Yield	=I53*AI2/(I4*(2*maxA  (\$F\$27+2*maxA  (\$F\$28)))			
24	=AF24*\$I\$53	Final Protein % (dry weight)				
25	=AF25*\$I\$53		=8*H3			
26	=AF26*\$I\$53	Total Area	=I8+I12+I17+I22+I27+I32+I37+I54	gal/day		
27	=AF27*\$I\$53	Total Permeate				
28						
29		Total Out				
30	=AJ55*\$I\$53	gal/day				
31	=AF31*(AG\$30/(AG\$30*(1-Given \$F5)+Given \$F5))	Final Protein Concentration	=AG33			
32	=AF32*(AG\$30/(AG\$30*(1-Given \$F6)+Given \$F6))	Yield	=K53*AJ30/(J4*(2*maxA  (\$F\$27+2*maxA  (\$F\$28)))			
33	=AG31+AG32	Final Protein % (dry weight)				
34	=AF34*(AG\$30/(AG\$30*(1-Given \$F7)+Given \$F7))					
35	=AF35*(AG\$30/(AG\$30*(1-Given \$F8)+Given \$F8))	Total Area	=8*H12			
36	=AF36*(AG\$30/(AG\$30*(1-Given \$F9)+Given \$F9))	Total Permeate	=J8+J12+J17+J22+J27+J32+J37+J42+J54	gal/day		
37						
38		10	Total Out			
39	=K\$48/\$K55	=K\$55/\$K53	gal/day			
40	=AF40*(AG\$39/(AG\$39*(1-Given \$F5)+Given \$F5))	=AH40*\$K\$53	Final Protein Concentration		=AH42	
41	=AF41*(AG\$39/(AG\$39*(1-Given \$F6)+Given \$F6))	=AG41*(AH\$39/(AH\$39*(1-Given \$F6)+Given \$F6))	Yield		=K53*AK39/(K4*(2*maxA  (\$F\$27+2*maxA  (\$F\$28)))	
42	=AG40+AG41	=AH40+AH41	Final Protein % (dry weight)			
43	=AF43*(AG\$39/(AG\$39*(1-Given \$F7)+Given \$F7))	=AG43*(AH\$39/(AH\$39*(1-Given \$F7)+Given \$F7))	Total Area			
44	=AF44*(AG\$39/(AG\$39*(1-Given \$F8)+Given \$F8))	=AG44*(AH\$39/(AH\$39*(1-Given \$F8)+Given \$F8))	Total Permeate			
45	=AF45*(AG\$39/(AG\$39*(1-Given \$F9)+Given \$F9))	=AG45*(AH\$39/(AH\$39*(1-Given \$F9)+Given \$F9))				
46		=SUM(AH42:AH45)				
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Appendix D

	AG	AH	AI	AJ	AK	AL
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Appendix D

	AG	AH	AI	AJ	AK	AL
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A		B	C
1	Total Soln into 35% (gal/day)		
2	From 75% (One Dia. Stage)	1 Stage	2 Stages
3	1 Diafiltration		
4	Solin Feed (gpd)	=2max55% B74-2maxAl I\$M23	
5	Water Added (gpd)	2430.83139016475	
6	Total Feed (gpd)	=B5+B4	
7	CF, D1	=B6/B4	
8	Concentrations		
9	True Protein	=2max55% B79*(1/((B\$6/B\$4)*(1-Given)\$5)+Given)\$5)^*(B\$3)	=2max55% C79*(1/((C\$6/C\$4)*(1-Given)\$5)+Given)\$5)^*(B\$3)
10	Non-Protein Nitrogen	=2max55% B80*(1/((B\$6/B\$4)*(1-Given)\$6)+Given)\$6)^*(B\$3)	=2max55% C80*(1/((C\$6/C\$4)*(1-Given)\$6)+Given)\$6)^*(B\$3)
11	Lactose	=2max55% B81*(1/((B\$6/B\$4)*(1-Given)\$7)+Given)\$7)^*(B\$3)	=2max55% C81*(1/((C\$6/C\$4)*(1-Given)\$7)+Given)\$7)^*(B\$3)
12	Ash	=2max55% B82*(1/((B\$6/B\$4)*(1-Given)\$8)+Given)\$8)^*(B\$3)	=2max55% C82*(1/((C\$6/C\$4)*(1-Given)\$8)+Given)\$8)^*(B\$3)
13	Butter Fat	=2max55% B83*(1/((B\$6/B\$4)*(1-Given)\$9)+Given)\$9)^*(B\$3)	=2max55% C83*(1/((C\$6/C\$4)*(1-Given)\$9)+Given)\$9)^*(B\$3)
14	Total Protein (dry weight)	=(B9+B10)/SUM(B9:B13)	=(C9+C10)/SUM(C9:C13)
15	Yield this part	=(B9+B10)*B4/((2max55% B79+2max55% B80)*B\$4)	=(C9+C10)*C4/((2max55% C79+2max55% C80)*C\$4)
16	CF overall	=B\$1/B4	=C\$1/C4
17	Area/stage	=B5/(27.9-5.3*LN(\$E\$1/B4))/B\$3	=C5/(27.9-5.3*LN(\$E\$1/C4))/B\$3
18	Cartridges/stage	=B17/26.5	=C17/26.5
19	Max Flow Rate (gpm)	=23*B18+B6/(20*60)	=23*C18+C6/(20*60)
20	2 Diafiltration		
21	Water Added/Stage (gpd)	745.45782823955	729.661615640051
22	Total Feed (gpd)	=B21+B4	=C21+C4
23	CF, D1	=(B4+B21)/B\$4	=(C4+C21)/C\$4
24	Concentrations		
25	True Protein	=2max55% B79*(1/((B\$4+B\$21)/B\$4)*(1-Given)\$5)+Given)\$5)^*(B\$20)	=2max55% C79*(1/((C\$4+C\$21)/C\$4)*(1-Given)\$5)+Given)\$5)^*(B\$20)
26	Non-Protein Nitrogen	=2max55% B80*(1/((B\$4+B\$21)/B\$4)*(1-Given)\$6)+Given)\$6)^*(B\$20)	=2max55% C80*(1/((C\$4+C\$21)/C\$4)*(1-Given)\$6)+Given)\$6)^*(B\$20)
27	Lactose	=2max55% B81*(1/((B\$4+B\$21)/B\$4)*(1-Given)\$7)+Given)\$7)^*(B\$20)	=2max55% C81*(1/((C\$4+C\$21)/C\$4)*(1-Given)\$7)+Given)\$7)^*(B\$20)
28	Ash	=2max55% B82*(1/((B\$4+B\$21)/B\$4)*(1-Given)\$8)+Given)\$8)^*(B\$20)	=2max55% C82*(1/((C\$4+C\$21)/C\$4)*(1-Given)\$8)+Given)\$8)^*(B\$20)
29	Butter Fat	=2max55% B83*(1/((B\$4+B\$21)/B\$4)*(1-Given)\$9)+Given)\$9)^*(B\$20)	=2max55% C83*(1/((C\$4+C\$21)/C\$4)*(1-Given)\$9)+Given)\$9)^*(B\$20)
30	Total Protein (dry weight)	=(B25+B26)/SUM(B25:B28)	=(C25+C26)/SUM(C25:C28)
31	Yield this part	=(B25+B26)*B4/((2max55% B79+2max55% B80)*B\$4)	=(C25+C26)*C4/((2max55% C79+2max55% C80)*C\$4)
32	CF overall	=B\$1/B4	=C\$1/C4
33	Area/stage	=B21/(27.9-5.3*LN(\$E\$1/B4))/B\$20	=C21/(27.9-5.3*LN(\$E\$1/C4))/B\$20
34	Cartridges/stage	=B33/26.5	=C33/26.5
35	Max Flow Rate (gpm)	=23*B34+B22/(20*60)	=23*C34+C22/(20*60)
36	From 75% (Two Dia. Stage)	1 Stage	2 Stages
37	1 Diafiltration		
38	Solin Feed (gpd)	=2max55% B74-2maxAl I\$M\$23	=2max55% C74-2maxAl I\$M\$23
39	Water Added (gpd)	2306.57963963939	2242.18773519988
40	Total Feed (gpd)	=B39+B38	=C39+C38
41	CF, D1	=B40/B38	=C40/C38
42	Concentrations		
43	True Protein	=2max55% B96*(1/((B\$40/B\$38)*(1-Given)\$5)+Given)\$5)^*(B\$37)	=2max55% C96*(1/((C\$40/C\$38)*(1-Given)\$5)+Given)\$5)^*(B\$37)
44	Non-Protein Nitrogen	=2max55% B97*(1/((B\$40/B\$38)*(1-Given)\$6)+Given)\$6)^*(B\$37)	=2max55% C97*(1/((C\$40/C\$38)*(1-Given)\$6)+Given)\$6)^*(B\$37)
45	Lactose	=2max55% B98*(1/((B\$40/B\$38)*(1-Given)\$7)+Given)\$7)^*(B\$37)	=2max55% C98*(1/((C\$40/C\$38)*(1-Given)\$7)+Given)\$7)^*(B\$37)
46	Ash	=2max55% B99*(1/((B\$40/B\$38)*(1-Given)\$8)+Given)\$8)^*(B\$37)	=2max55% C99*(1/((C\$40/C\$38)*(1-Given)\$8)+Given)\$8)^*(B\$37)
47	Butter Fat	=2max55% B100*(1/((B\$40/B\$38)*(1-Given)\$9)+Given)\$9)^*(B\$37)	=2max55% C100*(1/((C\$40/C\$38)*(1-Given)\$9)+Given)\$9)^*(B\$37)
48	Total Protein (dry weight)	=(B43+B44)/SUM(B43:B47)	=(C43+C44)/SUM(C43:C47)
49	Yield this part	=(B43+B44)*B38/((2max55% B96+2max55% B97)*B\$38)	=(C43+C44)*C38/((2max55% C96+2max55% C97)*C\$38)
50	CF overall	=B\$1/B38	=C\$1/C38
51	Area/stage	=B39/(27.9-5.3*LN(\$E\$1/B38))/B\$37	=C39/(27.9-5.3*LN(\$E\$1/C38))/B\$37
52	Cartridges/stage	=B51/26.5	=C51/26.5
53	Max Flow Rate (gpm)	=23*B52+B40/(20*60)	=23*C52+C40/(20*60)
54	2 Diafiltration		
55	Water Added/Stage (gpd)	722.868784035668	710.699801539138
56	Total Feed (gpd)	=B55+B38	=C55+C38



	A	B	C
57	CF, D1	= (B38+B55)/B38	= (C38+C55)/C34
58	Concentrations		
59	True Protein	=2max55%*B96*(1/((B338+B55)/B338)*(1-Given\$F5)+Given\$F5)*(\$B\$54)	=2max55%*C96*(1/((C338+C55)/C338)*(1-Given\$F5)+Given\$F5)*(\$B\$54)
60	Non-Protein Nitrogen	=2max55%*B97*(1/((B338+B55)/B338)*(1-Given\$F6)+Given\$F6)*(\$B\$54)	=2max55%*C97*(1/((C338+C55)/C338)*(1-Given\$F6)+Given\$F6)*(\$B\$54)
61	Lactose	=2max55%*B98*(1/((B338+B55)/B338)*(1-Given\$F7)+Given\$F7)*(\$B\$54)	=2max55%*C98*(1/((C338+C55)/C338)*(1-Given\$F7)+Given\$F7)*(\$B\$54)
62	Ash	=2max55%*B99*(1/((B338+B55)/B338)*(1-Given\$F8)+Given\$F8)*(\$B\$54)	=2max55%*C99*(1/((C338+C55)/C338)*(1-Given\$F8)+Given\$F8)*(\$B\$54)
63	Butter Fat	=2max55%*B100*(1/((B338+B55)/B338)*(1-Given\$F9)+Given\$F9)*(\$B\$54)	=2max55%*C100*(1/((C338+C55)/C338)*(1-Given\$F9)+Given\$F9)*(\$B\$54)
64	Total Protein (dry weight)	= (B59+B60)/SUM(B59:B63)	= (C59+C60)/SUM(C59:C63)
65	Yield (by part)	= (B59+B60)*B38)/((2max55%*B96+2max55%*B97)*B\$4)	= ((C59+C60)*C38)/((2max55%*C96+2max55%*C97)*C\$4)
66	CF overall	= \$E\$1/B38	= \$E\$1/C38
67	Area/stage	= B55/(27.9-5.3*LN(\$E\$1/B38))/B\$4	= C55/(27.9-5.3*LN(\$E\$1/C38))/B\$4
68	Cartridges/stage	= B67/26.5	= C67/26.5
69	Max Flow Rate (gpm)	= 23*B68+B56/(20*60)	= 23*C68+C56/(20*60)
70			
71			
72	Flow Rates (gpm)	1	2
73			
74	Cart/Stage	= B18	= C18
75	Actual	8	7
76	D1	= B6/(20*60)+23*B75	= C6/(20*60)+23*C75
77	Cart/Stage	= B34	= C34
78	Actual	2	2
79	D2	= B22/(20*60)+23*B78	= C22/(20*60)+23*C78
80			
81	Cart/Stage	= B52	= C52
82	Actual	8	7
83	D1	= B40/(20*60)+23*B81	= C40/(20*60)+23*C81
84	Cart/Stage	= B68	= C68
85	Actual	2	2
86	D2	= B56/(20*60)+23*B84	= C56/(20*60)+23*C84

	D	E
1		12301.03
2		
3	3 Stages	4 Stages
4	=2max55%ID74-2maxAI  \$M23	
5	2362.60674151125	2364.45689981026
6	=D6+D4	=E6+E4
7	=D6/D4	=E6/E4
8		
9	=2max55%ID79*(1/(D36/D34)*(1-Given(F5)+Given(F6))^(B\$3))	=2max55%IE79*(1/((E36/E34)*(1-Given(F5)+Given(F6))^(B\$3))
10	=2max55%ID80*(1/(D36/D34)*(1-Given(F6)+Given(F7))^(B\$3))	=2max55%IE80*(1/((E36/E34)*(1-Given(F6)+Given(F7))^(B\$3))
11	=2max55%ID81*(1/(D36/D34)*(1-Given(F7)+Given(F8))^(B\$3))	=2max55%IE81*(1/((E36/E34)*(1-Given(F7)+Given(F8))^(B\$3))
12	=2max55%ID82*(1/(D36/D34)*(1-Given(F8)+Given(F9))^(B\$3))	=2max55%IE82*(1/((E36/E34)*(1-Given(F8)+Given(F9))^(B\$3))
13	=2max55%ID83*(1/(D36/D34)*(1-Given(F9)+Given(F5))^(B\$3))	=2max55%IE83*(1/((E36/E34)*(1-Given(F9)+Given(F5))^(B\$3))
14	=(D9+D10)/SUM(D9:D13)	=(E9+E10)/SUM(E9:E13)
15	=(D9+D10)*D4/((2max55%ID79+2max55%ID80)*D\$4)	=(E9+E10)*E4/((2max55%IE79+2max55%IE80)*E\$4)
16	=E\$1/D4	=E\$1/E4
17	=E5/(27.9-5.3*LN(E\$1/D4))\$B3	=E5/(27.9-5.3*LN(E\$1/E4))\$B3
18	=D17/26.5	=E17/26.5
19	=23*D18+D6/(20*60)	=23*E18+E6/(20*60)
20		
21	732.396972077881	732.396972077881
22	=D21+D4	=E21+E4
23	=(D4+D21)/D\$4	=(E4+E21)/E\$4
24		
25	=2max55%ID79*(1/((D34+D\$21)/D\$4)*(1-Given(F5)+Given(F6))^(B\$20))	=2max55%IE79*(1/((E34+E\$21)/E\$4)*(1-Given(F5)+Given(F6))^(B\$20))
26	=2max55%ID80*(1/((D34+D\$21)/D\$4)*(1-Given(F6)+Given(F7))^(B\$20))	=2max55%IE80*(1/((E34+E\$21)/E\$4)*(1-Given(F6)+Given(F7))^(B\$20))
27	=2max55%ID81*(1/((D34+D\$21)/D\$4)*(1-Given(F7)+Given(F8))^(B\$20))	=2max55%IE81*(1/((E34+E\$21)/E\$4)*(1-Given(F7)+Given(F8))^(B\$20))
28	=2max55%ID82*(1/((D34+D\$21)/D\$4)*(1-Given(F8)+Given(F9))^(B\$20))	=2max55%IE82*(1/((E34+E\$21)/E\$4)*(1-Given(F8)+Given(F9))^(B\$20))
29	=2max55%ID83*(1/((D34+D\$21)/D\$4)*(1-Given(F9)+Given(F5))^(B\$20))	=2max55%IE83*(1/((E34+E\$21)/E\$4)*(1-Given(F9)+Given(F5))^(B\$20))
30	=(D25+D26)/SUM(D25:D29)	=(E25+E26)/SUM(E25:E29)
31	=(D25+D26)*D4/((2max55%ID79+2max55%ID80)*D\$4)	=(E25+E26)*E4/((2max55%IE79+2max55%IE80)*E\$4)
32	=E\$1/D4	=E\$1/E4
33	=D21/(27.9-5.3*LN(E\$1/D4))\$B20	=E21/(27.9-5.3*LN(E\$1/E4))\$B20
34	=D33/26.5	=E33/26.5
35	=23*D34+D22/(20*60)	=23*E34+E22/(20*60)
36		
37	3 Stages	4 Stages
38	=2max55%ID74-2maxAI  \$M23	
39	2226.30640318168	2219.11052789865
40	=D39+D38	=E39+E38
41	=D40/D38	=E40/E38
42		
43	=2max55%ID98*(1/(D340/D\$38)*(1-Given(F5)+Given(F6))^(B\$37))	=2max55%IE96*(1/((E340/E\$38)*(1-Given(F5)+Given(F6))^(B\$37))
44	=2max55%ID97*(1/(D340/D\$38)*(1-Given(F6)+Given(F7))^(B\$37))	=2max55%IE97*(1/((E340/E\$38)*(1-Given(F6)+Given(F7))^(B\$37))
45	=2max55%ID98*(1/(D340/D\$38)*(1-Given(F7)+Given(F8))^(B\$37))	=2max55%IE98*(1/((E340/E\$38)*(1-Given(F7)+Given(F8))^(B\$37))
46	=2max55%ID99*(1/(D340/D\$38)*(1-Given(F8)+Given(F9))^(B\$37))	=2max55%IE99*(1/((E340/E\$38)*(1-Given(F8)+Given(F9))^(B\$37))
47	=2max55%ID100*(1/(D340/D\$38)*(1-Given(F9)+Given(F5))^(B\$37))	=2max55%IE100*(1/((E340/E\$38)*(1-Given(F9)+Given(F5))^(B\$37))
48	=(D43+D44)/SUM(D43:D47)	=(E43+E44)/SUM(E43:E47)
49	=(D43+D44)*D38/((2max55%ID96+2max55%ID97)*D\$38)	=(E43+E44)*E38/((2max55%IE96+2max55%IE97)*E\$38)
50	=E\$1/D38	=E\$1/E38
51	=D39/(27.9-5.3*LN(E\$1/D38))\$B37	=E39/(27.9-5.3*LN(E\$1/E38))\$B37
52	=D51/26.5	=E51/26.5
53	=23*D52+D40/(20*60)	=23*E52+E40/(20*60)
54		
55	707.657039189757	706.244115371224
56	=D55+D38	=E55+E38

	D	E
57	=(D38+D55)/D\$4	=(E38+E55)/E\$4
58		
59	=2*max55%*ID96*(1/((D\$38+D\$55)/D\$38)*(1-Given(F5)+Given(F6)))*(\$B\$54)	=2*max55%*IE96*(1/((E\$38+E\$55)/E\$38)*(1-Given(F5)+Given(F6)))*(\$B\$54)
60	=2*max55%*ID97*(1/((D\$38+D\$55)/D\$38)*(1-Given(F6)+Given(F7)))*(\$B\$54)	=2*max55%*IE97*(1/((E\$38+E\$55)/E\$38)*(1-Given(F6)+Given(F7)))*(\$B\$54)
61	=2*max55%*ID98*(1/((D\$38+D\$55)/D\$38)*(1-Given(F7)+Given(F8)))*(\$B\$54)	=2*max55%*IE98*(1/((E\$38+E\$55)/E\$38)*(1-Given(F7)+Given(F8)))*(\$B\$54)
62	=2*max55%*ID99*(1/((D\$38+D\$55)/D\$38)*(1-Given(F8)+Given(F9)))*(\$B\$54)	=2*max55%*IE99*(1/((E\$38+E\$55)/E\$38)*(1-Given(F8)+Given(F9)))*(\$B\$54)
63	=2*max55%*ID100*(1/((D\$38+D\$55)/D\$38)*(1-Given(F9)+Given(F9)))*(\$B\$54)	=2*max55%*IE100*(1/((E\$38+E\$55)/E\$38)*(1-Given(F9)+Given(F9)))*(\$B\$54)
64	=(D59+D60)/SUM(D59:D63)	=(E59+E60)/SUM(E59:E63)
65	=(D59+D60)*D38)/((2*max55%*ID96+2*max55%*ID97)*D\$4)	=(E59+E60)*E38)/((2*max55%*IE96+2*max55%*IE97)*E\$4)
66	=\$E\$1/D38	=\$E\$1/E38
67	=D55/(27.9-5.3*LN(\$E\$1/D38))/B\$4	=E55/(27.9-5.3*LN(\$E\$1/E38))/B\$4
68	=D67/26.5	=E67/26.5
69	=23*D68+D56/(20*60)	=23*E68+E56/(20*60)
70		
71		
72	3	4
73		
74	=D18	=E18
75	=D18	7
76	=D6/(20*60)+23*D75	=E6/(20*60)+23*E75
77	=D34	=E34
78	2	2
79	=D22/(20*60)+23*D78	=E22/(20*60)+23*E78
80		
81	=D52	=E52
82	7	7
83	=D40/(20*60)+23*D81	=E40/(20*60)+23*E81
84	=D68	=E68
85	2	2
86	=D56/(20*60)+23*D84	=E56/(20*60)+23*E84

F		G	
1	=2\$!opt.!G19		
2			6 Stages
3			
4	=2max55%!F74-2max!M23		=2max55%!G74-2max!M23
5	2350.03878079124		2347.20411768415
6	=F5+F4		=G5+G4
7	=F6/F4		=G6/G4
8			
9	=2max55%!F79*(1/((F\$6/F\$4)*(1-Given\$F5)+Given\$F5))^(B\$3)		=2max55%!G79*(1/((G\$6/G\$4)*(1-Given\$F5)+Given\$F5))^(B\$3)
10	=2max55%!F80*(1/((F\$6/F\$4)*(1-Given\$F6)+Given\$F6))^(B\$3)		=2max55%!G80*(1/((G\$6/G\$4)*(1-Given\$F6)+Given\$F6))^(B\$3)
11	=2max55%!F81*(1/((F\$6/F\$4)*(1-Given\$F7)+Given\$F7))^(B\$3)		=2max55%!G81*(1/((G\$6/G\$4)*(1-Given\$F7)+Given\$F7))^(B\$3)
12	=2max55%!F82*(1/((F\$6/F\$4)*(1-Given\$F8)+Given\$F8))^(B\$3)		=2max55%!G82*(1/((G\$6/G\$4)*(1-Given\$F8)+Given\$F8))^(B\$3)
13	=2max55%!F83*(1/((F\$6/F\$4)*(1-Given\$F9)+Given\$F9))^(B\$3)		=2max55%!G83*(1/((G\$6/G\$4)*(1-Given\$F9)+Given\$F9))^(B\$3)
14	=(F9+F10)/SUM(F9:F13)		=(G9+G10)/SUM(G9:G13)
15	=(F9+F10)*F4/((2max55%!F79+2max55%!F80)*F\$4)		=(G9+G10)*G4/((2max55%!G79+2max55%!G80)*G\$4)
16	=\$E\$1/F4		=\$E\$1/G4
17	=F5/(27.9-5.3*LN(\$E\$1/F4))/B3		=G5/(27.9-5.3*LN(\$E\$1/G4))/B3
18	=F17/26.5		=G17/26.5
19	=23*F18+F6/(20*60)		=23*G18+G6/(20*60)
20			
21	731.588038982079		731.0679898649993
22	=F21+F4		=G21+G4
23	=(F4+F21)/F\$4		=(G4+G21)/G\$4
24			
25	=2max55%!F79*(1/((F\$4+F\$21)/F\$4)*(1-Given\$F5)+Given\$F5))^(B\$20)		=2max55%!G79*(1/((G\$4+G\$21)/G\$4)*(1-Given\$F5)+Given\$F5))^(B\$20)
26	=2max55%!F80*(1/((F\$4+F\$21)/F\$4)*(1-Given\$F6)+Given\$F6))^(B\$20)		=2max55%!G80*(1/((G\$4+G\$21)/G\$4)*(1-Given\$F6)+Given\$F6))^(B\$20)
27	=2max55%!F81*(1/((F\$4+F\$21)/F\$4)*(1-Given\$F7)+Given\$F7))^(B\$20)		=2max55%!G81*(1/((G\$4+G\$21)/G\$4)*(1-Given\$F7)+Given\$F7))^(B\$20)
28	=2max55%!F82*(1/((F\$4+F\$21)/F\$4)*(1-Given\$F8)+Given\$F8))^(B\$20)		=2max55%!G82*(1/((G\$4+G\$21)/G\$4)*(1-Given\$F8)+Given\$F8))^(B\$20)
29	=2max55%!F83*(1/((F\$4+F\$21)/F\$4)*(1-Given\$F9)+Given\$F9))^(B\$20)		=2max55%!G83*(1/((G\$4+G\$21)/G\$4)*(1-Given\$F9)+Given\$F9))^(B\$20)
30	=(F25+F26)/SUM(F25:F29)		=(G25+G26)/SUM(G25:G29)
31	=(F25+F26)*F4/((2max55%!F78+2max55%!F80)*F\$4)		=(G25+G26)*G4/((2max55%!G78+2max55%!G80)*G\$4)
32	=\$E\$1/F4		=\$E\$1/G4
33	=F21/(27.9-5.3*LN(\$E\$1/F4))/B20		=G21/(27.9-5.3*LN(\$E\$1/G4))/B20
34	=F33/26.5		=G33/26.5
35	=23*F34+F22/(20*60)		=23*G34+G22/(20*60)
36			6 Stages
37			
38	=2max55%!F74-2max!M23		=2max55%!G74-2max!M23
39	2215.13636198061		2212.55289184417
40	=F39+F38		=G39+G38
41	=F40/F38		=G40/G38
42			
43	=2max55%!F96*(1/((F\$40/F\$38)*(1-Given\$F5)+Given\$F5))^(B\$37)		=2max55%!G96*(1/((G\$40/G\$38)*(1-Given\$F5)+Given\$F5))^(B\$37)
44	=2max55%!F97*(1/((F\$40/F\$38)*(1-Given\$F6)+Given\$F6))^(B\$37)		=2max55%!G97*(1/((G\$40/G\$38)*(1-Given\$F6)+Given\$F6))^(B\$37)
45	=2max55%!F98*(1/((F\$40/F\$38)*(1-Given\$F7)+Given\$F7))^(B\$37)		=2max55%!G98*(1/((G\$40/G\$38)*(1-Given\$F7)+Given\$F7))^(B\$37)
46	=2max55%!F99*(1/((F\$40/F\$38)*(1-Given\$F8)+Given\$F8))^(B\$37)		=2max55%!G99*(1/((G\$40/G\$38)*(1-Given\$F8)+Given\$F8))^(B\$37)
47	=2max55%!F100*(1/((F\$40/F\$38)*(1-Given\$F9)+Given\$F9))^(B\$37)		=2max55%!G100*(1/((G\$40/G\$38)*(1-Given\$F9)+Given\$F9))^(B\$37)
48	=(F43+F44)/SUM(F43:F47)		=(G43+G44)/SUM(G43:G47)
49	=(F43+F44)*F38/((2max55%!F96+2max55%!F97)*F\$38)		=(G43+G44)*G38/((2max55%!G96+2max55%!G97)*G\$38)
50	=\$E\$1/F38		=\$E\$1/G38
51	=F39/(27.9-5.3*LN(\$E\$1/F38))/B37		=G39/(27.9-5.3*LN(\$E\$1/G38))/B37
52	=F51/26.5		=G51/26.5
53	=23*F52+F40/(20*60)		=23*G52+G40/(20*60)
54			
55	705.473806213882		704.971259142447
56	=F55+F38		=G55+G38

F		G
57	= (F38+F55)/F\$4	= (G38+G55)/G\$4
58		
59	= 2*max55%*IF96*(1/((F\$38+F\$55)/F\$38)*(1-Given)\$F5)+Given)\$F5)*(\$B\$54)	= 2*max55%*G96*(1/(((G\$38+G\$55)/G\$38)*(1-Given)\$F5)+Given)\$F5)*(\$B\$54)
60	= 2*max55%*IF97*(1/((F\$38+F\$55)/F\$38)*(1-Given)\$F6)+Given)\$F6)*(\$B\$54)	= 2*max55%*G97*(1/(((G\$38+G\$55)/G\$38)*(1-Given)\$F6)+Given)\$F6)*(\$B\$54)
61	= 2*max55%*IF98*(1/((F\$38+F\$55)/F\$38)*(1-Given)\$F7)+Given)\$F7)*(\$B\$54)	= 2*max55%*G98*(1/(((G\$38+G\$55)/G\$38)*(1-Given)\$F7)+Given)\$F7)*(\$B\$54)
62	= 2*max55%*IF99*(1/((F\$38+F\$55)/F\$38)*(1-Given)\$F8)+Given)\$F8)*(\$B\$54)	= 2*max55%*G99*(1/(((G\$38+G\$55)/G\$38)*(1-Given)\$F8)+Given)\$F8)*(\$B\$54)
63	= 2*max55%*IF100*(1/((F\$38+F\$55)/F\$38)*(1-Given)\$F9)+Given)\$F9)*(\$B\$54)	= 2*max55%*G100*(1/(((G\$38+G\$55)/G\$38)*(1-Given)\$F9)+Given)\$F9)*(\$B\$54)
64	= (F59+F60)/SUM(F59:F63)	= (G59+G60)/SUM(G59:G63)
65	= (F59+F60)*F38/((2*max55%*IF96+2*max55%*IF97)*F\$4)	= (G59+G60)*G38/((2*max55%*G96+2*max55%*G97)*G\$4)
66	= \$E\$1/F38	= \$E\$1/G38
67	= F55/(27.9-5.3*LN(\$E\$1/F38))/\$B54	= G55/(27.9-5.3*LN(\$E\$1/G38))/\$B54
68	= F67/26.5	= G67/26.5
69	= 23*F68+F56/(20*60)	= 23*G68+G56/(20*60)
70		
71		
72		
73		
74		
75		
76		
77		
78		
79		
80		
81		
82		
83		
84		
85		
86		
<b>Flow Rates: Feed + Recycle</b>		
72		6
73		1 Diafiltration
74	= F18	= G18
75		7
76	= F6/(20*60)+23*F75	= G6/(20*60)+23*G75
77	= F34	= G34
78		2
79	= F22/(20*60)+23*F78	= G22/(20*60)+23*G78
80		
81	= F52	= G52
82		7
83	= F40/(20*60)+23*F81	= G40/(20*60)+23*G81
84	= F68	= G68
85		2
86	= F56/(20*60)+23*F84	= G56/(20*60)+23*G84

	H	
1		
2		
3		8 Stages
4		
5		
6		
7		
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9		
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11		
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17		
18		
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29		
30		
31		
32		
33		
34		
35		
36		
37		8 Stages
38		
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42		
43		
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51		
52		
53		
54		
55		
56		

	H	I
57	$= (H38+H55)/H\$4$	$= (I38+I55)/I\$4$
58	$= 2max55\% \cdot H96^* \cdot 1 / ( ( ( (H\$38+H\$55)/H\$38) \cdot (1-Given\$F5) + Given\$F5) ) \cdot (\$B\$54)$	$= 2max55\% \cdot I96^* \cdot 1 / ( ( ( (I\$38+I\$55)/I\$38) \cdot (1-Given\$F5) + Given\$F5) ) \cdot (\$B\$54)$
59	$= 2max55\% \cdot H97^* \cdot 1 / ( ( ( (H\$38+H\$55)/H\$38) \cdot (1-Given\$F6) + Given\$F6) ) \cdot (\$B\$54)$	$= 2max55\% \cdot I97^* \cdot 1 / ( ( ( (I\$38+I\$55)/I\$38) \cdot (1-Given\$F6) + Given\$F6) ) \cdot (\$B\$54)$
60	$= 2max55\% \cdot H98^* \cdot 1 / ( ( ( (H\$38+H\$55)/H\$38) \cdot (1-Given\$F7) + Given\$F7) ) \cdot (\$B\$54)$	$= 2max55\% \cdot I98^* \cdot 1 / ( ( ( (I\$38+I\$55)/I\$38) \cdot (1-Given\$F7) + Given\$F7) ) \cdot (\$B\$54)$
61	$= 2max55\% \cdot H99^* \cdot 1 / ( ( ( (H\$38+H\$55)/H\$38) \cdot (1-Given\$F8) + Given\$F8) ) \cdot (\$B\$54)$	$= 2max55\% \cdot I99^* \cdot 1 / ( ( ( (I\$38+I\$55)/I\$38) \cdot (1-Given\$F8) + Given\$F8) ) \cdot (\$B\$54)$
62	$= 2max55\% \cdot H100^* \cdot 1 / ( ( ( (H\$38+H\$55)/H\$38) \cdot (1-Given\$F9) + Given\$F9) ) \cdot (\$B\$54)$	$= 2max55\% \cdot I100^* \cdot 1 / ( ( ( (I\$38+I\$55)/I\$38) \cdot (1-Given\$F9) + Given\$F9) ) \cdot (\$B\$54)$
63	$= (H59+H60)/SUM(H59:H63)$	$= (I59+I60)/SUM(I59:I63)$
64	$= (H59+H60) \cdot H38 / ( (2max55\% \cdot H96 + 2max55\% \cdot H97) \cdot H\$4)$	$= (I59+I60) \cdot I38 / ( (2max55\% \cdot I96 + 2max55\% \cdot I97) \cdot I\$4)$
66	$= \$E\$1/38$	$= \$E\$1/38$
67	$= H55 / (27.9 \cdot 5.3 \cdot LN(\$E\$1/38)) / \$B\$4$	$= I55 / (27.9 \cdot 5.3 \cdot LN(\$E\$1/38)) / \$B\$4$
68	$= H67/26.5$	$= I67/26.5$
69	$= 23 \cdot H68 + H56 / (20 \cdot 60)$	$= 23 \cdot I68 + I56 / (20 \cdot 60)$
70		
71		
72	7	8
73		
74	$= H18$	$= I18$
75	7	7
76	$= H6 / (20 \cdot 60) + 23 \cdot H75$	$= I6 / (20 \cdot 60) + 23 \cdot I75$
77	$= H34$	$= I34$
78	2	2
79	$= H22 / (20 \cdot 60) + 23 \cdot H78$	$= I22 / (20 \cdot 60) + 23 \cdot I78$
80		
81	$= H52$	$= I52$
82	7	7
83	$= H40 / (20 \cdot 60) + 23 \cdot H81$	$= I40 / (20 \cdot 60) + 23 \cdot I81$
84	$= H68$	$= I68$
85	2	2
86	$= H66 / (20 \cdot 60) + 23 \cdot H84$	$= I66 / (20 \cdot 60) + 23 \cdot I84$

	J	K
1		
2		
3	8 Stages	10 Stages
4	=2max55%J74+2maxAIISM23	=2max55%IK74+2maxAIISM23
5	2315.67307698038	2314.96564954952
6	=J5+J4	=K5+K4
7	=J6/J4	=K6/K4
8		
9	=2max55%J79*(1/(J86/J54)*(1-Given\$F5)+Given\$F5)^(\$B\$3)	=2max55%IK79*(1/(K86/K54)*(1-Given\$F5)+Given\$F5)^(\$B\$3)
10	=2max55%J80*(1/(J86/J54)*(1-Given\$F6)+Given\$F6)^(\$B\$3)	=2max55%IK80*(1/(K86/K54)*(1-Given\$F6)+Given\$F6)^(\$B\$3)
11	=2max55%J81*(1/(J86/J54)*(1-Given\$F7)+Given\$F7)^(\$B\$3)	=2max55%IK81*(1/(K86/K54)*(1-Given\$F7)+Given\$F7)^(\$B\$3)
12	=2max55%J82*(1/(J86/J54)*(1-Given\$F8)+Given\$F8)^(\$B\$3)	=2max55%IK82*(1/(K86/K54)*(1-Given\$F8)+Given\$F8)^(\$B\$3)
13	=2max55%J83*(1/(J86/J54)*(1-Given\$F9)+Given\$F9)^(\$B\$3)	=2max55%IK83*(1/(K86/K54)*(1-Given\$F9)+Given\$F9)^(\$B\$3)
14	=J9+J10)/SUM(J9:J13)	=K9+K10)/SUM(K9:K13)
15	=J9+J10)^J4)/((2max55%J79+2max55%J80)^J54)	=K9+K10)^K4)/((2max55%IK79+2max55%IK80)^K54)
16	=\$E\$1/J4	=\$E\$1/K4
17	=J5/(27.9-5.3*LN(\$E\$1/J4))/B3	=K5/(27.9-5.3*LN(\$E\$1/K4))/B3
18	=J17/26.5	=K17/26.5
19	=23*J18+J6/(20^60)	=23*K18+K6/(20^60)
20		
21	724.454014482437	724.454014482437
22	=J21+J4	=K21+K4
23	=J4+J21)/J54	=K4+K21)/K54
24		
25	=2max55%J79*(1/(J54+J52)/J54*(1-Given\$F5)+Given\$F5)^(\$B\$20)	=2max55%IK79*(1/(K54+K52)/K54*(1-Given\$F5)+Given\$F5)^(\$B\$20)
26	=2max55%J80*(1/(J54+J52)/J54*(1-Given\$F6)+Given\$F6)^(\$B\$20)	=2max55%IK80*(1/(K54+K52)/K54*(1-Given\$F6)+Given\$F6)^(\$B\$20)
27	=2max55%J81*(1/(J54+J52)/J54*(1-Given\$F7)+Given\$F7)^(\$B\$20)	=2max55%IK81*(1/(K54+K52)/K54*(1-Given\$F7)+Given\$F7)^(\$B\$20)
28	=2max55%J82*(1/(J54+J52)/J54*(1-Given\$F8)+Given\$F8)^(\$B\$20)	=2max55%IK82*(1/(K54+K52)/K54*(1-Given\$F8)+Given\$F8)^(\$B\$20)
29	=2max55%J83*(1/(J54+J52)/J54*(1-Given\$F9)+Given\$F9)^(\$B\$20)	=2max55%IK83*(1/(K54+K52)/K54*(1-Given\$F9)+Given\$F9)^(\$B\$20)
30	=J25+J26)/SUM(J25:J29)	=K25+K26)/SUM(K25:K29)
31	=J25+J26)^J4)/((2max55%J79+2max55%J80)^J54)	=K25+K26)^K4)/((2max55%IK79+2max55%IK80)^K54)
32	=\$E\$1/J4	=\$E\$1/K4
33	=J21/(27.9-5.3*LN(\$E\$1/J4))/B20	=K21/(27.9-5.3*LN(\$E\$1/K4))/B20
34	=J33/26.5	=K33/26.5
35	=23*J34+J22/(20^60)	=23*K34+K22/(20^60)
36		
37	9 Stages	10 Stages
38	=2max55%J74+2maxAIISM23	=2max55%IK74+2maxAIISM23
39	2208.38198848231	2207.57072829751
40	=J39+J38	=K39+K38
41	=J40/J38	=K40/K38
42		
43	=2max55%J96*(1/(J540/J38)*(1-Given\$F5)+Given\$F5)^(\$B\$37)	=2max55%IK96*(1/(K540/K38)*(1-Given\$F5)+Given\$F5)^(\$B\$37)
44	=2max55%J97*(1/(J540/J38)*(1-Given\$F6)+Given\$F6)^(\$B\$37)	=2max55%IK97*(1/(K540/K38)*(1-Given\$F6)+Given\$F6)^(\$B\$37)
45	=2max55%J98*(1/(J540/J38)*(1-Given\$F7)+Given\$F7)^(\$B\$37)	=2max55%IK98*(1/(K540/K38)*(1-Given\$F7)+Given\$F7)^(\$B\$37)
46	=2max55%J99*(1/(J540/J38)*(1-Given\$F8)+Given\$F8)^(\$B\$37)	=2max55%IK99*(1/(K540/K38)*(1-Given\$F8)+Given\$F8)^(\$B\$37)
47	=2max55%J100*(1/(J540/J38)*(1-Given\$F9)+Given\$F9)^(\$B\$37)	=2max55%IK100*(1/(K540/K38)*(1-Given\$F9)+Given\$F9)^(\$B\$37)
48	=J43+J44)/SUM(J43:J47)	=K43+K44)/SUM(K43:K47)
49	=J43+J44)^J38)/((2max55%J96+2max55%J97)^J38)	=K43+K44)^K38)/((2max55%IK96+2max55%IK97)^K38)
50	=\$E\$1/J38	=\$E\$1/K38
51	=J39/(27.9-5.3*LN(\$E\$1/J38))/B37	=K39/(27.9-5.3*LN(\$E\$1/K38))/B37
52	=J51/26.5	=K51/26.5
53	=23*J52+J40/(20^60)	=23*K52+K40/(20^60)
54		
55	704.001176727826	704.001176727826
56	=J55+J38	=K55+K38



	J	K
57	=J38+J55/J\$4	=(K38+K55)/K\$4
58		
59	=2max55%*J96*(1/((J\$38+J\$55)/J\$38)*(1-Given)\$F5)+Given)\$F5)*(\$B\$54)	=2max55%*K96*(1/((K\$38+K\$55)/K\$38)*(1-Given)\$F5)+Given)\$F5)*(\$B\$54)
60	=2max55%*J97*(1/((J\$38+J\$55)/J\$38)*(1-Given)\$F6)+Given)\$F6)*(\$B\$54)	=2max55%*K97*(1/((K\$38+K\$55)/K\$38)*(1-Given)\$F6)+Given)\$F6)*(\$B\$54)
61	=2max55%*J98*(1/((J\$38+J\$55)/J\$38)*(1-Given)\$F7)+Given)\$F7)*(\$B\$54)	=2max55%*K98*(1/((K\$38+K\$55)/K\$38)*(1-Given)\$F7)+Given)\$F7)*(\$B\$54)
62	=2max55%*J99*(1/((J\$38+J\$55)/J\$38)*(1-Given)\$F8)+Given)\$F8)*(\$B\$54)	=2max55%*K99*(1/((K\$38+K\$55)/K\$38)*(1-Given)\$F8)+Given)\$F8)*(\$B\$54)
63	=2max55%*J100*(1/((J\$38+J\$55)/J\$38)*(1-Given)\$F9)+Given)\$F9)*(\$B\$54)	=2max55%*K100*(1/((K\$38+K\$55)/K\$38)*(1-Given)\$F9)+Given)\$F9)*(\$B\$54)
64	=J59+J60/SUM(J59:J63)	=(K59+K60)/SUM(K59:K63)
65	=(J59+J60)*J38/(2max55%*J96+2max55%*J97)*J\$4	=(K59+K60)*K38/((2max55%*K96+2max55%*K97)*K\$4)
66	=\$E\$1/J38	=\$E\$1/K38
67	=J55/(27.9-5.3*LN(\$E\$1/J38))/J\$B54	=K55/(27.9-5.3*LN(\$E\$1/K38))/J\$B54
68	=J67/26.5	=K67/26.5
69	=23*J68+J56/(20^60)	=23*K68+K56/(20^60)
70		
71		
72	9	10
73		
74	=J18	=K18
75	7	7
76	=J6/(20^60)+23*J75	=K6/(20^60)+23*K75
77	=J34	=K34
78	2	2
79	=J22/(20^60)+23*J78	=K22/(20^60)+23*K78
80		
81	=J52	=K52
82	7	7
83	=J40/(20^60)+23*J81	=K40/(20^60)+23*K81
84	=J68	=K68
85	2	2
86	=J56/(20^60)+23*J84	=K56/(20^60)+23*K84

Appendix D

A	B	C	D	E	F	G	H	I	J
Stream Description	Feed	Exit	Waste	0.35	Feed:55%	Exit:55%	Waste:55%	Feed:2	Water:2
1	2	3	4	5	6	7	8	9	
2 Stream Number									
3 Component									
4 lbs/dav									
5 Protein	=B\$12*B26	=C\$12*C26	=B5-C5	=E\$12*E26	=C5-E5	=G\$12*G26	=F5-G5	=I5/8.5	=J5/8.5
6 True Protein	=B\$12*B27	=C\$12*C27	=B6-C6	=E\$12*E27	=C6-E6	=G\$12*G27	=F6-G6	=I6/8.5	=J6/8.5
7 Non-Protein Nitrogen	=B\$12*B28	=C\$12*C28	=B7-C7	=E\$12*E28	=C7-E7	=G\$12*G28	=F7-G7	=I7/8.5	=J7/8.5
8 Lactose	=B\$12*B29	=C\$12*C29	=B8-C8	=E\$12*E29	=C8-E8	=G\$12*G29	=F8-G8	=I8/8.5	=J8/8.5
9 Ash	=B\$12*B30	=C\$12*C30	=B9-C9	=E\$12*E30	=C9-E9	=G\$12*G30	=F9-G9	=I9/8.5	=J9/8.5
10 Butter Fat	=B\$12*B31	=C\$12*C31	=B10-C10	=E\$12*E31	=C10-E10	=G\$12*G31	=F10-G10	=I10/8.5	=J10/8.5
11 Water	=B\$12*B32	=C\$12*C32	=B11-C11	=E\$12*E32	=C11-E11	=G\$12*G32	=F11-G11	=I11/8.5	=J11/8.5
12 Total	=Given/12	=C23*8.5	=D23*8.5	=E13/E35	=C12-E12	=G23*8.5	=H23*8.5	=I12/8.5	=J23*8.5
13 Total Solids	=SUM(B6:B10)	=SUM(C6:C10)	=SUM(D6:D10)	=2\$1opt*1E12	=C13-E13	=SUM(G6:G10)	=SUM(H6:H10)	=F13-H13	0
14									
15 gal/dav									
16 Protein	=B5/8.5	=C5/8.5	=D5/8.5	=E5/8.5	=F5/8.5	=G5/8.5	=H5/8.5	=I5/8.5	=J5/8.5
17 True Protein	=B6/8.5	=C6/8.5	=D6/8.5	=E6/8.5	=F6/8.5	=G6/8.5	=H6/8.5	=I6/8.5	=J6/8.5
18 Non-Protein Nitrogen	=B7/8.5	=C7/8.5	=D7/8.5	=E7/8.5	=F7/8.5	=G7/8.5	=H7/8.5	=I7/8.5	=J7/8.5
19 Lactose	=B8/8.5	=C8/8.5	=D8/8.5	=E8/8.5	=F8/8.5	=G8/8.5	=H8/8.5	=I8/8.5	=J8/8.5
20 Ash	=B9/8.5	=C9/8.5	=D9/8.5	=E9/8.5	=F9/8.5	=G9/8.5	=H9/8.5	=I9/8.5	=J9/8.5
21 Butter Fat	=B10/8.5	=C10/8.5	=D10/8.5	=E10/8.5	=F10/8.5	=G10/8.5	=H10/8.5	=I10/8.5	=J10/8.5
22 Water	=B11/8.5	=C11/8.5	=D11/8.5	=E11/8.5	=F11/8.5	=G11/8.5	=H11/8.5	=I11/8.5	=J11/8.5
23 Total	=B12/8.5	=C11/8.5	=D11/8.5	=E11/8.5	=F11/8.5	=G11/8.5	=H11/8.5	=I11/8.5	=J11/8.5
24									
25 Mass %									
26 Protein	=B27+B28	=C27+C28	=D27+D28	=E27+E28	=F27+F28	=G27+G28	=H27+H28	=I27+I28	0
27 True Protein	0.006	=max35%/IA40	=D6/D\$12	=C27	=C27	=2max55%/IC65	=H6/H\$12	=G27	0
28 Non-Protein Nitrogen	0.003	=max35%/IA41	=D7/D\$12	=C28	=C28	=2max55%/IC66	=H7/H\$12	=G28	0
29 Lactose	0.049	=max35%/IA43	=D8/D\$12	=C29	=C29	=2max55%/IC67	=H8/H\$12	=G29	0
30 Ash	0.008	=max35%/IA44	=D9/D\$12	=C30	=C30	=2max55%/IC68	=H9/H\$12	=G30	0
31 Butter Fat	0.0005	=max35%/IA45	=D10/D\$12	=C31	=C31	=2max55%/IC69	=H10/H\$12	=G31	0
32 Water	=1-SUM(B27:B31)	=C33-SUM(C27:C31)	=D33-SUM(D27:D31)	=E33-SUM(E27:E31)	=F33-SUM(F27:F31)	=G33-SUM(G27:G31)	=H33-SUM(H27:H31)	=I33-SUM(I27:I31)	1
33 Total	=SUM(B27:B32)	1	1	=C33	=C33	=D33	1	1	1
34									
35 % Solids	=SUM(B6:B10)/B12	=SUM(C6:C10)/C12	=SUM(D6:D10)/D12	=C35	=SUM(F6:F10)/F12	=SUM(G6:G10)/G12	=SUM(H6:H10)/H12	=SUM(I6:I10)/I12	=SUM(J6:J10)/J22
36 % Protein of Solids	=B5/SUM(B6:B10)	=C6/SUM(C6:C10)	=D5/SUM(D6:D10)	=C36	=F5/SUM(F6:F10)	=G5/SUM(G6:G10)	=H5/SUM(H6:H10)	=I5/SUM(I6:I10)	0

Appendix D

	K	L	M	N	O	P	Q	R	S	T
	Exit 2	Waste 2	Waste 3	Feed 3	Water 3	0.85	Waste 3	Total Permeate	Animal Feed	H2O Rem
	11	12	13	14	15	16	17	18	19	19
1										
2										
3										
4										
5	=K5/K26	=L5/L5	=M5/M26	=N5/M5	0	=P5/P26	=Q5/P5+O5	=R5/R8.5	=S5/S16*8.5	=T5/S5
6	=K6/K27	=L6/L6	=M6/M27	=N6/M6	0	=P6/P27	=Q6/P6+O6	=R6/R8.5	=S6/S17*8.5	=T6/S6
7	=K7/K28	=L7/L7	=M7/M28	=N7/M7	0	=P7/P28	=Q7/P7+O7	=R7/R8.5	=S7/S18*8.5	=T7/S7
8	=K8/K29	=L8/L8	=M8/M29	=N8/M8	0	=P8/P29	=Q8/P8+O8	=R8/R8.5	=S8/S19*8.5	=T8/S8
9	=K9/K30	=L9/L9	=M9/M30	=N9/M9	0	=P9/P30	=Q9/P9+O9	=R9/R8.5	=S9/S20*8.5	=T9/S9
10	=K10/K31	=L10/L10	=M10/M31	=N10/M10	0	=P10/P31	=Q10/P10+O10	=R10/R8.5	=S10/S21*8.5	=T10/S10
11	=K11/K32	=L11-K11+J11	=M11/M32	=N11-M11	=O22*8.5	=P11/P32	=Q11-P11+O11	=R11/R8.5	=S11/S22*8.5	=T11-S11
12	=K23*8.5	=L23*8.5	=M13/M35	=N12-M12	=O23*8.5	=P23*8.5	=Q12-P12+O12	=R23/R8.5	=S23*8.5	=T12-S12
13	=SUM(K6:K10)	=SUM(L6:L10)	=SUM(M6:M10)	=SUM(N6:N10)	0	=SUM(P6:P10)	=SUM(Q6:Q10)	=SUM(R6:R10)	=SUM(S6:S10)	=SUM(T6:T10)
14										
15										
16	=K5/8.5	=L5/8.5	=M5/8.5	=N5/8.5	=O5/8.5	=P5/8.5	=Q5/8.5	=R5/8.5	=S5/8.5	=T5/8.5
17	=K6/8.5	=L6/8.5	=M6/8.5	=N6/8.5	=O6/8.5	=P6/8.5	=Q6/8.5	=R6/8.5	=S6/8.5	=T6/8.5
18	=K7/8.5	=L7/8.5	=M7/8.5	=N7/8.5	=O7/8.5	=P7/8.5	=Q7/8.5	=R7/8.5	=S7/8.5	=T7/8.5
19	=K8/8.5	=L8/8.5	=M8/8.5	=N8/8.5	=O8/8.5	=P8/8.5	=Q8/8.5	=R8/8.5	=S8/8.5	=T8/8.5
20	=K9/8.5	=L9/8.5	=M9/8.5	=N9/8.5	=O9/8.5	=P9/8.5	=Q9/8.5	=R9/8.5	=S9/8.5	=T9/8.5
21	=K10/8.5	=L10/8.5	=M10/8.5	=N10/8.5	=O10/8.5	=P10/8.5	=Q10/8.5	=R10/8.5	=S10/8.5	=T10/8.5
22	=K11/8.5	=L11/8.5	=M11/8.5	=N11/8.5	=O11/8.5	=P11/8.5	=Q11/8.5	=R11/8.5	=S11/8.5	=T11/8.5
23	=2max55%/C74	=SUM(L17:L22)	=SUM(M17:M22)	=N12/8.5	=O22	=2max85%/C4	=Q12/8.5	=R23+L23+H23+D23	=SUM(S17:S22)	=T23-S23
24										
25										
26	=K27+K28	=L27+L28	=M27+M28	=N27+N28	0	=P27+P28	=Q27+Q28	=R27+R28	=S27+S28	=T27+T28
27	=2max55%/C79	=L6/L\$12	=2max55%/C79	=K27	0	=2max85%/C9	=Q67/Q\$12	=R6/R\$12	=S6/S\$12	=T6/T\$12
28	=2max55%/C80	=L7/L\$12	=2max55%/C80	=K28	0	=2max85%/C10	=Q7/Q\$12	=R7/R\$12	=S7/S\$12	=T7/T\$12
29	=2max55%/C81	=L8/L\$12	=2max55%/C81	=K29	0	=2max85%/C11	=Q8/Q\$12	=R8/R\$12	=S8/S\$12	=T8/T\$12
30	=2max55%/C82	=L9/L\$12	=2max55%/C82	=K30	0	=2max85%/C12	=Q9/Q\$12	=R9/R\$12	=S9/S\$12	=T9/T\$12
31	=2max55%/C83	=L10/L\$12	=2max55%/C83	=K31	0	=2max85%/C13	=Q10/Q\$12	=R10/R\$12	=S10/S\$12	=T10/T\$12
32	=K33-SUM(K27:K31)	=L33-SUM(L27:L31)	=M33-SUM(M27:M31)	=N33-SUM(N27:N31)	1	=P33-SUM(P27:P31)	=Q33-SUM(Q27:Q31)	=R33-SUM(R27:R31)	=S33-SUM(S27:S31)	=T33-SUM(T27:T31)
33	=D33	=E33	=F33	=K33	1		=M33	=N33	=O33	=P33
34										
35	=SUM(K6:K10)/K12	=SUM(L6:L10)/L12	=SUM(M6:M10)/M12	=SUM(N6:N10)/N12	=SUM(O6:O10)/O12	=SUM(P6:P10)/P12	=SUM(Q6:Q10)/Q12	=SUM(R6:R10)/R12	=SUM(S6:S10)/S12	=SUM(T6:T10)/T12
36	=K5/SUM(K6:K10)	=L5/SUM(L6:L10)	=M5/SUM(M6:M10)	=N5/SUM(N6:N10)	0	=P5/SUM(P6:P10)	=Q5/SUM(Q6:Q10)	=R5/SUM(R6:R10)	=S5/SUM(S6:S10)	0

Appendix D

	U	V	W
1	=35%*P10	=75%*P10	=85%*P10
2			
3			
4			
5	=U\$12*U26	=V\$12*V26	=W\$12*W26
6	=E6	=M6	=P6
7	=E7	=M7	=P7
8	=E8	=M8	=P8
9	=E9	=M9	=P9
10	=E10	=M10	=P10
11	0	0	0
12	=SUM(U6:U11)	=SUM(V6:V11)	=SUM(W6:W11)
13	=SUM(U6:U10)	=SUM(V6:V10)	=SUM(W6:W10)
14			
15			
16	=U5/8.5	=V5/8.5	=W5/8.5
17	=U6/8.5	=V6/8.5	=W6/8.5
18	=U7/8.5	=V7/8.5	=W7/8.5
19	=U8/8.5	=V8/8.5	=W8/8.5
20	=U9/8.5	=V9/8.5	=W9/8.5
21	=U10/8.5	=V10/8.5	=W10/8.5
22	=U11/8.5	=V11/8.5	=W11/8.5
23	=U12/8.5	=V12/8.5	=W12/8.5
24			
25			
26	=U27+U28	=V27+V28	=W27+W28
27	=U6/U\$12	=V6/V\$12	=W6/W\$12
28	=U7/U\$12	=V7/V\$12	=W7/W\$12
29	=U8/U\$12	=V8/V\$12	=W8/W\$12
30	=U9/U\$12	=V9/V\$12	=W9/W\$12
31	=U10/U\$12	=V10/V\$12	=W10/W\$12
32	=U33-SUM(U27:U31)	=V33-SUM(V27:V31)	=W33-SUM(W27:W31)
33	=Q33	=R33	=S33
34			
35	=SUM(U8:U10)/U12	=SUM(V6:V10)/V12	=SUM(W6:W10)/W12
36	=U5/SUM(U6:U10)	=V5/SUM(V6:V10)	=W5/SUM(W6:W10)

Appendix D

	A	B	C	D	E	F	G	H	I	J	K
1				Yield (ind.)	72.94%	78.5%	89.80%				
2	<b>Year</b>	<b>Actual</b>	<b>Calc</b>	<b>Diff.</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>\$</b>	<b>a</b>	<b>b</b>	<b>c</b>
3	1	9000.0	9000.0	0.00	14000.0	1237.7	400.0	\$ 11,647.17	4900.0	928.3	340.0
4	2	9360.0	9360.0	0.00	14560.0	1287.2	416.0	\$ 12,113.06	5096.0	965.4	353.6
5	3	9734.4	9734.4	0.00	15142.4	1338.7	432.6	\$ 12,597.58	5299.8	1004.1	367.7
6	4	10123.8	10123.8	0.00	15748.1	1392.3	449.9	\$ 13,101.49	5511.8	1044.2	382.5
7	5	10528.7	10528.7	0.00	16378.0	1448.0	467.9	\$ 13,625.55	5732.3	1086.0	397.8
8	6	10949.9	10949.9	0.00	17033.1	1505.9	486.7	\$ 14,170.57	5961.6	1129.4	413.7
9	7	11387.9	11387.9	0.00	17714.5	1566.1	506.1	\$ 14,737.39	6200.1	1174.6	430.2
10	8	11843.4	11843.4	0.00	18423.0	1628.8	526.4	\$ 15,326.89	6448.1	1221.6	447.4
11	9	12317.1	12317.1	0.00	19160.0	1693.9	547.4	\$ 15,939.96	6706.0	1270.4	465.3
12	10	12809.8	12809.8	0.00	19926.4	1761.7	569.3	\$ 16,577.56	6974.2	1321.3	483.9
13	Total Protein available				max		max				
14					lbs/day product (dry weight)				lbs/day protein		
15					Total Soln In						
16			Year 1	lb/day	746433	180105.1	73461.6		6717.9	1620.95	661.154
17				gal/day	87815.7	21188.8	8642.54				
18			Year 10	lb/day	1062407	256345.7	104559		9561.7	2307.11	941.029
19				gal/day	124989	30158.3	12301				

A		B		C		D		E		F		G		H	
1	Year	Dialfiltration stage to 75%	Actual	Calc	Yield (ind.)	Diff.	min35%:K70	max75%:IK70	min35%:K70	max75%:IK70	min35%:IK70	max75%:IK70	min35%:IK70	max75%:IK70	assumed
3	1	=0.009*Giventil3		$\frac{1}{(\$E\$1)} * 0.35 * E3 + \frac{1}{(\$E\$1)} * 0.75 * F3 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B3-C3	14000	=E3*0.04+E3	891.337904215136	400	=0.65*E3+1.25*F3+2.5*G3					
4	2	=0.009*Giventil4		$\frac{1}{(\$E\$1)} * 0.35 * E4 + \frac{1}{(\$E\$1)} * 0.75 * F4 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B4-C4	=E3*0.04+E3	=E4*0.04+E4	926.9814203883741	=G3*0.04+G3	=0.65*E4+1.25*F4+2.5*G4					
5	3	=0.009*Giventil5		$\frac{1}{(\$E\$1)} * 0.35 * E5 + \frac{1}{(\$E\$1)} * 0.75 * F5 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B5-C5	=E4*0.04+E4	=E5*0.04+E5	964.071077199091	=G4*0.04+G4	=0.65*E5+1.25*F5+2.5*G5					
6	4	=0.009*Giventil6		$\frac{1}{(\$E\$1)} * 0.35 * E6 + \frac{1}{(\$E\$1)} * 0.75 * F6 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B6-C6	=E5*0.04+E5	=E6*0.04+E6	1002.63392028705	=G5*0.04+G5	=0.65*E6+1.25*F6+2.5*G6					
7	5	=0.009*Giventil7		$\frac{1}{(\$E\$1)} * 0.35 * E7 + \frac{1}{(\$E\$1)} * 0.75 * F7 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B7-C7	=E6*0.04+E6	=E7*0.04+E7	1042.73927709854	=G6*0.04+G6	=0.65*E7+1.25*F7+2.5*G7					
8	6	=0.009*Giventil8		$\frac{1}{(\$E\$1)} * 0.35 * E8 + \frac{1}{(\$E\$1)} * 0.75 * F8 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B8-C8	=E7*0.04+E7	=E8*0.04+E8	1084.44884819248	=G7*0.04+G7	=0.65*E8+1.25*F8+2.5*G8					
9	7	=0.009*Giventil9		$\frac{1}{(\$E\$1)} * 0.35 * E9 + \frac{1}{(\$E\$1)} * 0.75 * F9 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B9-C9	=E8*0.04+E8	=E9*0.04+E9	1121.82680210978	=G8*0.04+G8	=0.65*E9+1.25*F9+2.5*G9					
10	8	=0.009*Giventil10		$\frac{1}{(\$E\$1)} * 0.35 * E10 + \frac{1}{(\$E\$1)} * 0.75 * F10 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B10-C10	=E9*0.04+E9	=E10*0.04+E10	1179.93987419417	=G9*0.04+G9	=0.65*E10+1.25*F10+2.5*G10					
11	9	=0.009*Giventil11		$\frac{1}{(\$E\$1)} * 0.35 * E11 + \frac{1}{(\$E\$1)} * 0.75 * F11 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B11-C11	=E10*0.04+E10	=E11*0.04+E11	1219.85746916193	=G10*0.04+G10	=0.65*E11+1.25*F11+2.5*G11					
12	10	=0.009*Giventil12		$\frac{1}{(\$E\$1)} * 0.35 * E12 + \frac{1}{(\$E\$1)} * 0.75 * F12 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B12-C12	=E11*0.04+E11	max	1268.6517053766	=G11*0.04+G11	=0.65*E12+1.25*F12+2.5*G12					
13			Total Protein available				max	lbs/day product				max			
14															
15															
16		Dialfiltration stage to 75%		Calc	Yield (ind.)	Diff.	min35%:K70	max75%:IK70	min35%:K70	max75%:IK70	min35%:IK70	max75%:IK70	min35%:IK70	max75%:IK70	assumed
17	Year		Actual												
18	1	=0.009*Giventil3		$\frac{1}{(\$E\$1)} * 0.35 * E18 + \frac{1}{(\$E\$1)} * 0.75 * F18 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B18-C18	14000	=E18*0.04+E18	824.626857163395	400	=0.65*E18+1.25*F18+2.5*G18					
19	2	=0.009*Giventil4		$\frac{1}{(\$E\$1)} * 0.35 * E19 + \frac{1}{(\$E\$1)} * 0.75 * F19 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B19-C19	=E18*0.04+E18	=E19*0.04+E19	857.611931449931	=G18*0.04+G18	=0.65*E19+1.25*F19+2.5*G19					
20	3	=0.009*Giventil5		$\frac{1}{(\$E\$1)} * 0.35 * E20 + \frac{1}{(\$E\$1)} * 0.75 * F20 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B20-C20	=E19*0.04+E19	=E20*0.04+E20	891.91640870793	=G19*0.04+G19	=0.65*E20+1.25*F20+2.5*G20					
21	4	=0.009*Giventil6		$\frac{1}{(\$E\$1)} * 0.35 * E21 + \frac{1}{(\$E\$1)} * 0.75 * F21 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B21-C21	=E20*0.04+E20	=E21*0.04+E21	927.5930605056246	=G20*0.04+G20	=0.65*E21+1.25*F21+2.5*G21					
22	5	=0.009*Giventil7		$\frac{1}{(\$E\$1)} * 0.35 * E22 + \frac{1}{(\$E\$1)} * 0.75 * F22 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B22-C22	=E21*0.04+E21	=E22*0.04+E22	964.696787658498	=G21*0.04+G21	=0.65*E22+1.25*F22+2.5*G22					
23	6	=0.009*Giventil8		$\frac{1}{(\$E\$1)} * 0.35 * E23 + \frac{1}{(\$E\$1)} * 0.75 * F23 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B23-C23	=E22*0.04+E22	=E23*0.04+E23	1003.28465916484	=G22*0.04+G22	=0.65*E23+1.25*F23+2.5*G23					
24	7	=0.009*Giventil9		$\frac{1}{(\$E\$1)} * 0.35 * E24 + \frac{1}{(\$E\$1)} * 0.75 * F24 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B24-C24	=E23*0.04+E23	=E24*0.04+E24	1043.41604659143	=G23*0.04+G23	=0.65*E24+1.25*F24+2.5*G24					
25	8	=0.009*Giventil10		$\frac{1}{(\$E\$1)} * 0.35 * E25 + \frac{1}{(\$E\$1)} * 0.75 * F25 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B25-C25	=E24*0.04+E24	=E25*0.04+E25	1085.15268735269	=G24*0.04+G24	=0.65*E25+1.25*F25+2.5*G25					
26	9	=0.009*Giventil11		$\frac{1}{(\$E\$1)} * 0.35 * E26 + \frac{1}{(\$E\$1)} * 0.75 * F26 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B26-C26	=E25*0.04+E25	max	1128.5587948468	=G25*0.04+G25	=0.65*E26+1.25*F26+2.5*G26					
27	10	=0.009*Giventil12		$\frac{1}{(\$E\$1)} * 0.35 * E27 + \frac{1}{(\$E\$1)} * 0.75 * F27 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B27-C27	=E26*0.04+E26	max	1173.70114664067	=G26*0.04+G26	=0.65*E27+1.25*F27+2.5*G27					
28			Total Protein available				max	lbs/day product				max			
29															
30															
31		Dialfiltration stage to 75%		Calc	Yield (ind.)	Diff.	min35%:K70	max75%:IK70	min35%:K70	max75%:IK70	min35%:IK70	max75%:IK70	min35%:IK70	max75%:IK70	assumed
32	Year		Actual												
33	1	=0.009*Giventil3		$\frac{1}{(\$E\$1)} * 0.35 * E33 + \frac{1}{(\$E\$1)} * 0.75 * F33 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B33-C33	14000	=E33*0.04+E33	824.626857163395	400	=0.65*E33+1.25*F33+2.5*G33					
34	2	=0.009*Giventil4		$\frac{1}{(\$E\$1)} * 0.35 * E34 + \frac{1}{(\$E\$1)} * 0.75 * F34 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B34-C34	=E33*0.04+E33	=E34*0.04+E34	857.611931449931	=G33*0.04+G33	=0.65*E34+1.25*F34+2.5*G34					
35	3	=0.009*Giventil5		$\frac{1}{(\$E\$1)} * 0.35 * E35 + \frac{1}{(\$E\$1)} * 0.75 * F35 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B35-C35	=E34*0.04+E34	=E35*0.04+E35	891.91640870793	=G34*0.04+G34	=0.65*E35+1.25*F35+2.5*G35					
36	4	=0.009*Giventil6		$\frac{1}{(\$E\$1)} * 0.35 * E36 + \frac{1}{(\$E\$1)} * 0.75 * F36 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B36-C36	=E35*0.04+E35	=E36*0.04+E36	927.5930605056246	=G35*0.04+G35	=0.65*E36+1.25*F36+2.5*G36					
37	5	=0.009*Giventil7		$\frac{1}{(\$E\$1)} * 0.35 * E37 + \frac{1}{(\$E\$1)} * 0.75 * F37 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B37-C37	=E36*0.04+E36	=E37*0.04+E37	964.696787658498	=G36*0.04+G36	=0.65*E37+1.25*F37+2.5*G37					
38	6	=0.009*Giventil8		$\frac{1}{(\$E\$1)} * 0.35 * E38 + \frac{1}{(\$E\$1)} * 0.75 * F38 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B38-C38	=E37*0.04+E37	=E38*0.04+E38	1003.28465916484	=G37*0.04+G37	=0.65*E38+1.25*F38+2.5*G38					
39	7	=0.009*Giventil9		$\frac{1}{(\$E\$1)} * 0.35 * E39 + \frac{1}{(\$E\$1)} * 0.75 * F39 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B39-C39	=E38*0.04+E38	=E39*0.04+E39	1043.41604659143	=G38*0.04+G38	=0.65*E39+1.25*F39+2.5*G39					
40	8	=0.009*Giventil10		$\frac{1}{(\$E\$1)} * 0.35 * E40 + \frac{1}{(\$E\$1)} * 0.75 * F40 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B40-C40	=E39*0.04+E39	max	1085.15268735269	=G39*0.04+G39	=0.65*E40+1.25*F40+2.5*G40					
41	9	=0.009*Giventil11		$\frac{1}{(\$E\$1)} * 0.35 * E41 + \frac{1}{(\$E\$1)} * 0.75 * F41 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B41-C41	=E40*0.04+E40	max	1128.5587948468	=G40*0.04+G40	=0.65*E41+1.25*F41+2.5*G41					
42	10	=0.009*Giventil12		$\frac{1}{(\$E\$1)} * 0.35 * E42 + \frac{1}{(\$E\$1)} * 0.75 * F42 + \frac{1}{(\$E\$1)} * (\$E\$1 * \$F\$1 + (\$E\$1 * \$F\$1) * \$G\$1)$	=B42-C42	=E41*0.04+E41	max	1173.70114664067	=G41*0.04+G41	=0.65*E42+1.25*F42+2.5*G42					
43			Total Protein available				max	lbs/day product				max			
44															

Appendix D

	I	J	K	L	M	N	O	P	Q	R	S	T
1												
2	a	b	c		exit from 1	waste 1	a	to 2	exit from 2	waste 2	b	to 3
3	=0.35*E3	=0.75*F3	=0.85*G3		=C3*\$E\$1	=C3-M3	=I3	=M3-O3	=P3*\$F\$1	=P3-Q3	=J3	=Q3-S3
4	=0.35*E4	=0.75*F4	=0.85*G4		=C4*\$E\$1	=C4-M4	=I4	=M4-O4	=P4*\$F\$1	=P4-Q4	=J4	=Q4-S4
5	=0.35*E5	=0.75*F5	=0.85*G5		=C5*\$E\$1	=C5-M5	=I5	=M5-O5	=P5*\$F\$1	=P5-Q5	=J5	=Q5-S5
6	=0.35*E6	=0.75*F6	=0.85*G6		=C6*\$E\$1	=C6-M6	=I6	=M6-O6	=P6*\$F\$1	=P6-Q6	=J6	=Q6-S6
7	=0.35*E7	=0.75*F7	=0.85*G7		=C7*\$E\$1	=C7-M7	=I7	=M7-O7	=P7*\$F\$1	=P7-Q7	=J7	=Q7-S7
8	=0.35*E8	=0.75*F8	=0.85*G8		=C8*\$E\$1	=C8-M8	=I8	=M8-O8	=P8*\$F\$1	=P8-Q8	=J8	=Q8-S8
9	=0.35*E9	=0.75*F9	=0.85*G9		=C9*\$E\$1	=C9-M9	=I9	=M9-O9	=P9*\$F\$1	=P9-Q9	=J9	=Q9-S9
10	=0.35*E10	=0.75*F10	=0.85*G10		=C10*\$E\$1	=C10-M10	=I10	=M10-O10	=P10*\$F\$1	=P10-Q10	=J10	=Q10-S10
11	=0.35*E11	=0.75*F11	=0.85*G11		=C11*\$E\$1	=C11-M11	=I11	=M11-O11	=P11*\$F\$1	=P11-Q11	=J11	=Q11-S11
12	=0.35*E12	=0.75*F12	=0.85*G12		=C12*\$E\$1	=C12-M12	=I12	=M12-O12	=P12*\$F\$1	=P12-Q12	=J12	=Q12-S12
13												
14												
15												
16												
17	a	b	c		exit from 1	waste 1	a	to 2	exit from 2	waste 2	b	to 3
18	=0.35*E18	=0.75*F18	=0.85*G18		=C18*\$E\$1	=C18-M18	=I18	=M18-O18	=P18*\$F\$1	=P18-Q18	=J18	=Q18-S18
19	=0.35*E19	=0.75*F19	=0.85*G19		=C19*\$E\$1	=C19-M19	=I19	=M19-O19	=P19*\$F\$1	=P19-Q19	=J19	=Q19-S19
20	=0.35*E20	=0.75*F20	=0.85*G20		=C20*\$E\$1	=C20-M20	=I20	=M20-O20	=P20*\$F\$1	=P20-Q20	=J20	=Q20-S20
21	=0.35*E21	=0.75*F21	=0.85*G21		=C21*\$E\$1	=C21-M21	=I21	=M21-O21	=P21*\$F\$1	=P21-Q21	=J21	=Q21-S21
22	=0.35*E22	=0.75*F22	=0.85*G22		=C22*\$E\$1	=C22-M22	=I22	=M22-O22	=P22*\$F\$1	=P22-Q22	=J22	=Q22-S22
23	=0.35*E23	=0.75*F23	=0.85*G23		=C23*\$E\$1	=C23-M23	=I23	=M23-O23	=P23*\$F\$1	=P23-Q23	=J23	=Q23-S23
24	=0.35*E24	=0.75*F24	=0.85*G24		=C24*\$E\$1	=C24-M24	=I24	=M24-O24	=P24*\$F\$1	=P24-Q24	=J24	=Q24-S24
25	=0.35*E25	=0.75*F25	=0.85*G25		=C25*\$E\$1	=C25-M25	=I25	=M25-O25	=P25*\$F\$1	=P25-Q25	=J25	=Q25-S25
26	=0.35*E26	=0.75*F26	=0.85*G26		=C26*\$E\$1	=C26-M26	=I26	=M26-O26	=P26*\$F\$1	=P26-Q26	=J26	=Q26-S26
27	=0.35*E27	=0.75*F27	=0.85*G27		=C27*\$E\$1	=C27-M27	=I27	=M27-O27	=P27*\$F\$1	=P27-Q27	=J27	=Q27-S27
28												
29												
30												
31												
32	a	b	c		exit from 1	waste 1	a	to 2	exit from 2	waste 2	b	to 3
33	=0.35*E33	=0.75*F33	=0.85*G33		=C33*\$E\$1	=C33-M33	=I33	=M33-O33	=P33*\$F\$1	=P33-Q33	=J33	=Q33-S33
34	=0.35*E34	=0.75*F34	=0.85*G34		=C34*\$E\$1	=C34-M34	=I34	=M34-O34	=P34*\$F\$1	=P34-Q34	=J34	=Q34-S34
35	=0.35*E35	=0.75*F35	=0.85*G35		=C35*\$E\$1	=C35-M35	=I35	=M35-O35	=P35*\$F\$1	=P35-Q35	=J35	=Q35-S35
36	=0.35*E36	=0.75*F36	=0.85*G36		=C36*\$E\$1	=C36-M36	=I36	=M36-O36	=P36*\$F\$1	=P36-Q36	=J36	=Q36-S36
37	=0.35*E37	=0.75*F37	=0.85*G37		=C37*\$E\$1	=C37-M37	=I37	=M37-O37	=P37*\$F\$1	=P37-Q37	=J37	=Q37-S37
38	=0.35*E38	=0.75*F38	=0.85*G38		=C38*\$E\$1	=C38-M38	=I38	=M38-O38	=P38*\$F\$1	=P38-Q38	=J38	=Q38-S38
39	=0.35*E39	=0.75*F39	=0.85*G39		=C39*\$E\$1	=C39-M39	=I39	=M39-O39	=P39*\$F\$1	=P39-Q39	=J39	=Q39-S39
40	=0.35*E40	=0.75*F40	=0.85*G40		=C40*\$E\$1	=C40-M40	=I40	=M40-O40	=P40*\$F\$1	=P40-Q40	=J40	=Q40-S40
41	=0.35*E41	=0.75*F41	=0.85*G41		=C41*\$E\$1	=C41-M41	=I41	=M41-O41	=P41*\$F\$1	=P41-Q41	=J41	=Q41-S41
42	=0.35*E42	=0.75*F42	=0.85*G42		=C42*\$E\$1	=C42-M42	=I42	=M42-O42	=P42*\$F\$1	=P42-Q42	=J42	=Q42-S42
43												
44												

Appendix D

	U	V	W	X	Y	Z
1						
2	exit from 3	waste 3	A	lbs/day product flow to 2		B
3	=T3*\$G\$1	=T3-U3	=O3/0.35			=S3/0.75
4	=T4*\$G\$1	=T4-U4				
5	=T5*\$G\$1	=T5-U5				
6	=T6*\$G\$1	=T6-U6				
7	=T7*\$G\$1	=T7-U7				
8	=T8*\$G\$1	=T8-U8				
9	=T9*\$G\$1	=T9-U9				
10	=T10*\$G\$1	=T10-U10				
11	=T11*\$G\$1	=T11-U11				
12	=T12*\$G\$1	=T12-U12				
13						
14						
15						
16				lbs/day product flow to 2		B
17	exit from 3	waste 3	A	lbs/day product flow to 2		B
18	=T18*\$G\$1	=T18-U18	=O18/0.35			=S18/0.75
19	=T19*\$G\$1	=T19-U19				
20	=T20*\$G\$1	=T20-U20				
21	=T21*\$G\$1	=T21-U21				
22	=T22*\$G\$1	=T22-U22				
23	=T23*\$G\$1	=T23-U23				
24	=T24*\$G\$1	=T24-U24				
25	=T25*\$G\$1	=T25-U25				
26	=T26*\$G\$1	=T26-U26				
27	=T27*\$G\$1	=T27-U27				
28						
29						
30						
31				lbs/day product flow to 2		B
32	exit from 3	waste 3	A	lbs/day product flow to 2		B
33	=T33*\$G\$1	=T33-U33	=O33/0.35			=S33/0.75
34	=T34*\$G\$1	=T34-U34				
35	=T35*\$G\$1	=T35-U35				
36	=T36*\$G\$1	=T36-U36				
37	=T37*\$G\$1	=T37-U37				
38	=T38*\$G\$1	=T38-U38				
39	=T39*\$G\$1	=T39-U39				
40	=T40*\$G\$1	=T40-U40				
41	=T41*\$G\$1	=T41-U41				
42	=T42*\$G\$1	=T42-U42				
43						
44						



A		B		C		D	
1. NOT UPDATED FOR CORRECTED CP		1 Stage		2 Stages		3 Stages	
1							
2							
3	1 Diafiltration						
4	Solin Feed (gpd)	=max35%:B58-2*maxA  \$E\$23					
5	Water Added (gpd)	50487.32368141889					
6	Total Feed (gpd)	=B5+B4					
7	CF, D1	=B6/B4					
8	Concentrations						
9	True Protein	=max35%:B70*1/((B56/B54)*1-Given:\$F5)+Given:\$F5)/(\$B\$3)					
10	Non-Protein Nitrogen	=max35%:B71*1/((B56/B54)*1-Given:\$F6)+Given:\$F6)/(\$B\$3)					
11	Lactose	=max35%:B72*1/((B56/B54)*1-Given:\$F7)+Given:\$F7)/(\$B\$3)					
12	Ash	=max35%:B73*1/((B56/B54)*1-Given:\$F8)+Given:\$F8)/(\$B\$3)					
13	Butter Fat	=max35%:B74*1/((B56/B54)*1-Given:\$F9)+Given:\$F9)/(\$B\$3)					
14	Total Protein (dry weight)	=(B9+B10)/SUM(B9:B13)					
15	Yield	=(B9+B10)*B4/((max35%:B\$70+max35%:B\$71)*B\$4)					
16	Area/stage	=B5/(27.9-5.3*LN(B7))/B3					
17	Cartridges/stage	=B16/26.5					
18	Max Flow Rate (gpm)	=23*B17+B6/(20*60)					
19	2 Diafiltration	14911.567974298					
20	Water Added/Stage (gpd)	=B20+B4					
21	Total Feed (gpd)	=(B4+B20)/B\$4					
22	CF, D1						
23	Concentrations						
24	True Protein	=max35%:B70*1/((B\$4+B\$20)/B\$4)*1-Given:\$F5)+Given:\$F5)/(\$B\$19)					
25	Non-Protein Nitrogen	=max35%:B71*1/((B\$4+B\$20)/B\$4)*1-Given:\$F6)+Given:\$F6)/(\$B\$19)					
26	Lactose	=max35%:B72*1/((B\$4+B\$20)/B\$4)*1-Given:\$F7)+Given:\$F7)/(\$B\$19)					
27	Ash	=max35%:B73*1/((B\$4+B\$20)/B\$4)*1-Given:\$F8)+Given:\$F8)/(\$B\$19)					
28	Butter Fat	=max35%:B74*1/((B\$4+B\$20)/B\$4)*1-Given:\$F9)+Given:\$F9)/(\$B\$19)					
29	Total Protein (dry weight)	=(B24+B25)/SUM(B24:B28)					
30	Yield	=(B24+B25)*B4/((max35%:B\$70+max35%:B\$71)*B\$4)					
31	Area/stage	=B20/(27.9-5.3*LN(B22))/B19					
32	Cartridges/stage	=B31/26.5					
33	Max Flow Rate (gpm)	=23*B32+B2/(20*60)					
34	3 Diafiltration	7757.3778113997					
35	Water Added	=B33+B4					
36	Total Feed	=(B35+B4)/B\$4					
37	CF, D2						
38	Concentrations						
39	True Protein	=max35%:B70*1/((B\$4+B\$35)/B\$4)*1-Given:\$F5)+Given:\$F5)/(\$B\$34)					
40	Non-Protein Nitrogen	=max35%:B71*1/((B\$4+B\$35)/B\$4)*1-Given:\$F6)+Given:\$F6)/(\$B\$34)					
41	Lactose	=max35%:B72*1/((B\$4+B\$35)/B\$4)*1-Given:\$F7)+Given:\$F7)/(\$B\$34)					
42	Ash	=max35%:B73*1/((B\$4+B\$35)/B\$4)*1-Given:\$F8)+Given:\$F8)/(\$B\$34)					
43	Butter Fat	=max35%:B74*1/((B\$4+B\$35)/B\$4)*1-Given:\$F9)+Given:\$F9)/(\$B\$34)					
44	Total Protein (dry weight)	=(B39+B40)/SUM(B39:B43)					
45	Yield	=(B39+B40)*B4/((max35%:B\$70+max35%:B\$71)*B\$4)					
46	Area/stage	=B35/(27.9-5.3*LN(B37))/B34					
47	Cartridges/stage	=B45/26.5					
48	Max Flow Rate (gpm)	=23*B47+B36/(20*60)					



	H	I	J
1			
2			
3			
4	=max35%*H58-2*maxAllI\$E\$23		
5	103111.868866638		
6	=H5+H4		
7	=H6/H4		
8			
9	=max35%*H70*(1/(H58+H54)*(1-Given\$F5)+Given\$F5)+Given\$F5)*(\$B\$3)		
10	=max35%*H71*(1/(H56+H54)*(1-Given\$F6)+Given\$F6)+Given\$F6)*(\$B\$3)		
11	=max35%*H72*(1/(H56+H54)*(1-Given\$F7)+Given\$F7)+Given\$F7)*(\$B\$3)		
12	=max35%*H73*(1/(H56+H54)*(1-Given\$F8)+Given\$F8)+Given\$F8)*(\$B\$3)		
13	=max35%*H74*(1/(H56+H54)*(1-Given\$F9)+Given\$F9)+Given\$F9)*(\$B\$3)		
14	=(H9+H10)/SUM(H9:H13)		
15	=(H9+H10)*H4/(max35%*H570+max35%*H571)*H54		
16	=H5/(27.9-5.3*L*N(17))/\$B3		
17	=H6/26.5		
18	=23*H7+H6/(20*60)		
19			
20	17761.2554343204		
21	=H20+H4		
22	=(H4+H20)/H4		
23			
24	=max35%*H70*(1/(H54+H520)/H54*(1-Given\$F5)+Given\$F5)+Given\$F5)*(\$B\$19)		
25	=max35%*H71*(1/(H54+H520)/H54*(1-Given\$F6)+Given\$F6)+Given\$F6)*(\$B\$19)		
26	=max35%*H72*(1/(H54+H520)/H54*(1-Given\$F7)+Given\$F7)+Given\$F7)*(\$B\$19)		
27	=max35%*H73*(1/(H54+H520)/H54*(1-Given\$F8)+Given\$F8)+Given\$F8)*(\$B\$19)		
28	=max35%*H74*(1/(H54+H520)/H54*(1-Given\$F9)+Given\$F9)+Given\$F9)*(\$B\$19)		
29	=(H24+H25)/SUM(H24:H28)		
30	=(H24+H25)*H4/(max35%*H570+max35%*H571)*H54		
31	=H20/(27.9-5.3*L*N(H22))/\$B19		
32	=H31/26.5		
33	=23*H32+H21/(20*60)		
34			
35	9238.36022174423		
36	=H35+H4		
37	=(H35+H4)/H4		
38			
39	=max35%*H70*(1/(H54+H535)/H54*(1-Given\$F5)+Given\$F5)+Given\$F5)*(\$B\$34)		
40	=max35%*H71*(1/(H54+H535)/H54*(1-Given\$F6)+Given\$F6)+Given\$F6)*(\$B\$34)		
41	=max35%*H72*(1/(H54+H535)/H54*(1-Given\$F7)+Given\$F7)+Given\$F7)*(\$B\$34)		
42	=max35%*H73*(1/(H54+H535)/H54*(1-Given\$F8)+Given\$F8)+Given\$F8)*(\$B\$34)		
43	=max35%*H74*(1/(H54+H535)/H54*(1-Given\$F9)+Given\$F9)+Given\$F9)*(\$B\$34)		
44	=(H39+H40)/SUM(H39:H43)		
45	=(H39+H40)*H4/(max35%*H570+max35%*H571)*H54		
46	=H35/(27.9-5.3*L*N(H37))/\$B34		
47	=H46/26.5		
48	=23*H47+H36/(20*60)		
9 Stages			
8 Stages			
7 Stages			
6 Stages			
5 Stages			
4 Stages			
3 Stages			
2 Stages			
1 Stage			

	K	L	M
1			
2			
3	10 Stages		
4	=max35%IK58-2maxAllISE\$23		
5	103281.379551814		
6	=K5+K4		
7	=K6/K4		
8			
9	=max35%IK70*1/((K56/K\$4)*(1-Given(\$F5)+Given(\$F5))^((\$B\$3))		
10	=max35%IK71*1/((K56/K\$4)*(1-Given(\$F6)+Given(\$F6))^((\$B\$3))		
11	=max35%IK72*1/((K56/K\$4)*(1-Given(\$F7)+Given(\$F7))^((\$B\$3))		
12	=max35%IK73*1/((K56/K\$4)*(1-Given(\$F8)+Given(\$F8))^((\$B\$3))		
13	=max35%IK74*1/((K56/K\$4)*(1-Given(\$F9)+Given(\$F9))^((\$B\$3))		
14	=(K9+K10)/SUM(K9:K13)		
15	=(K9+K10)*K4/((max35%IK\$70+max35%IK\$71)*K\$4)		
16	=K5/(27.9-5.3*LN(K7))/\$B3		
17	=K16/26.5		
18	=23*K17+K9/(20^60)		
19			
20	17776.3584732852		
21	=K20+K4		
22	=(K4+K20)/K\$4		
23			
24	=max35%IK70*1/((K\$4+K\$20)/K\$4)*(1-Given(\$F5)+Given(\$F5))^((\$B\$19)		
25	=max35%IK71*1/((K\$4+K\$20)/K\$4)*(1-Given(\$F6)+Given(\$F6))^((\$B\$19)		
26	=max35%IK72*1/((K\$4+K\$20)/K\$4)*(1-Given(\$F7)+Given(\$F7))^((\$B\$19)		
27	=max35%IK73*1/((K\$4+K\$20)/K\$4)*(1-Given(\$F8)+Given(\$F8))^((\$B\$19)		
28	=max35%IK74*1/((K\$4+K\$20)/K\$4)*(1-Given(\$F9)+Given(\$F9))^((\$B\$19)		
29	=(K24+K25)/SUM(K24:K28)		
30	=(K24+K25)*K4/((max35%IK\$70+max35%IK\$71)*K\$4)		
31	=K20/(27.9-5.3*LN(K22))/\$B19		
32	=K31/26.5		
33	=23*K32+K21/(20^60)		
34			
35	9275.7525123147		
36	=K35+K4		
37	=(K35+K4)/K\$4		
38			
39	=max35%IK70*1/((K\$4+K\$35)/K\$4)*(1-Given(\$F5)+Given(\$F5))^((\$B\$34)		
40	=max35%IK71*1/((K\$4+K\$35)/K\$4)*(1-Given(\$F6)+Given(\$F6))^((\$B\$34)		
41	=max35%IK72*1/((K\$4+K\$35)/K\$4)*(1-Given(\$F7)+Given(\$F7))^((\$B\$34)		
42	=max35%IK73*1/((K\$4+K\$35)/K\$4)*(1-Given(\$F8)+Given(\$F8))^((\$B\$34)		
43	=max35%IK74*1/((K\$4+K\$35)/K\$4)*(1-Given(\$F9)+Given(\$F9))^((\$B\$34)		
44	=(K39+K40)/SUM(K39:K43)		
45	=(K39+K40)*K\$4/((max35%IK\$70+max35%IK\$71)*K\$4)		
46	=K35/(27.9-5.3*LN(K37))/\$B34		
47	=K46/26.5		
48	=23*K47+K36/(20^60)		

A		B		C		D		E		F		G		H	
Year	Stream	Year	Stream	Year	Stream	Year	Stream	Year	Stream	Year	Stream	Year	Stream	Year	Stream
1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Stream Number	Description	Stream Number	Description	Stream Number	Description	Stream Number	Description	Stream Number	Description	Stream Number	Description	Stream Number	Description	Stream Number	Description
Component		Component		Component		Component		Component		Component		Component		Component	
5	lbs/day	B512*B19	=C512*C18	=B6-C6	=E512*E19	=F6-E6	=H512*H19	=G6-E6							
6	True Protein	=B512*B20	=C512*C20	=B7-C7	=E512*E20	=F7-E7	=H512*H20	=G7-E7							
7	Non-Protein Nitrogen	=B512*B21	=C512*C21	=B8-C8	=E512*E21	=F8-E8	=H512*H21	=G8-E8							
8	Lactose	=B512*B22	=C512*C22	=B9-C9	=E512*E22	=F9-E9	=H512*H22	=G9-E9							
9	Ash	=B512*B23	=C512*C23	=B10-C10	=E512*E23	=F10-E10	=H512*H23	=G10-E10							
10	Butter Fat	=B512*B24	=C512*C24	=B11-C11	=E512*E24	=F11-E11	=H512*H24	=G11-E11							
11	Water	=B512*B24	=C512*C24	=B12-C12	=E512*E24	=F12-E12	=H512*H24	=G12-E12							
12	Total	=B512*B24	=C512*C24	=B12-C12	=E512*E24	=F12-E12	=H512*H24	=G12-E12							
13	Total Solids	=B512*B24	=C512*C24	=B12-C12	=E512*E24	=F12-E12	=H512*H24	=G12-E12							
14	Total	=B512*B24	=C512*C24	=B12-C12	=E512*E24	=F12-E12	=H512*H24	=G12-E12							
15	gal/day	B12*B8.5	=10years*B14	=B16-C16	=10years*B19	=C16-E16	=G12*B8.5	=10years*B24							
16	Mass %														
17	True Protein														
18	Non-Protein Nitrogen														
19	Lactose														
20	Ash														
21	Butter Fat														
22	Water														
23	Total														
24	Total Solids														
25	Total														
26	% Solids														
27	% Protein of Solids														
28	% Protein of Solids														
29	Year 2														
30	Stream Number														
31	Description														
32	Component														
33	lbs/day	B542*B49	=C542*C49	=B36-C36	=E542*E49	=F36-E36	=H542*H49	=G36-E36							
34	True Protein	=B542*B50	=C542*C50	=B37-C37	=E542*E50	=F37-E37	=H542*H50	=G37-E37							
35	Non-Protein Nitrogen	=B542*B51	=C542*C51	=B38-C38	=E542*E51	=F38-E38	=H542*H51	=G38-E38							
36	Lactose	=B542*B52	=C542*C52	=B39-C39	=E542*E52	=F39-E39	=H542*H52	=G39-E39							
37	Ash	=B542*B53	=C542*C53	=B40-C40	=E542*E53	=F40-E40	=H542*H53	=G40-E40							
38	Butter Fat	=B542*B54	=C542*C54	=B41-C41	=E542*E54	=F41-E41	=H542*H54	=G41-E41							
39	Water	=B542*B54	=C542*C54	=B42-C42	=E542*E54	=F42-E42	=H542*H54	=G42-E42							
40	Total	=B542*B54	=C542*C54	=B42-C42	=E542*E54	=F42-E42	=H542*H54	=G42-E42							
41	Total Solids	=B542*B54	=C542*C54	=B42-C42	=E542*E54	=F42-E42	=H542*H54	=G42-E42							
42	Total	=B542*B54	=C542*C54	=B42-C42	=E542*E54	=F42-E42	=H542*H54	=G42-E42							
43	gal/day	B42*B8.5	=10years*BC314	=B46-C46	=10years*IC19	=C46-E46	=G42*B8.5	=10years*IC24							
44	Mass %														
45	True Protein														
46	Non-Protein Nitrogen														
47	Lactose														
48	Ash														
49	Butter Fat														
50	Water														
51	Total														
52	Total Solids														
53	Total														
54	% Solids														
55	% Protein of Solids														
56	Year 3														
57	Stream Number														
58	Description														
59	Component														
60	lbs/day	B572*B79	=C572*C79	=B66-C66	=E572*E79	=F66-E66	=H572*H79	=G66-E66							
61	True Protein	=B572*B80	=C572*C80	=B67-C67	=E572*E80	=F67-E67	=H572*H80	=G67-E67							
62	Non-Protein Nitrogen	=B572*B81	=C572*C81	=B68-C68	=E572*E81	=F68-E68	=H572*H81	=G68-E68							
63	Lactose	=B572*B82	=C572*C82	=B69-C69	=E572*E82	=F69-E69	=H572*H82	=G69-E69							
64	Ash	=B572*B83	=C572*C83	=B70-C70	=E572*E83	=F70-E70	=H572*H83	=G70-E70							
65	Butter Fat	=B572*B84	=C572*C84	=B71-C71	=E572*E84	=F71-E71	=H572*H84	=G71-E71							
66	Water	=B572*B84	=C572*C84	=B72-C72	=E572*E84	=F72-E72	=H572*H84	=G72-E72							
67	Total	=B572*B84	=C572*C84	=B72-C72	=E572*E84	=F72-E72	=H572*H84	=G72-E72							
68	Total Solids	=B572*B84	=C572*C84	=B72-C72	=E572*E84	=F72-E72	=H572*H84	=G72-E72							
69	Total	=B572*B84	=C572*C84	=B72-C72	=E572*E84	=F72-E72	=H572*H84	=G72-E72							
70	gal/day	B72*B8.5	=10years*ID14	=B76-C76	=10years*ID19	=C76-E76	=G72*B8.5	=10years*ID24							
71	Mass %														
72	True Protein														
73	Non-Protein Nitrogen														
74	Lactose														
75	Ash														
76	Butter Fat														
77	Water														
78	Total														
79	Total Solids														
80	Total														
81	% Solids														
82	% Protein of Solids														
83	Year 3														
84	Stream Number														
85	Description														
86	Component														
87	lbs/day	B598*B37	=C337*C37	=D38-C38	=E338+E37	=F38-E38	=H338+H37	=G337+C37							
88	True Protein	=B598*B38	=C337*C38	=D39-C39	=E338+E37	=F39-E39	=H338+H37	=G337+C38							
89	Non-Protein Nitrogen	=B598*B39	=C337*C39	=D40-C40	=E338+E37	=F40-E40	=H338+H37	=G337+C39							
90	Lactose	=B598*B40	=C337*C40	=D41-C41	=E338+E37	=F41-E41	=H338+H37	=G337+C40							
91	Ash	=B598*B41	=C337*C41	=D42-C42	=E338+E37	=F42-E42	=H338+H37	=G337+C41							
92	Butter Fat	=B598*B42	=C337*C42	=D43-C43	=E338+E37	=F43-E43	=H338+H37	=G337+C42							
93	Water	=B598*B42	=C337*C42	=D44-C44	=E338+E37	=F44-E44	=H338+H37	=G337+C43							
94	Total	=B598*B42	=C337*C42	=D44-C44	=E338+E37	=F44-E44	=H338+H37	=G337+C44							
95	Total Solids	=B598*B42	=C337*C42	=D44-C44	=E338+E37	=F44-E44	=H338+H37	=G337+C45							
96	Total	=B598*B42	=C337*C42	=D44-C44	=E338+E37	=F44-E44	=H338+H37	=G337+C46							
97	% Solids														
98	% Protein of Solids														
99	Year 3														
100	Stream Number														
101	Description														
102	Component														
103	lbs/day	B684*B36	=C366*C36	=D36-C36	=E366+E36	=F36-E36	=H366+H36	=G366+E36							
104	True Protein	=B684*B37	=C366*C37	=D37-C37	=E366+E36	=F37-E37	=H366+H36	=G366+E37							
105	Non-Protein Nitrogen	=B684*B38	=C366*C38	=D38-C38	=E366+E36	=F38-E38	=H366+H36	=G366+E38							
106	Lactose	=B684*B39	=C366*C39	=D39-C39	=E366+E36	=F39-E39	=H366+H36	=G366+E39							
107	Ash	=B684*B40	=C366*C40	=D40-C40	=E366+E36	=F40-E40	=H366+H36	=G366+E40							
108	Butter Fat	=B684*B41	=C366*C41	=D41-C41	=E366+E36	=F41-E41	=H366+H36	=G366+E41							
109	Water	=B684*B41	=C366*C41	=D42-C42	=E366+E36	=F42-E42	=H366+H36	=G366+E42							
110	Total	=B684*B41	=C366*C41	=D42-C42	=E366+E36	=F42-E42	=H366+H36	=G366+E43							
111	Total Solids	=B684*B41	=C366*C41	=D42-C42	=E366+E36	=F42-E42	=H366+H36	=G366+E44							
112	Total	=B684*B41	=C366*C41	=D42-C42	=E366+E36	=F42-E42	=H366+H36	=G366+E45							
113	% Solids														
114	% Protein of Solids														
115	Year 3														
116	Stream Number														
117	Description														
118	Component														
119	lbs/day	B684*B36	=C366*C36	=D36-C36	=E366+E36	=F36-E36	=H684*B36	=G366+E36							
120	True Protein	=B684*B37	=C366*C37	=D37-C37	=E366+E36	=F37-E37	=H684*B37	=G366+E37							
121	Non-Protein Nitrogen	=B684*B38	=C366*C38	=D38-C38	=E366+E36	=F38-E38	=H684*B38	=G366+E38							
122	Lactose	=B684*B39	=C366*C39	=D39-C39	=E366+E36	=F39-E39	=H684*B39	=G366+E39							
123	Ash														

Appendix D

A	B	C	D	E	F	G	H
77	Mass %						
78	True Protein	=10years IO24	=D66/D572	=10years IP24	=F69/F572	=G66/G572	=10years IO24
79	Non-Protein Nitrogen	=10years IO25	=D67/D572	=10years IP25	=F67/F572	=G67/G572	=10years IO25
80	Lactose	=10years IO26	=D68/D572	=10years IP26	=F68/F572	=G68/G572	=10years IO26
81	Ash	=10years IO27	=D69/D572	=10years IP27	=F69/F572	=G69/G572	=10years IO27
82	Butter Fat	=10years IO28	=D70/D572	=10years IP28	=F70/F572	=G70/G572	=10years IO28
83	Water	=1-SUM(B78:B83)	=D71/D572	=1-SUM(E78:E83)	=F71/F572	=G71/G572	=1-SUM(H78:H83)
84	Total	1		1			1
85	% Solids	=SUM(C66:C70)/C72	=SUM(D66:D70)/D72	=SUM(E66:E70)/E72	=SUM(F66:F70)/F72	=SUM(G66:G70)/G72	=SUM(H66:H70)/H72
86	% Protein of Solids	=SUM(C66+C67)/SUM(C66:C70)	=SUM(D66+D67)/SUM(D66:D70)	=SUM(E66+E67)/SUM(E66:E70)	=SUM(F66+F67)/SUM(F66:F70)	=SUM(G66+G67)/SUM(G66:G70)	=SUM(H66+H67)/SUM(H66:H70)
87	Year 4						
88	Stream Description						
89	Stream Number						
90	Component						
91	lbs/day						
92	True Protein	=B\$102*B109	=B88-C86	=E\$102*E109	=C88-E86	=F96-D86	=H\$102*H109
93	Non-Protein Nitrogen	=B\$102*B110	=B87-C87	=E\$102*E110	=C87-E87	=F97-D87	=H\$102*H110
94	Lactose	=B\$102*B111	=B88-C88	=E\$102*E111	=C88-E88	=F98-D88	=H\$102*H111
95	Ash	=B\$102*B112	=B89-C89	=E\$102*E112	=C89-E89	=F99-D89	=H\$102*H112
96	Butter Fat	=B\$102*B113	=B100-C100	=E\$102*E113	=C100-E100	=F100+D100	=H\$102*H113
97	Water	=B\$102*B114	=B101-C101	=E\$102*E114	=C101-E101	=F101+D101	=H\$102*H114
98	Total	=SUM(B109:B114)	=B102-C102	=E106*8.5	=C102-E102	=F102+D102	=H106*8.5
99	Total Solids	=SUM(C96:C100)	=SUM(D96:D100)	=SUM(E96:E100)	=SUM(F96:F100)	=SUM(G96:G100)	=SUM(H96:H100)
100	gal/day						
101	Total	=B102/8.5	=B106-C106	=E10years IE19	=C106-E106	=G102/8.5	=E10years IE24
102	Mass %						
103	True Protein	=10years IO33	=D96/D5102	=10years IP33	=F96/F5102	=G96/G5102	=10years IO33
104	Non-Protein Nitrogen	=10years IO34	=D97/D5102	=10years IP34	=F97/F5102	=G97/G5102	=10years IO34
105	Lactose	=10years IO35	=D98/D5102	=10years IP35	=F98/F5102	=G98/G5102	=10years IO35
106	Ash	=10years IO36	=D99/D5102	=10years IP36	=F99/F5102	=G99/G5102	=10years IO36
107	Butter Fat	=10years IO37	=D100/D5102	=10years IP37	=F100/F5102	=G100/G5102	=10years IO37
108	Water	=1-SUM(B109:B113)	=D101/D5102	=1-SUM(E109:E113)	=F101/F5102	=G101/G5102	=1-SUM(H109:H113)
109	Total	1		1			1
110	% Solids	=SUM(C96:C100)/C102	=SUM(D96:D100)/D102	=SUM(E96:E100)/E102	=SUM(F96:F100)/F102	=SUM(G96:G100)/G102	=SUM(H96:H100)/H102
111	% Protein of Solids	=SUM(C96+C97)/SUM(C96:C100)	=SUM(D96+D97)/SUM(D96:D100)	=SUM(E96+E97)/SUM(E96:E100)	=SUM(F96+F97)/SUM(F96:F100)	=SUM(G96+G97)/SUM(G96:G100)	=SUM(H96+H97)/SUM(H96:H100)
112	Year 5						
113	Stream Description						
114	Stream Number						
115	Component						
116	lbs/day						
117	True Protein	=B\$132*B139	=B126-C126	=E\$132*E139	=C126-E126	=F126+D126	=H\$132*H139
118	Non-Protein Nitrogen	=B\$132*B140	=B127-C127	=E\$132*E140	=C127-E127	=F127+D127	=H\$132*H140
119	Lactose	=B\$132*B141	=B128-C128	=E\$132*E141	=C128-E128	=F128+D128	=H\$132*H141
120	Ash	=B\$132*B142	=B129-C129	=E\$132*E142	=C129-E129	=F129+D129	=H\$132*H142
121	Butter Fat	=B\$132*B143	=B130-C130	=E\$132*E143	=C130-E130	=F130+D130	=H\$132*H143
122	Water	=B\$132*B144	=B131-C131	=E\$132*E144	=C131-E131	=F131+D131	=H\$132*H144
123	Total	=SUM(B139:B144)	=B132-C132	=E136*8.5	=C132-E132	=F132+D132	=H136*8.5
124	Total Solids	=SUM(C126:C130)	=SUM(D126:D130)	=SUM(E126:E130)	=SUM(F126:F130)	=SUM(G126:G130)	=SUM(H126:H130)
125	gal/day						
126	Total	=B132/8.5	=B136-C136	=E10years IF19	=C136-E136	=G132/8.5	=E10years IF24
127	Mass %						
128	True Protein	=10years IO42	=D126/D5132	=10years IP42	=F126/F5132	=G126/G5132	=10years IO42
129	Non-Protein Nitrogen	=10years IO43	=D127/D5132	=10years IP43	=F127/F5132	=G127/G5132	=10years IO43
130	Lactose	=10years IO44	=D128/D5132	=10years IP44	=F128/F5132	=G128/G5132	=10years IO44
131	Ash	=10years IO45	=D129/D5132	=10years IP45	=F129/F5132	=G129/G5132	=10years IO45
132	Butter Fat	=10years IO46	=D130/D5132	=10years IP46	=F130/F5132	=G130/G5132	=10years IO46
133	Water	=1-SUM(B139:B143)	=D131/D5132	=1-SUM(E139:E143)	=F131/F5132	=G131/G5132	=1-SUM(H139:H143)
134	Total	1		1			1
135	% Solids	=SUM(C126:C130)/C132	=SUM(D126:D130)/D132	=SUM(E126:E130)/E132	=SUM(F126:F130)/F132	=SUM(G126:G130)/G132	=SUM(H126:H130)/H132
136	% Protein of Solids	=SUM(C126+C127)/SUM(C126:C130)	=SUM(D126+D127)/SUM(D126:D130)	=SUM(E126+E127)/SUM(E126:E130)	=SUM(F126+F127)/SUM(F126:F130)	=SUM(G126+G127)/SUM(G126:G130)	=SUM(H126+H127)/SUM(H126:H130)
137	Year 6						
138	Stream Description						
139	Stream Number						
140	Component						
141	lbs/day						
142	True Protein						
143	Non-Protein Nitrogen						
144	Lactose						
145	Ash						
146	Butter Fat						
147	Water						
148	Total						
149	Total Solids						
150	gal/day						
151	Total						
152	Stream Description						

Appendix D

A	B	C	D	E	F	G	H
153 Stream Number							
154 Component							
155 lbs/day							
156 True Protein	=BS162/B169	=C3162/C169	=B156-C166	=E3162/E169	=C155-E156	=F156-D155	=H162-H169
157 Non-Protein Nitrogen	=BS162/B170	=C3162/C170	=B157-C157	=E3162/E170	=C157-E157	=F157-D157	=H162-H170
158 Lactose	=BS162/B171	=C3162/C171	=B159-C168	=E3162/E171	=C158-E158	=F158-D158	=H162-H171
159 Ash	=BS162/B172	=C3162/C172	=B159-C168	=E3162/E172	=C159-E159	=F159-D159	=H162-H172
160 Butter Fat	=BS162/B173	=C3162/C173	=B160-C180	=E3162/E173	=C160-E160	=F160-D160	=H162-H173
161 Water	=BS162/B174	=C3162/C174	=B161-C181	=E3162/E174	=C161-E161	=F161-D161	=H162-H174
162 Total	=GIVEN/8.5	=C166*8.5	=B162-C162	=E168*8.5	=C162-E162	=F162-D162	=H166*8.5
163 Total Solids	=SUM(B166:B160)	=SUM(C156:C160)	=SUM(D156:D160)	=SUM(E156:E160)	=SUM(F156:F160)	=SUM(G163:G168)	=SUM(H156:H180)
164 gal/day							
165 Total		=10years/G14	=B165-C165	=E10years/G19	=C166-E166	=G162/G8.5	=10years/G24
166 Mass %							
167 True Protein		=10years/AF8	=D156/D162	=E10years/AG8	=F159/F162	=G158/G162	=10years/AH6
168 Non-Protein Nitrogen		=10years/AF7	=D157/D162	=E10years/AG7	=F157/F162	=G157/G162	=10years/AH7
169 Lactose		=10years/AF8	=D158/D162	=E10years/AG8	=F159/F162	=G159/G162	=10years/AH8
170 Ash		=10years/AF9	=D160/D162	=E10years/AG10	=F160/F162	=G160/G162	=10years/AH10
171 Butter Fat		=1-SUM(C169:C173)	=D162/D162	=E1-SUM(E168:E173)	=F162/F162	=G162/G162	=1-SUM(H169:H173)
172 Water		=SUM(B166:B174)					
173 Total Solids							
174 % Solids		=SUM(C156:C160)/C162	=SUM(D156:D160)/D162	=SUM(E156:E160)/E162	=SUM(F156:F160)/F162	=SUM(G163:G168)/G162	=SUM(H156:H180)/H182
175 % Protein of Solids		=SUM(C156:C173)/SUM(C156:C160)	=SUM(D156:D167)/SUM(D156:D160)	=SUM(E156:E167)/SUM(E156:E160)	=SUM(F156:F167)/SUM(F156:F160)	=SUM(G156:G167)/SUM(G156:G160)	=SUM(H156:H167)/SUM(H156:H160)
176							
177							
178							
179							
180							
181 Year 7							
182 Stream Description							
183 Stream Number							
184 Component							
185 lbs/day							
186 True Protein	=BS192/B189	=C3192/C189	=B186-C186	=E3192/E189	=C185-E186	=F186-D186	=H192-H189
187 Non-Protein Nitrogen	=BS192/B200	=C3192/C200	=B187-C187	=E3192/E200	=C187-E187	=F187-D187	=H192-H200
188 Lactose	=BS192/B201	=C3192/C201	=B188-C188	=E3192/E201	=C188-E188	=F188-D188	=H192-H201
189 Ash	=BS192/B202	=C3192/C202	=B189-C190	=E3192/E202	=C189-E189	=F189-D189	=H192-H202
190 Butter Fat	=BS192/B203	=C3192/C203	=B190-C191	=E3192/E203	=C190-E190	=F190-D190	=H192-H203
191 Water	=BS192/B204	=C3192/C204	=B191-C191	=E3192/E204	=C191-E191	=F191-D191	=H192-H204
192 Total	=GIVEN/8.5	=C196*8.5	=B192-C192	=E196*8.5	=C192-E192	=F192-D192	=H196*8.5
193 Total Solids	=SUM(B186:B190)	=SUM(C186:C190)	=SUM(D186:D190)	=SUM(E186:E190)	=SUM(F186:F190)	=SUM(G193:G193)	=SUM(H186:H190)
194 gal/day							
195 Total		=10years/IH14	=B193-C186	=E10years/IH19	=C196-E196	=G192/G8.5	=10years/IH24
196 Mass %							
197 True Protein		=10years/AF15	=D186/D192	=E10years/AG15	=F185/F192	=G186/G192	=10years/AH15
198 Non-Protein Nitrogen		=10years/AF16	=D187/D192	=E10years/AG16	=F187/F192	=G187/G192	=10years/AH16
199 Lactose		=10years/AF17	=D188/D192	=E10years/AG17	=F189/F192	=G188/G192	=10years/AH17
200 Ash		=10years/AF18	=D189/D192	=E10years/AG18	=F190/F192	=G189/G192	=10years/AH18
201 Butter Fat		=1-SUM(C199:C203)	=D190/D192	=E1-SUM(E198:E203)	=F190/F192	=G190/G192	=1-SUM(H199:H203)
202 Water		=SUM(B196:B204)					
203 Total Solids							
204 % Solids		=SUM(C186:C190)/C192	=SUM(D186:D190)/D192	=SUM(E186:E190)/E192	=SUM(F186:F190)/F192	=SUM(G186:G190)/G192	=SUM(H186:H190)/H192
205 % Protein of Solids		=SUM(C186:C203)/SUM(C186:C190)	=SUM(D186:D203)/SUM(D186:D190)	=SUM(E186:E203)/SUM(E186:E190)	=SUM(F186:F203)/SUM(F186:F190)	=SUM(G186:G203)/SUM(G186:G190)	=SUM(H186:H203)/SUM(H186:H190)
206							
207							
208							
209							
210							
211 Year 8							
212 Stream Description							
213 Stream Number							
214 Component							
215 lbs/day							
216 True Protein	=BS222/B229	=C3222/C229	=B216-C216	=E3222/E229	=C216-E216	=F216-D216	=H222*H229
217 Non-Protein Nitrogen	=BS222/B230	=C3222/C230	=B217-C217	=E3222/E230	=C217-E217	=F217-D217	=H222*H230
218 Lactose	=BS222/B231	=C3222/C231	=B218-C218	=E3222/E231	=C218-E218	=F218-D218	=H222*H231
219 Ash	=BS222/B232	=C3222/C232	=B219-C219	=E3222/E232	=C219-E219	=F219-D219	=H222*H232
220 Butter Fat	=BS222/B233	=C3222/C233	=B220-C220	=E3222/E233	=C220-E220	=F220-D220	=H222*H233
221 Water	=BS222/B234	=C3222/C234	=B221-C221	=E3222/E234	=C221-E221	=F221-D221	=H222*H234
222 Total	=GIVEN/8.5	=C226*8.5	=B222-C222	=E226*8.5	=C222-E222	=F222-D222	=H226*8.5
223 Total Solids	=SUM(B216:B220)	=SUM(C216:C220)	=SUM(D216:D220)	=SUM(E216:E220)	=SUM(F216:F220)	=SUM(G223:G223)	=SUM(H216:H220)
224 gal/day							
225 Total		=10years/IJ14	=B226-C226	=E10years/IJ19	=C226-E226	=G222/G8.5	=10years/IJ24
226							
227							
228 Mass %							

A	B	C	D	E	F	G	H
229 True Protein	0.006	=10years'IAF24	=D216/D3222	=10years'IAQ24	=F216/F3222	=G216/G3222	=10years'IAH24
230 Non-Protein Nitrogen	0.003	=10years'IAF25	=D217/D3222	=10years'IAQ25	=F217/F3222	=G217/G3222	=10years'IAH25
231 Lactose	0.049	=10years'IAF26	=D218/D3222	=10years'IAQ26	=F218/F3222	=G218/G3222	=10years'IAH26
232 Ash	0.008	=10years'IAF27	=D219/D3222	=10years'IAQ27	=F219/F3222	=G219/G3222	=10years'IAH27
233 Butter Fat	0.0005	=10years'IAF28	=D220/D3222	=10years'IAQ28	=F220/F3222	=G220/G3222	=10years'IAH28
234 Water	=1-SUM(B229:B233)	=1-SUM(C229:C233)	=1-SUM(D229:D233)	=1-SUM(E229:E233)	=1-SUM(F229:F233)	=1-SUM(G229:G233)	=1-SUM(H229:H233)
235 Total	=SUM(B229:B234)	=SUM(C229:C233)	=SUM(D229:D234)	=SUM(E229:E233)	=SUM(F229:F234)	=SUM(G229:G234)	=SUM(H229:H234)
236							
237 % Solids	=SUM(B216:B220)/B222	=SUM(C216:C220)/C222	=SUM(D216:D220)/D222	=SUM(E216:E220)/E222	=SUM(F216:F220)/F222	=SUM(G216:G220)/G222	=SUM(H216:H220)/H222
238 % Protein of Solids	=B216*B217/SUM(B216:B220)	=C216*C217/SUM(C216:C220)	=D216*D217/SUM(D216:D220)	=E216*E217/SUM(E216:E220)	=F216*F217/SUM(F216:F220)	=G216*G217/SUM(G216:G220)	=H216*H217/SUM(H216:H220)
239							
240 Year 9							
242 Stream Description							
243 Stream Number							
244 Component							
245 lb/dM							
246 True Protein	=B252*B259	=C252*C259	=D246/D246	=E252*E259	=F246/F246	=G246/G246	=H252*H259
247 Non-Protein Nitrogen	=B252*B260	=C252*C260	=D247/D247	=E252*E260	=F247/F247	=G247/G247	=H252*H260
248 Lactose	=B252*B261	=C252*C261	=D248/D248	=E252*E261	=F248/F248	=G248/G248	=H252*H261
249 Ash	=B252*B262	=C252*C262	=D249/D249	=E252*E262	=F249/F249	=G249/G249	=H252*H262
250 Butter Fat	=B252*B263	=C252*C263	=D250/D250	=E252*E263	=F250/F250	=G250/G250	=H252*H263
251 Water	=B252*B264	=C252*C264	=D251/D251	=E252*E264	=F251/F251	=G251/G251	=H252*H264
252 Total	=GivenI811	=C252*G252	=D252/D252	=E252*G252	=F252/F252	=G252*G252	=H252*G252
253 Total Solids	=SUM(B246:B250)	=SUM(C246:C250)	=SUM(D246:D250)	=SUM(E246:E250)	=SUM(F246:F250)	=SUM(G246:G250)	=SUM(H246:H250)
254							
255 lb/dM							
256 Total	=B252*8.5	=10years'U14	=B256/C256	=10years'U19	=C256/E256	=G252*8.5	=10years'U24
257							
258 Mass %							
259 True Protein	0.006	=10years'IAF33	=D246/D3252	=10years'IAQ33	=F246/F3252	=G246/G3252	=10years'IAH33
260 Non-Protein Nitrogen	0.003	=10years'IAF34	=D247/D3252	=10years'IAQ34	=F247/F3252	=G247/G3252	=10years'IAH34
261 Lactose	0.049	=10years'IAF35	=D248/D3252	=10years'IAQ35	=F248/F3252	=G248/G3252	=10years'IAH35
262 Ash	0.008	=10years'IAF36	=D249/D3252	=10years'IAQ36	=F249/F3252	=G249/G3252	=10years'IAH36
263 Butter Fat	0.0005	=10years'IAF37	=D250/D3252	=10years'IAQ37	=F250/F3252	=G250/G3252	=10years'IAH37
264 Water	=1-SUM(B259:B263)	=1-SUM(C259:C263)	=1-SUM(D259:D263)	=1-SUM(E259:E263)	=1-SUM(F259:F263)	=1-SUM(G259:G263)	=1-SUM(H259:H263)
265 Total	=SUM(B259:B264)	=SUM(C259:C263)	=SUM(D259:D264)	=SUM(E259:E264)	=SUM(F259:F264)	=SUM(G259:G264)	=SUM(H259:H264)
266							
267 % Solids	=SUM(B246:B250)/B252	=SUM(C246:C250)/C252	=SUM(D246:D250)/D252	=SUM(E246:E250)/E252	=SUM(F246:F250)/F252	=SUM(G246:G250)/G252	=SUM(H246:H250)/H252
268 % Protein of Solids	=B246*B247/SUM(B246:B250)	=C246*C247/SUM(C246:C250)	=D246*D247/SUM(D246:D250)	=E246*E247/SUM(E246:E250)	=F246*F247/SUM(F246:F250)	=G246*G247/SUM(G246:G250)	=H246*H247/SUM(H246:H250)
269							
270 Year 10							
271 Stream Description							
272 Stream Number							
273 Component							
274 lb/dM							
275 True Protein	=B282*B289	=C282*C289	=D276/D276	=E282*E289	=F276/F276	=G276/G276	=H282*H289
276 Non-Protein Nitrogen	=B282*B290	=C282*C290	=D277/D277	=E282*E290	=F277/F277	=G277/G277	=H282*H290
277 Lactose	=B282*B291	=C282*C291	=D278/D278	=E282*E291	=F278/F278	=G278/G278	=H282*H291
278 Ash	=B282*B292	=C282*C292	=D279/D279	=E282*E292	=F279/F279	=G279/G279	=H282*H292
280 Butter Fat	=B282*B293	=C282*C293	=D280/D280	=E282*E293	=F280/F280	=G280/G280	=H282*H293
281 Water	=B282*B294	=C282*C294	=D281/D281	=E282*E294	=F281/F281	=G281/G281	=H282*H294
282 Total	=GivenI812	=C282*G282	=D282/D282	=E282*G282	=F282/F282	=G282*G282	=H282*G282
283 Total Solids	=SUM(B276:B280)	=SUM(C276:C280)	=SUM(D276:D280)	=SUM(E276:E280)	=SUM(F276:F280)	=SUM(G276:G280)	=SUM(H276:H280)
284							
285 lb/dM							
286 Total	=B282*8.5	=10years'U14	=B288/C288	=10years'U19	=C288/E288	=G282*8.5	=10years'U24
287							
288 Mass %							
289 True Protein	0.006	=10years'IAF42	=D276/D3282	=10years'IAQ42	=F276/F3282	=G276/G3282	=10years'IAH42
290 Non-Protein Nitrogen	0.003	=10years'IAF43	=D277/D3282	=10years'IAQ43	=F277/F3282	=G277/G3282	=10years'IAH43
291 Lactose	0.049	=10years'IAF44	=D278/D3282	=10years'IAQ44	=F278/F3282	=G278/G3282	=10years'IAH44
292 Ash	0.008	=10years'IAF45	=D279/D3282	=10years'IAQ45	=F279/F3282	=G279/G3282	=10years'IAH45
293 Butter Fat	0.0005	=10years'IAF46	=D280/D3282	=10years'IAQ46	=F280/F3282	=G280/G3282	=10years'IAH46
294 Water	=1-SUM(B289:B293)	=1-SUM(C289:C293)	=1-SUM(D289:D293)	=1-SUM(E289:E293)	=1-SUM(F289:F293)	=1-SUM(G289:G293)	=1-SUM(H289:H293)
295 Total	=SUM(B289:B294)	=SUM(C289:C293)	=SUM(D289:D294)	=SUM(E289:E294)	=SUM(F289:F294)	=SUM(G289:G294)	=SUM(H289:H294)
296							
297 % Solids	=SUM(B276:B280)/B282	=SUM(C276:C280)/C282	=SUM(D276:D280)/D282	=SUM(E276:E280)/E282	=SUM(F276:F280)/F282	=SUM(G276:G280)/G282	=SUM(H276:H280)/H282
298 % Protein of Solids	=B276*B277/SUM(B276:B280)	=C276*C277/SUM(C276:C280)	=D276*D277/SUM(D276:D280)	=E276*E277/SUM(E276:E280)	=F276*F277/SUM(F276:F280)	=G276*G277/SUM(G276:G280)	=H276*H277/SUM(H276:H280)
299							
300							
301							



Appendix D

	I	J	K	L	M	N	O	P
	Perm. Mix	Perm. Mix	Bleed	Perm. Mix	Perm. Mix	Bleed	Perm. Mix	Perm. Mix
	9	10	11	12	13	14	15	16
1								
2								
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Appendix D

Item #	I	J	K	L	M	N	O	P
		Perm. Mix	Bleed 4	Perm. 4	Perm. Mix	Bleed 5	Perm. 5	Perm. Mix
		9	10	11	12	13	14	15
77								
78								
79		=J66+S72	=10years IR24	=L66/L572	=M66/M572	=10years IS24	=O66/O572	=P66/P572
80		=J67+S72	=10years IR25	=L67/L572	=M67/M572	=10years IS25	=O67/O572	=P67/P572
81		=J68+S72	=10years IR26	=L68/L572	=M68/M572	=10years IS26	=O68/O572	=P68/P572
82		=J69+S72	=10years IR27	=L69/L572	=M69/M572	=10years IS27	=O69/O572	=P69/P572
83		=J70+S72	=10years IR28	=L70/L572	=M70/M572	=10years IS28	=O70/O572	=P70/P572
84		=1-SUM(J70:J83)	=1-SUM(K70:K83)	=1-SUM(L70:L83)	=1-SUM(M70:M83)	=1-SUM(N70:N83)	=1-SUM(O70:O83)	=1-SUM(P70:P83)
85		=J72+S72		=L72/L572	=M72/M572	1	=O72/O572	=P72/P572
86								
87								
88		=SUM(J66:J70)/J72	=SUM(K66:K70)/K72	=SUM(L66:L70)/L72	=SUM(M66:M70)/M72	=SUM(N66:N70)/N72	=SUM(O66:O70)/O72	=SUM(P66:P70)/P72
89		=SUM(J66:J70)/J70	=SUM(K66:K70)/K70	=SUM(L66:L70)/L70	=SUM(M66:M70)/M70	=SUM(N66:N70)/N70	=SUM(O66:O70)/O70	=SUM(P66:P70)/P70
90								
91								
92								
93		Perm. 3	Bleed 4	Perm. 4	Perm. Mix	Bleed 5	Perm. 5	Perm. Mix
94								
95								
96		=E96+G96	=K3 I02/K109	=H96+K96	=L96+J96	=N96 I02/N109	=O96+M96	
97		=E97+H97	=K3 I02/K110	=H97+K97	=L97+J97	=N97 I02/N110	=O97+M97	
98		=E98+H98	=K3 I02/K111	=H98+K98	=L98+J98	=N98 I02/N111	=O98+M98	
99		=E99+G99	=K3 I02/K112	=H99+K99	=L99+J99	=N99 I02/N112	=O99+M99	
100		=E100+H100	=K3 I02/K113	=H100+K100	=L100+J100	=N100 I02/N113	=O100+M100	
101		=E101+H101	=K3 I02/K114	=H101+K101	=L101+J101	=N101 I02/N114	=O101+M101	
102		=E102+H102	=K109+G85	=H102+K102	=L102+J102	=N109+G85	=O102+M102	
103		=E103+G103	=SUM(K96:K100)	=H103+K103	=L103+J103	=SUM(N96:N100)	=O103+M103	
104								
105								
106		=E106+G106	=10years IE29	=H106+K106	=L106+J106	=10years IE34	=O106+M106	
107								
108								
109		=E96+S102	=10years IR33	=L96/L5102	=M96/M5102	=10years IS33	=O96/O5102	=P96/P5102
110		=E97+S102	=10years IR34	=L97/L5102	=M97/M5102	=10years IS34	=O97/O5102	=P97/P5102
111		=E98+S102	=10years IR35	=L98/L5102	=M98/M5102	=10years IS35	=O98/O5102	=P98/P5102
112		=E99+S102	=10years IR36	=L99/L5102	=M99/M5102	=10years IS36	=O99/O5102	=P99/P5102
113		=E100+S102	=10years IR37	=L100/L5102	=M100/M5102	=10years IS37	=O100/O5102	=P100/P5102
114		=E101+S102	=1-SUM(K109:K113)	=1-SUM(L109:L113)	=1-SUM(M109:M113)	=1-SUM(N109:N113)	=1-SUM(O109:O113)	=1-SUM(P109:P113)
115		=E102+S102		=L102/L5102	=M102/M5102	1	=O102/O5102	=P102/P5102
116		=SUM(J96:J100)/J102	=SUM(K96:K100)/K102	=SUM(L96:L100)/L102	=SUM(M96:M100)/M102	=SUM(N96:N100)/N102	=SUM(O96:O100)/O102	=SUM(P96:P100)/P102
117		=SUM(J96+J97)/SUM(J96:J100)	=SUM(K96+K97)/SUM(K96:K100)	=SUM(L96+L97)/SUM(L96:L100)	=SUM(M96+M97)/SUM(M96:M100)	=SUM(N96+M97)/SUM(N96:N100)	=SUM(O96+O97)/SUM(O96:O100)	=SUM(P96+P97)/SUM(P96:P100)
118								
119								
120								
121								
122								
123		Perm. 3	Bleed 4	Perm. 4	Perm. Mix	Bleed 5	Perm. 5	Perm. Mix
124								
125								
126		=E126+H126	=K8 I32/K139	=H126+K126	=L126+J126	=N8 I32/N139	=O126+M126	
127		=E127+H127	=K8 I32/K140	=H127+K127	=L127+J127	=N8 I32/N140	=O127+M127	
128		=E128+H128	=K8 I32/K141	=H128+K128	=L128+J128	=N8 I32/N141	=O128+M128	
129		=E129+H129	=K8 I32/K142	=H129+K129	=L129+J129	=N8 I32/N142	=O129+M129	
130		=E130+G130	=K8 I32/K143	=H130+K130	=L130+J130	=N8 I32/N143	=O130+M130	
131		=E131+G131	=K8 I32/K144	=H131+K131	=L131+J131	=N8 I32/N144	=O131+M131	
132		=E132+H132	=K136+G85	=H132+K132	=L132+J132	=N136+G85	=O132+M132	
133		=E133+H133	=SUM(K126:K130)	=H133+K133	=L133+J133	=SUM(N126:N130)	=O133+M133	
134								
135		=E136+G136	=10years IF29	=H136+K136	=L136+J136	=10years IF34	=O136+M136	
136								
137								
138		=E126+S132	=10years IR42	=L126/L5132	=M126/M5132	=10years IS43	=O126/O5132	=P126/P5132
139		=E127+S132	=10years IR43	=L127/L5132	=M127/M5132	=10years IS44	=O127/O5132	=P127/P5132
140		=E128+S132	=10years IR44	=L128/L5132	=M128/M5132	=10years IS45	=O128/O5132	=P128/P5132
141		=E129+S132	=10years IR45	=L129/L5132	=M129/M5132	=10years IS46	=O129/O5132	=P129/P5132
142		=E130+S132	=1-SUM(L139:L143)	=L130/L5132	=M130/M5132	=1-SUM(N139:N143)	=O130/O5132	=P130/P5132
143		=E131+S132		=L131/L5132	=M131/M5132	1	=O131/O5132	=P131/P5132
144		=E132+S132	=SUM(K136:K143)	=L132/L5132	=M132/M5132	1	=O132/O5132	=P132/P5132
145		=E133+S132		=L133/L5132	=M133/M5132			
146								
147		=SUM(J126:J130)/J132	=SUM(K126:K130)/K132	=SUM(L126:L130)/L132	=SUM(M126:M130)/M132	=SUM(N126:N130)/N132	=SUM(O126:O130)/O132	=SUM(P126:P130)/P132
148		=SUM(J126+J127)/SUM(J126:J130)	=SUM(K126+K127)/SUM(K126:K130)	=SUM(L126+L127)/SUM(L126:L130)	=SUM(M126+M127)/SUM(M126:M130)	=SUM(N126+N127)/SUM(N126:N130)	=SUM(O126+O127)/SUM(O126:O130)	=SUM(P126+P127)/SUM(P126:P130)
149								
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Appendix D

	I	J	K	L	M	N	O	P
153								
154								
155	=E156-H156	=I158-G156	=K162-K169	=H156-K156	=L158-J156	=N162-N169	=O156-N156	=O156-M156
156	=E157-H157	=I157-G157	=K162-K170	=H157-K157	=L157-J157	=N162-N170	=O157-N157	=O157-M157
157	=E158-H158	=I158-G158	=K162-K171	=H158-K158	=L158-J158	=N162-N171	=O158-N158	=O158-M158
158	=E159-H159	=I159-G159	=K162-K172	=H159-K159	=L159-J159	=N162-N172	=O159-N159	=O159-M159
159	=E160-H160	=I160-G160	=K162-K173	=H160-K160	=L160-J160	=N162-N173	=O160-N160	=O160-M160
160	=E161-H161	=I161-G161	=K162-K174	=H161-K161	=L161-J161	=N162-N174	=O161-N161	=O161-M161
161	=E162-H162	=I162-G162	=K162-K175	=H162-K162	=L162-J162	=N162-N175	=O162-N162	=O162-M162
162	=E163-H163	=I163-G163	=K162-K176	=H163-K163	=L163-J163	=N162-N176	=O163-N163	=O163-M163
163	=E164-H164							
164	=E165-H165	=I165-G165	=K162-K177	=H165-K165	=L165-J165	=N162-N177	=O165-N165	=O165-M165
165	=E166-H166	=I166-G166	=K162-K178	=H166-K166	=L166-J166	=N162-N178	=O166-N166	=O166-M166
166	=E167-H167							
167	=E168-H168	=I168-G168	=K162-K179	=H168-K168	=L168-J168	=N162-N179	=O168-N168	=O168-M168
168	=E169-H169	=I169-G169	=K162-K180	=H169-K169	=L169-J169	=N162-N180	=O169-N169	=O169-M169
169	=E170-H170	=I170-G170	=K162-K181	=H170-K170	=L170-J170	=N162-N181	=O170-N170	=O170-M170
170	=E171-H171	=I171-G171	=K162-K182	=H171-K171	=L171-J171	=N162-N182	=O171-N171	=O171-M171
171	=E172-H172	=I172-G172	=K162-K183	=H172-K172	=L172-J172	=N162-N183	=O172-N172	=O172-M172
172	=E173-H173	=I173-G173	=K162-K184	=H173-K173	=L173-J173	=N162-N184	=O173-N173	=O173-M173
173	=E174-H174	=I174-G174	=K162-K185	=H174-K174	=L174-J174	=N162-N185	=O174-N174	=O174-M174
174	=E175-H175	=I175-G175	=K162-K186	=H175-K175	=L175-J175	=N162-N186	=O175-N175	=O175-M175
175	=E176-H176	=I176-G176	=K162-K187	=H176-K176	=L176-J176	=N162-N187	=O176-N176	=O176-M176
176	=E177-H177	=I177-G177	=K162-K188	=H177-K177	=L177-J177	=N162-N188	=O177-N177	=O177-M177
177	=E178-H178	=I178-G178	=K162-K189	=H178-K178	=L178-J178	=N162-N189	=O178-N178	=O178-M178
178	=E179-H179	=I179-G179	=K162-K190	=H179-K179	=L179-J179	=N162-N190	=O179-N179	=O179-M179
179	=E180-H180	=I180-G180	=K162-K191	=H180-K180	=L180-J180	=N162-N191	=O180-N180	=O180-M180
180	=E181-H181	=I181-G181	=K162-K192	=H181-K181	=L181-J181	=N162-N192	=O181-N181	=O181-M181
181	=E182-H182	=I182-G182	=K162-K193	=H182-K182	=L182-J182	=N162-N193	=O182-N182	=O182-M182
182	=E183-H183	=I183-G183	=K162-K194	=H183-K183	=L183-J183	=N162-N194	=O183-N183	=O183-M183
183	=E184-H184	=I184-G184	=K162-K195	=H184-K184	=L184-J184	=N162-N195	=O184-N184	=O184-M184
184	=E185-H185	=I185-G185	=K162-K196	=H185-K185	=L185-J185	=N162-N196	=O185-N185	=O185-M185
185	=E186-H186	=I186-G186	=K162-K197	=H186-K186	=L186-J186	=N162-N197	=O186-N186	=O186-M186
186	=E187-H187	=I187-G187	=K162-K198	=H187-K187	=L187-J187	=N162-N198	=O187-N187	=O187-M187
187	=E188-H188	=I188-G188	=K162-K199	=H188-K188	=L188-J188	=N162-N199	=O188-N188	=O188-M188
188	=E189-H189	=I189-G189	=K162-K200	=H189-K189	=L189-J189	=N162-N200	=O189-N189	=O189-M189
189	=E190-H190	=I190-G190	=K162-K201	=H190-K190	=L190-J190	=N162-N201	=O190-N190	=O190-M190
190	=E191-H191	=I191-G191	=K162-K202	=H191-K191	=L191-J191	=N162-N202	=O191-N191	=O191-M191
191	=E192-H192	=I192-G192	=K162-K203	=H192-K192	=L192-J192	=N162-N203	=O192-N192	=O192-M192
192	=E193-H193	=I193-G193	=K162-K204	=H193-K193	=L193-J193	=N162-N204	=O193-N193	=O193-M193
193	=E194-H194	=I194-G194	=K162-K205	=H194-K194	=L194-J194	=N162-N205	=O194-N194	=O194-M194
194	=E195-H195	=I195-G195	=K162-K206	=H195-K195	=L195-J195	=N162-N206	=O195-N195	=O195-M195
195	=E196-H196	=I196-G196	=K162-K207	=H196-K196	=L196-J196	=N162-N207	=O196-N196	=O196-M196
196	=E197-H197							
197	=E198-H198	=I198-G198	=K162-K208	=H198-K198	=L198-J198	=N162-N208	=O198-N198	=O198-M198
198	=E199-H199	=I199-G199	=K162-K209	=H199-K199	=L199-J199	=N162-N209	=O199-N199	=O199-M199
199	=E200-H200	=I200-G200	=K162-K210	=H200-K200	=L200-J200	=N162-N210	=O200-N200	=O200-M200
200	=E201-H201	=I201-G201	=K162-K211	=H201-K201	=L201-J201	=N162-N211	=O201-N201	=O201-M201
201	=E202-H202	=I202-G202	=K162-K212	=H202-K202	=L202-J202	=N162-N212	=O202-N202	=O202-M202
202	=E203-H203	=I203-G203	=K162-K213	=H203-K203	=L203-J203	=N162-N213	=O203-N203	=O203-M203
203	=E204-H204	=I204-G204	=K162-K214	=H204-K204	=L204-J204	=N162-N214	=O204-N204	=O204-M204
204	=E205-H205	=I205-G205	=K162-K215	=H205-K205	=L205-J205	=N162-N215	=O205-N205	=O205-M205
205	=E206-H206	=I206-G206	=K162-K216	=H206-K206	=L206-J206	=N162-N216	=O206-N206	=O206-M206
206	=E207-H207	=I207-G207	=K162-K217	=H207-K207	=L207-J207	=N162-N217	=O207-N207	=O207-M207
207	=E208-H208	=I208-G208	=K162-K218	=H208-K208	=L208-J208	=N162-N218	=O208-N208	=O208-M208
208	=E209-H209	=I209-G209	=K162-K219	=H209-K209	=L209-J209	=N162-N219	=O209-N209	=O209-M209
209	=E210-H210	=I210-G210	=K162-K220	=H210-K200	=L210-J210	=N162-N220	=O210-N210	=O210-M210
210	=E211-H211	=I211-G211	=K162-K221	=H211-K211	=L211-J211	=N162-N221	=O211-N211	=O211-M211
211	=E212-H212	=I212-G212	=K162-K222	=H212-K212	=L212-J212	=N162-N222	=O212-N212	=O212-M212
212	=E213-H213	=I213-G213	=K162-K223	=H213-K213	=L213-J213	=N162-N223	=O213-N213	=O213-M213
213	=E214-H214	=I214-G214	=K162-K224	=H214-K214	=L214-J214	=N162-N224	=O214-N214	=O214-M214
214	=E215-H215	=I215-G215	=K162-K225	=H215-K215	=L215-J215	=N162-N225	=O215-N215	=O215-M215
215	=E216-H216	=I216-G216	=K162-K226	=H216-K216	=L216-J216	=N162-N226	=O216-N216	=O216-M216
216	=E217-H217	=I217-G217	=K162-K227	=H217-K217	=L217-J217	=N162-N227	=O217-N217	=O217-M217
217	=E218-H218	=I218-G218	=K162-K228	=H218-K218	=L218-J218	=N162-N228	=O218-N218	=O218-M218
218	=E219-H219	=I219-G219	=K162-K229	=H219-K219	=L219-J219	=N162-N229	=O219-N219	=O219-M219
219	=E220-H220	=I220-G220	=K162-K230	=H220-K220	=L220-J220	=N162-N230	=O220-N220	=O220-M220
220	=E221-H221	=I221-G221	=K162-K231	=H221-K221	=L221-J221	=N162-N231	=O221-N221	=O221-M221
221	=E222-H222	=I222-G222	=K162-K232	=H222-K222	=L222-J222	=N162-N232	=O222-N222	=O222-M222
222	=E223-H223	=I223-G223	=K162-K233	=H223-K223	=L223-J223	=N162-N233	=O223-N223	=O223-M223
223	=E224-H224	=I224-G224	=K162-K234	=H224-K224	=L224-J224	=N162-N234	=O224-N224	=O224-M224
224	=E225-H225	=I225-G225	=K162-K235	=H225-K225	=L225-J225	=N162-N235	=O225-N225	=O225-M225
225	=E226-H226	=I226-G226	=K162-K236	=H226-K226	=L226-J226	=N162-N236	=O226-N226	=O226-M226
226	=E227-H227							
227	=E228-H228	=I228-G228	=K162-K237	=H228-K228	=L228-J228	=N162-N237	=O228-N228	=O228-M228
228	=E229-H229	=I229-G229	=K162-K238	=H229-K229	=L229-J229	=N162-N238	=O229-N229	=O229-M229
229	=E230-H230							
230	=E231-H231							

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	I	J	K	L	M	N	O	P
229	=I216I1\$222	=I216J1\$222	=I216K1\$222	=I216L1\$222	=M216M\$222	=N10yearsIA124	=O216O\$222	=P216P\$222
230	=I217I1\$222	=I217J1\$222	=I217K1\$222	=I217L1\$222	=M217M\$222	=N10yearsIA125	=O217O\$222	=P217P\$222
231	=I218I1\$222	=I218J1\$222	=I218K1\$222	=I218L1\$222	=M218M\$222	=N10yearsIA126	=O218O\$222	=P218P\$222
232	=I219I1\$222	=I219J1\$222	=I219K1\$222	=I219L1\$222	=M219M\$222	=N10yearsIA127	=O219O\$222	=P219P\$222
233	=I220I1\$222	=I220J1\$222	=I220K1\$222	=I220L1\$222	=M220M\$222	=N10yearsIA128	=O220O\$222	=P220P\$222
234	=I221I1\$222	=I221J1\$222	=I221K1\$222	=I221L1\$222	=M221M\$222	=N1-SUM(N228-N233)	=O221O\$222	=P221P\$222
235	=I222I1\$222	=I222J1\$222	=I222K1\$222	=I222L1\$222	=M222M\$222	=N1-SUM(N229-N233)	=O222O\$222	=P222P\$222
236								
237	=SUM(I216:I220)/J222	=SUM(J216:J220)/K222	=SUM(K216:K220)/L222	=SUM(L216:L220)/M222	=SUM(M216:M220)/N222	=SUM(N216:N220)/O222	=SUM(O216:O220)/P222	=SUM(P216:P220)/Q222
238	=SUM(I216:I220)/J220	=SUM(J216:J220)/K220	=SUM(K216:K220)/L220	=SUM(L216:L220)/M220	=SUM(M216:M220)/N220	=SUM(N216:N220)/O220	=SUM(O216:O220)/P220	=SUM(P216:P220)/Q220
239								
240								
241								
242	Perms Mix	Perms Mix	Bleed 4	Perms Mix	Perms Mix	Bleed 5	Perms Mix	Perms Mix
243	9	10	11	12	13	14	15	15
244								
245								
246	=E246+G246	=I246+G246	=K246+G246	=H246+K246	=L246+J246	=N246+M246	=O246+M246	=O246+M246
247	=E247+G247	=I247+G247	=K247+G247	=H247+K247	=L247+J247	=N247+M247	=O247+M247	=O247+M247
248	=E248+G248	=I248+G248	=K248+G248	=H248+K248	=L248+J248	=N248+M248	=O248+M248	=O248+M248
249	=E249+G249	=I249+G249	=K249+G249	=H249+K249	=L249+J249	=N249+M249	=O249+M249	=O249+M249
250	=E250+G250	=I250+G250	=K250+G250	=H250+K250	=L250+J250	=N250+M250	=O250+M250	=O250+M250
251	=E251+G251	=I251+G251	=K251+G251	=H251+K251	=L251+J251	=N251+M251	=O251+M251	=O251+M251
252	=E252+G252	=I252+G252	=K252+G252	=H252+K252	=L252+J252	=N252+M252	=O252+M252	=O252+M252
253	=E253+G253	=I253+G253	=K253+G253	=H253+K253	=L253+J253	=N253+M253	=O253+M253	=O253+M253
254								
255								
256	=E256+G256	=I256+G256	=K256+G256	=H256+K256	=L256+J256	=N256+M256	=O256+M256	=O256+M256
257								
258								
259	=I246/I\$252	=I246/J\$252	=I246/K\$252	=I246/L\$252	=M246M\$252	=N10yearsIA133	=O246O\$252	=P246P\$252
260	=I247/I\$252	=I247/J\$252	=I247/K\$252	=I247/L\$252	=M247M\$252	=N10yearsIA134	=O247O\$252	=P247P\$252
261	=I248/I\$252	=I248/J\$252	=I248/K\$252	=I248/L\$252	=M248M\$252	=N10yearsIA135	=O248O\$252	=P248P\$252
262	=I249/I\$252	=I249/J\$252	=I249/K\$252	=I249/L\$252	=M249M\$252	=N10yearsIA136	=O249O\$252	=P249P\$252
263	=I250/I\$252	=I250/J\$252	=I250/K\$252	=I250/L\$252	=M250M\$252	=N10yearsIA137	=O250O\$252	=P250P\$252
264	=I251/I\$252	=I251/J\$252	=I251/K\$252	=I251/L\$252	=M251M\$252	=N1-SUM(N259-N263)	=O251O\$252	=P251P\$252
265	=I252/I\$252	=I252/J\$252	=I252/K\$252	=I252/L\$252	=M252M\$252	=N1-SUM(N259-N263)	=O252O\$252	=P252P\$252
266								
267	=SUM(I246:I250)/J252	=SUM(J246:J250)/K252	=SUM(K246:K250)/L252	=SUM(L246:L250)/M252	=SUM(M246:M250)/N252	=SUM(N246:N250)/O252	=SUM(O246:O250)/P252	=SUM(P246:P250)/Q252
268	=SUM(I246:I250)/J246	=SUM(J246:J250)/K246	=SUM(K246:K250)/L246	=SUM(L246:L250)/M246	=SUM(M246:M250)/N246	=SUM(N246:N250)/O246	=SUM(O246:O250)/P246	=SUM(P246:P250)/Q246
269								
270								
271								
272	Perms Mix	Perms Mix	Bleed 4	Perms Mix	Perms Mix	Bleed 5	Perms Mix	Perms Mix
273	9	10	11	12	13	14	15	15
274								
275								
276	=E276+G276	=I276+G276	=K276+G276	=H276+K276	=L276+J276	=N276+M276	=O276+M276	=O276+M276
277	=E277+G277	=I277+G277	=K277+G277	=H277+K277	=L277+J277	=N277+M277	=O277+M277	=O277+M277
278	=E278+G278	=I278+G278	=K278+G278	=H278+K278	=L278+J278	=N278+M278	=O278+M278	=O278+M278
279	=E279+G279	=I279+G279	=K279+G279	=H279+K279	=L279+J279	=N279+M279	=O279+M279	=O279+M279
280	=E280+G280	=I280+G280	=K280+G280	=H280+K280	=L280+J280	=N280+M280	=O280+M280	=O280+M280
281	=E281+G281	=I281+G281	=K281+G281	=H281+K281	=L281+J281	=N281+M281	=O281+M281	=O281+M281
282	=E282+G282	=I282+G282	=K282+G282	=H282+K282	=L282+J282	=N282+M282	=O282+M282	=O282+M282
283	=E283+G283	=I283+G283	=K283+G283	=H283+K283	=L283+J283	=N283+M283	=O283+M283	=O283+M283
284								
285								
286	=E286+G286	=I286+G286	=K286+G286	=H286+K286	=L286+J286	=N286+M286	=O286+M286	=O286+M286
287								
288								
289	=I276/I\$282	=I276/J\$282	=I276/K\$282	=I276/L\$282	=M276M\$282	=N10yearsIA142	=O276O\$282	=P276P\$282
290	=I277/I\$282	=I277/J\$282	=I277/K\$282	=I277/L\$282	=M277M\$282	=N10yearsIA143	=O277O\$282	=P277P\$282
291	=I278/I\$282	=I278/J\$282	=I278/K\$282	=I278/L\$282	=M278M\$282	=N10yearsIA144	=O278O\$282	=P278P\$282
292	=I279/I\$282	=I279/J\$282	=I279/K\$282	=I279/L\$282	=M279M\$282	=N10yearsIA145	=O279O\$282	=P279P\$282
293	=I280/I\$282	=I280/J\$282	=I280/K\$282	=I280/L\$282	=M280M\$282	=N10yearsIA146	=O280O\$282	=P280P\$282
294	=I281/I\$282	=I281/J\$282	=I281/K\$282	=I281/L\$282	=M281M\$282	=N1-SUM(N288-N293)	=O281O\$282	=P281P\$282
295	=I282/I\$282	=I282/J\$282	=I282/K\$282	=I282/L\$282	=M282M\$282	=N1-SUM(N288-N293)	=O282O\$282	=P282P\$282
296								
297	=SUM(I276:I280)/J282	=SUM(J276:J280)/K282	=SUM(K276:K280)/L282	=SUM(L276:L280)/M282	=SUM(M276:M280)/N282	=SUM(N276:N280)/O282	=SUM(O276:O280)/P282	=SUM(P276:P280)/Q282
298	=SUM(I276:I280)/J276	=SUM(J276:J280)/K276	=SUM(K276:K280)/L276	=SUM(L276:L280)/M276	=SUM(M276:M280)/N276	=SUM(N276:N280)/O276	=SUM(O276:O280)/P276	=SUM(P276:P280)/Q276
299								
300								
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Appendix D

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Appendix D

	Q	R	S	T	U	V	W	X
77								
78								
79		=R66/R872	=S60/S572	=10yearsIU24	=U66/U572	=V66/V572	=10yearsIV24	=X66/X572
80		=R67/R872	=S67/S572	=10yearsIU25	=U67/U572	=V67/V572	=10yearsIV25	=X67/X572
81		=R68/R872	=S68/S572	=10yearsIU26	=U68/U572	=V68/V572	=10yearsIV26	=X68/X572
82		=R69/R872	=S69/S572	=10yearsIU27	=U69/U572	=V69/V572	=10yearsIV27	=X69/X572
83		=R70/R872	=S70/S572	=10yearsIU28	=U70/U572	=V70/V572	=10yearsIV28	=X70/X572
84		=1-SUM(R79:R83)	=1-SUM(S79:S83)	=1-SUM(T79:T83)	=1-SUM(U79:U83)	=1-SUM(V79:V83)	=1-SUM(W79:W83)	=1-SUM(X79:X83)
85		=R72/R872	=S72/S572	1	=U72/U572	=V72/V572	=1-SUM(W79:W83)	=1-SUM(X79:X83)
86								
87	=SUM(Q66:Q70)/Q102	=SUM(R66:R70)/R72	=SUM(S66:S70)/S72	=SUM(T66:T70)/T72	=SUM(U66:U70)/U72	=SUM(V66:V70)/V72	=SUM(W66:W70)/W72	=SUM(X66:X70)/X72
88	=SUM(Q66:Q70)/Q102	=SUM(R66:R70)/R72	=SUM(S66:S70)/S72	=SUM(T66:T70)/T72	=SUM(U66:U70)/U72	=SUM(V66:V70)/V72	=SUM(W66:W70)/W72	=SUM(X66:X70)/X72
89								
90								
91								
92								
93								
94								
95								
96		=N96-Q96	=R96+P96	=10yearsIU29	=U96/U86	=V96/V86	=10yearsIV29	=X96/X86
97		=N97-Q97	=R97+P97	=10yearsIU30	=U97/U87	=V97/V87	=10yearsIV30	=X97/X87
98		=N98-Q98	=R98+P98	=10yearsIU31	=U98/U88	=V98/V88	=10yearsIV31	=X98/X88
99		=N99-Q99	=R99+P99	=10yearsIU32	=U99/U89	=V99/V89	=10yearsIV32	=X99/X89
100		=N100-Q100	=R100+P100	=10yearsIU33	=U100/U90	=V100/V90	=10yearsIV33	=X100/X90
101		=N101-Q101	=R101+P101	=10yearsIU34	=U101/U91	=V101/V91	=10yearsIV34	=X101/X91
102		=N102-Q102	=R102+P102	=10yearsIU35	=U102/U92	=V102/V92	=10yearsIV35	=X102/X92
103		=N103-Q103	=R103+P103	=10yearsIU36	=U103/U93	=V103/V93	=10yearsIV36	=X103/X93
104								
105								
106		=N106-Q106	=R106+P106	=10yearsIU37	=U106/U94	=V106/V94	=10yearsIV37	=X106/X94
107								
108								
109		=R96/R8102	=S96/S8102	=10yearsIU38	=U96/U95	=V96/V95	=10yearsIV38	=X96/X95
110		=R97/R8102	=S97/S8102	=10yearsIU39	=U97/U96	=V97/V96	=10yearsIV39	=X97/X96
111		=R98/R8102	=S98/S8102	=10yearsIU40	=U98/U97	=V98/V97	=10yearsIV40	=X98/X97
112		=R99/R8102	=S99/S8102	=10yearsIU41	=U99/U98	=V99/V98	=10yearsIV41	=X99/X98
113		=R100/R8102	=S100/S8102	=10yearsIU42	=U100/U99	=V100/V99	=10yearsIV42	=X100/X99
114		=1-SUM(R109:R113)	=1-SUM(S109:S113)	=1-SUM(T109:T113)	=1-SUM(U109:U113)	=1-SUM(V109:V113)	=1-SUM(W109:W113)	=1-SUM(X109:X113)
115		=R102/R8102	=S102/S8102	1	=U102/U92	=V102/V92	=1-SUM(W109:W113)	=1-SUM(X109:X113)
116								
117	=SUM(Q96:Q100)/Q102	=SUM(R96:R100)/R102	=SUM(S96:S100)/S102	=SUM(T96:T100)/T102	=SUM(U96:U100)/U102	=SUM(V96:V100)/V102	=SUM(W96:W100)/W102	=SUM(X96:X100)/X102
118	=SUM(Q96:Q100)/Q102	=SUM(R96:R100)/R102	=SUM(S96:S100)/S102	=SUM(T96:T100)/T102	=SUM(U96:U100)/U102	=SUM(V96:V100)/V102	=SUM(W96:W100)/W102	=SUM(X96:X100)/X102
119								
120								
121								
122								
123								
124								
125								
126		=N126-Q126	=R126+P126	=10yearsIU43	=U126/T126	=V126/S126	=10yearsIV43	=X126/W126
127		=N127-Q127	=R127+P127	=10yearsIU44	=U127/T127	=V127/S127	=10yearsIV44	=X127/W127
128		=N128-Q128	=R128+P128	=10yearsIU45	=U128/T128	=V128/S128	=10yearsIV45	=X128/W128
129		=N129-Q129	=R129+P129	=10yearsIU46	=U129/T129	=V129/S129	=10yearsIV46	=X129/W129
130		=N130-Q130	=R130+P130	=10yearsIU47	=U130/T130	=V130/S130	=10yearsIV47	=X130/W130
131		=N131-Q131	=R131+P131	=10yearsIU48	=U131/T131	=V131/S131	=10yearsIV48	=X131/W131
132		=N132-Q132	=R132+P132	=10yearsIU49	=U132/T132	=V132/S132	=10yearsIV49	=X132/W132
133		=N133-Q133	=R133+P133	=10yearsIU50	=U133/T133	=V133/S133	=10yearsIV50	=X133/W133
134								
135								
136		=N136-Q136	=R136+P136	=10yearsIU51	=U136/T136	=V136/S136	=10yearsIV51	=X136/W136
137								
138								
139		=R126/R8132	=S126/S8132	=10yearsIU52	=U126/U8132	=V126/V8132	=10yearsIV52	=X126/X8132
140		=R127/R8132	=S127/S8132	=10yearsIU53	=U127/U8133	=V127/V8133	=10yearsIV53	=X127/X8133
141		=R128/R8132	=S128/S8132	=10yearsIU54	=U128/U8134	=V128/V8134	=10yearsIV54	=X128/X8134
142		=R129/R8132	=S129/S8132	=10yearsIU55	=U129/U8135	=V129/V8135	=10yearsIV55	=X129/X8135
143		=R130/R8132	=S130/S8132	=10yearsIU56	=U130/U8136	=V130/V8136	=10yearsIV56	=X130/X8136
144		=1-SUM(R139:R143)	=1-SUM(S139:S143)	=1-SUM(T139:T143)	=1-SUM(U139:U143)	=1-SUM(V139:V143)	=1-SUM(W139:W143)	=1-SUM(X139:X143)
145		=R132/R8132	=S132/S8132	1	=U132/U8132	=V132/V8132	=1-SUM(W139:W143)	=1-SUM(X139:X143)
146								
147	=SUM(Q126:Q130)/Q132	=SUM(R126:R130)/R132	=SUM(S126:S130)/S132	=SUM(T126:T130)/T132	=SUM(U126:U130)/U132	=SUM(V126:V130)/V132	=SUM(W126:W130)/W132	=SUM(X126:X130)/X132
148	=SUM(Q126:Q130)/Q132	=SUM(R126:R130)/R132	=SUM(S126:S130)/S132	=SUM(T126:T130)/T132	=SUM(U126:U130)/U132	=SUM(V126:V130)/V132	=SUM(W126:W130)/W132	=SUM(X126:X130)/X132
149								
150								
151								
152								

Appendix D

	Q	R	S	T	U	V	W	X
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Appendix D

Table with columns Q, R, S, T, U, V, W, X. Each cell contains alphanumeric codes and formulas such as =SUM(Q246:Q250), =R246:R247, etc.



Appendix D

	Y	Z	AA	AB	AC	AD	AE
1							
2	Perm. Mix	Blank	Perm. 9	Perm. Mix	Blank 10	Perm. 10	Perm. Mix
3	24	25	26	27	28	29	30
4							
5	=X8+V6	=Z512*Z19	=W6-Z8	=AA6+AE6	=AC\$12*AC19	=Z6-AC8	=AD6+AJ6
6	=X7+V7	=Z812*Z20	=W7-Z7	=AA7+AE7	=AC\$12*AC20	=Z7-AC7	=AD7+AJ7
7	=X6+V6	=Z812*Z21	=W8-Z8	=AA8+AE8	=AC\$12*AC21	=Z8-AC8	=AD8+AJ8
8	=X5+V5	=Z812*Z22	=W9-Z9	=AA9+AE9	=AC\$12*AC22	=Z9-AC9	=AD9+AJ9
9	=X4+V4	=Z812*Z23	=W10-Z10	=AA10+AE10	=AC\$12*AC23	=Z10-AC10	=AD10+AJ10
10	=X3+V3	=Z812*Z24	=W11-Z11	=AA11+AE11	=AC\$12*AC24	=Z11-AC11	=AD11+AJ11
11	=X2+V2	=Z16*8.5	=W12-Z12	=AA12+AE12	=AC16*8.5	=Z12-AC12	=AD12+AJ12
12	=X13+V13	=SUM(Z6:Z10)	=W13-Z13	=AA13+AE13	=SUM(AC6:AC10)	=Z13-AC13	=AD13+AJ13
13							
14							
15	=X16+V16	=10years1B56	=W16-Z16	=AA16+AE16	=10years1B54	=Z16-AC16	=AD16+AJ16
16							
17							
18	=Y8/Y\$12	=10years1W6	=AA8/AA\$12	=AB8/AB\$12	=10years1X8	=AD8/AD\$12	=AE8/AE\$12
19	=Y7/Y\$12	=10years1W7	=AA7/AA\$12	=AB7/AB\$12	=10years1X7	=AD7/AD\$12	=AE7/AE\$12
20	=Y6/Y\$12	=10years1W8	=AA6/AA\$12	=AB6/AB\$12	=10years1X6	=AD6/AD\$12	=AE6/AE\$12
21	=Y5/Y\$12	=10years1W9	=AA5/AA\$12	=AB5/AB\$12	=10years1X5	=AD5/AD\$12	=AE5/AE\$12
22	=Y4/Y\$12	=10years1W10	=AA4/AA\$12	=AB4/AB\$12	=10years1X4	=AD4/AD\$12	=AE4/AE\$12
23	=Y3/Y\$12	=1-SUM(Z18:Z23)	=AA10/AA\$12	=AB10/AB\$12	=1-SUM(AC18:AC23)	=AD10/AD\$12	=AE10/AE\$12
24	=1-SUM(Y18:Y23)	=1-SUM(Z18:Z23)	=1-SUM(AA18:AA23)	=1-SUM(AB18:AB23)	=1-SUM(AC18:AC23)	=1-SUM(AD18:AD23)	=1-SUM(AE18:AE23)
25	=Y12/Y\$12	7	=AA12/AA\$12	=AB12/AB\$12	1	=AD12/AD\$12	=AE12/AE\$12
26							
27	=SUM(Y6:Y10)/Y12	=SUM(Z6:Z10)/Z12	=SUM(AA6:AA10)/AA12	=SUM(AB6:AB10)/AB12	=SUM(AC6:AC10)/AC12	=SUM(AD6:AD10)/AD12	=SUM(AE6:AE10)/AE12
28	=Y6-Y7)/SUM(Y6:Y10)	=Z6-Z7)/SUM(Z6:Z10)	=AA6-AA7)/SUM(AA6:AA10)	=AB6-AB7)/SUM(AB6:AB10)	=AC6-AC7)/SUM(AC6:AC10)	=AD6-AD7)/SUM(AD6:AD10)	=AE6-AE7)/SUM(AE6:AE10)
29							
30							
31							
32	Perm. Mix	Blank 9	Perm. 9	Perm. Mix	Blank 10	Perm. 10	Perm. Mix
33	24	25	26	27	28	29	30
34							
35	=X36+V36	=Z842*Z49	=W36-Z36	=AA36+AE36	=AC\$42*AC49	=Z36-AC36	=AD36+AJ36
36	=X37+V37	=Z842*Z50	=W37-Z37	=AA37+AE37	=AC\$42*AC50	=Z37-AC37	=AD37+AJ37
37	=X38+V38	=Z842*Z51	=W38-Z38	=AA38+AE38	=AC\$42*AC51	=Z38-AC38	=AD38+AJ38
38	=X39+V39	=Z842*Z52	=W39-Z39	=AA39+AE39	=AC\$42*AC52	=Z39-AC39	=AD39+AJ39
39	=X40+V40	=Z842*Z53	=W40-Z40	=AA40+AE40	=AC\$42*AC53	=Z40-AC40	=AD40+AJ40
40	=X41+V41	=Z842*Z54	=W41-Z41	=AA41+AE41	=AC\$42*AC54	=Z41-AC41	=AD41+AJ41
41	=X42+V42	=Z46*8.5	=W42-Z42	=AA42+AE42	=AC46*8.5	=Z42-AC42	=AD42+AJ42
42	=X43+V43	=SUM(Z36:Z40)	=W43-Z43	=AA43+AE43	=SUM(AC36:AC40)	=Z43-AC43	=AD43+AJ43
43							
44							
45	=X46+V46	=10years1C56	=W46-Z46	=AA46+AE46	=10years1C54	=Z46-AC46	=AD46+AJ46
46							
47							
48	=Y36/Y\$42	=10years1W15	=AA36/AA\$42	=AB36/AB\$42	=10years1X15	=AD36/AD\$42	=AE36/AE\$42
49	=Y37/Y\$42	=10years1W16	=AA37/AA\$42	=AB37/AB\$42	=10years1X16	=AD37/AD\$42	=AE37/AE\$42
50	=Y38/Y\$42	=10years1W17	=AA38/AA\$42	=AB38/AB\$42	=10years1X17	=AD38/AD\$42	=AE38/AE\$42
51	=Y39/Y\$42	=10years1W18	=AA39/AA\$42	=AB39/AB\$42	=10years1X18	=AD39/AD\$42	=AE39/AE\$42
52	=Y40/Y\$42	=10years1W19	=AA40/AA\$42	=AB40/AB\$42	=10years1X19	=AD40/AD\$42	=AE40/AE\$42
53	=1-SUM(Y46:Y53)	=1-SUM(Z49:Z53)	=1-SUM(AA49:AA53)	=1-SUM(AB49:AB53)	=1-SUM(AC49:AC53)	=1-SUM(AD49:AD53)	=1-SUM(AE49:AE53)
54	=Y42/Y\$42	1	=AA42/AA\$42	=AB42/AB\$42	1	=AD42/AD\$42	=AE42/AE\$42
55							
56							
57	=SUM(Y36:Y40)/Y42	=SUM(Z36:Z40)/Z42	=SUM(AA36:AA40)/AA42	=SUM(AB36:AB40)/AB42	=SUM(AC36:AC40)/AC42	=SUM(AD36:AD40)/AD42	=SUM(AE36:AE40)/AE42
58	=Y36-Y37)/SUM(Y36:Y40)	=Z36-Z37)/SUM(Z36:Z40)	=AA36-AA37)/SUM(AA36:AA40)	=AB36-AB37)/SUM(AB36:AB40)	=AC36-AC37)/SUM(AC36:AC40)	=AD36-AD37)/SUM(AD36:AD40)	=AE36-AE37)/SUM(AE36:AE40)
59							
60							
61							
62	Perm. Mix	Blank 9	Perm. 9	Perm. Mix	Blank 10	Perm. 10	Perm. Mix
63	24	25	26	27	28	29	30
64							
65	=X65+V66	=Z872*Z79	=W65-Z66	=AA65+AE66	=AC\$72*AC79	=Z66-AC66	=AD66+AJ66
66	=X67+V67	=Z872*Z80	=W67-Z67	=AA67+AE68	=AC\$72*AC80	=Z67-AC67	=AD67+AJ67
67	=X68+V68	=Z872*Z81	=W68-Z68	=AA68+AE69	=AC\$72*AC81	=Z68-AC68	=AD68+AJ68
68	=X69+V69	=Z872*Z82	=W69-Z69	=AA69+AE70	=AC\$72*AC82	=Z69-AC69	=AD69+AJ69
69	=X70+V70	=Z872*Z83	=W70-Z70	=AA70+AE71	=AC\$72*AC83	=Z70-AC70	=AD70+AJ70
70	=X71+V71	=Z872*Z84	=W71-Z71	=AA71+AE72	=AC\$72*AC84	=Z71-AC71	=AD71+AJ71
71	=X72+V72	=Z76*8.5	=W72-Z72	=AA72+AE73	=AC76*8.5	=Z72-AC72	=AD72+AJ72
72	=X73+V73	=SUM(Z66:Z70)	=W73-Z73	=AA73+AE74	=SUM(AC66:AC70)	=Z73-AC73	=AD73+AJ73
73							
74							
75							
76	=X76+V76	=10years1D56	=W76-Z76	=AA76+AE76	=10years1D54	=Z76-AC76	=AD76+AJ76

Appendix D

Y	Z	AA	AB	AC	AD	AE
77						
78						
79	=10years\W24	=AA66\A\$72	=AB66\A\$72	=AC66\A\$72	=AD66\A\$72	=AE66\A\$72
80	=10years\W25	=AA67\A\$72	=AB67\A\$72	=AC67\A\$72	=AD67\A\$72	=AE67\A\$72
81	=10years\W26	=AA68\A\$72	=AB68\A\$72	=AC68\A\$72	=AD68\A\$72	=AE68\A\$72
82	=10years\W27	=AA69\A\$72	=AB69\A\$72	=AC69\A\$72	=AD69\A\$72	=AE69\A\$72
83	=10years\W28	=AA70\A\$72	=AB70\A\$72	=AC70\A\$72	=AD70\A\$72	=AE70\A\$72
84	=1-SUM(Z79-Z83)	=1-SUM(AA79-AA83)	=1-SUM(AB79-AB83)	=1-SUM(AC79-AC83)	=1-SUM(AD79-AD83)	=1-SUM(AE79-AE83)
85	=1	=AA72\A\$72	=AB72\A\$72	=AC72\A\$72	=AD72\A\$72	=AE72\A\$72
86						
87	=SUM(Y66:Y70)/Y72	=SUM(AA66-AA70)/AA72	=SUM(AB66-AB70)/AB72	=SUM(AC66-AC70)/AC72	=SUM(AD66-AD70)/AD72	=SUM(AE66-AE70)/AE72
88	=SUM(Y66:Y70)/SUM(Y66:Y70)	=SUM(AA66-AA70)/SUM(AA66-AA70)	=SUM(AB66-AB70)/SUM(AB66-AB70)	=SUM(AC66-AC70)/SUM(AC66-AC70)	=SUM(AD66-AD70)/SUM(AD66-AD70)	=SUM(AE66-AE70)/SUM(AE66-AE70)
89						
90						
91						
92	Perm. Mix	Perm. 9	Perm. Mix	Bleed 10	Perm. 10	Perm. Mix
93	24	25	26	27	28	29
94						
95	=X66+Y96	=Z\$102-Z109	=W96+V96	=AA96+AE96	=AC\$102-AC109	=Z96-AC96
96	=X67+Y97	=Z\$102-Z110	=W97+V97	=AA97+AE97	=AC\$102-AC110	=Z97-AC97
97	=X68+Y98	=Z\$102-Z111	=W98+V98	=AA98+AE98	=AC\$102-AC111	=Z98-AC98
98	=X69+Y99	=Z\$102-Z112	=W99+V99	=AA99+AE99	=AC\$102-AC112	=Z99-AC99
99	=X100+Y100	=Z\$102-Z113	=W100+V100	=AA100+AE100	=AC\$102-AC113	=Z100-AC100
100	=X101+Y101	=Z\$102-Z114	=W101+V101	=AA101+AE101	=AC\$102-AC114	=Z101-AC101
101	=X102+Y102	=Z106*6.5	=W102+V102	=AA102+AE102	=AC106*6.5	=Z102-AC102
102	=X103+Y103	=SUM(Z96-Z100)	=W103+V103	=AA103+AE103	=SUM(AC96-AC100)	=Z103-AC103
103						
104						
105						
106	=X106+Y106	=W106+V106	=AA106+AE106	=AC106+AE106	=Z106-AC106	=AD106+AJ106
107						
108						
109	=Y66*Y\$102	=W33	=AA96\A\$102	=AB96\A\$102	=AC96\A\$102	=AD96\A\$102
110	=Y67*Y\$102	=W34	=AA97\A\$102	=AB97\A\$102	=AC97\A\$102	=AD97\A\$102
111	=Y68*Y\$102	=W35	=AA98\A\$102	=AB98\A\$102	=AC98\A\$102	=AD98\A\$102
112	=Y69*Y\$102	=W36	=AA99\A\$102	=AB99\A\$102	=AC99\A\$102	=AD99\A\$102
113	=Y100*Y\$102	=W37	=AA100\A\$102	=AB100\A\$102	=AC100\A\$102	=AD100\A\$102
114	=1-SUM(Y109:Y113)	=1-SUM(Z109:Z113)	=1-SUM(AA109-AA113)	=1-SUM(AB109-AB113)	=1-SUM(AC109-AC113)	=1-SUM(AD109-AD113)
115	=Y102*Y\$102	1	=AA102\A\$102	=AB102\A\$102	=AC102\A\$102	=AD102\A\$102
116						
117	=SUM(Y96:Y100)/Y102	=SUM(Z96:Z100)/Z102	=SUM(AA96-AA100)/AA102	=SUM(AB96-AB100)/AB102	=SUM(AC96-AC100)/AC102	=SUM(AE96-AE100)/AE102
118	=SUM(Y96:Y100)/SUM(Y96:Y100)	=SUM(Z96:Z100)/SUM(Z96:Z100)	=SUM(AA96-AA100)/SUM(AA96-AA100)	=SUM(AB96-AB100)/SUM(AB96-AB100)	=SUM(AC96-AC100)/SUM(AC96-AC100)	=SUM(AE96-AE100)/SUM(AE96-AE100)
119						
120						
121						
122	Perm. Mix	Bleed 9	Perm. Mix	Bleed 10	Perm. 10	Perm. Mix
123	24	25	26	27	28	29
124						
125						
126	=X126+Y126	=Z\$132-Z139	=W126+V126	=AA126+AE126	=AC\$132-AC139	=Z126-AC126
127	=X127+Y127	=Z\$132-Z140	=W127+V127	=AA127+AE127	=AC\$132-AC140	=Z127-AC127
128	=X128+Y128	=Z\$132-Z141	=W128+V128	=AA128+AE128	=AC\$132-AC141	=Z128-AC128
129	=X129+Y129	=Z\$132-Z142	=W129+V129	=AA129+AE129	=AC\$132-AC142	=Z129-AC129
130	=X130+Y130	=Z\$132-Z143	=W130+V130	=AA130+AE130	=AC\$132-AC143	=Z130-AC130
131	=X131+Y131	=Z\$132-Z144	=W131+V131	=AA131+AE131	=AC\$132-AC144	=Z131-AC131
132	=X132+Y132	=Z136*6.5	=W132+V132	=AA132+AE132	=AC136*6.5	=Z132-AC132
133	=X133+Y133	=SUM(Z126-Z130)	=W133+V133	=AA133+AE133	=SUM(AC126-AC130)	=Z133-AC133
134						
135						
136	=X136+Y136	=W136+V136	=AA136+AE136	=AC136+AE136	=Z136-AC136	=AD136+AJ136
137						
138						
139	=Y126*Y\$132	=W42	=AA126\A\$132	=AB126\A\$132	=AC126\A\$132	=AD126\A\$132
140	=Y127*Y\$132	=W43	=AA127\A\$132	=AB127\A\$132	=AC127\A\$132	=AD127\A\$132
141	=Y128*Y\$132	=W44	=AA128\A\$132	=AB128\A\$132	=AC128\A\$132	=AD128\A\$132
142	=Y129*Y\$132	=W45	=AA129\A\$132	=AB129\A\$132	=AC129\A\$132	=AD129\A\$132
143	=Y130*Y\$132	=W46	=AA130\A\$132	=AB130\A\$132	=AC130\A\$132	=AD130\A\$132
144	=1-SUM(Y139:Y143)	=1-SUM(Z139:Z143)	=1-SUM(AA139-AA143)	=1-SUM(AB139-AB143)	=1-SUM(AC139-AC143)	=1-SUM(AD139-AD143)
145	=Y132*Y\$132	1	=AA132\A\$132	=AB132\A\$132	=AC132\A\$132	=AD132\A\$132
146						
147	=SUM(Y126:Y130)/Y132	=SUM(Z126-Z130)/Z132	=SUM(AA126-AA130)/AA132	=SUM(AB126-AB130)/AB132	=SUM(AC126-AC130)/AC132	=SUM(AE126-AE130)/AE132
148	=SUM(Y126:Y130)/SUM(Y126:Y130)	=SUM(Z126-Z130)/SUM(Z126-Z130)	=SUM(AA126-AA130)/SUM(AA126-AA130)	=SUM(AB126-AB130)/SUM(AB126-AB130)	=SUM(AC126-AC130)/SUM(AC126-AC130)	=SUM(AE126-AE130)/SUM(AE126-AE130)
149						
150						
151						
152	Perm. Mix	Bleed 9	Perm. Mix	Bleed 10	Perm. 10	Perm. Mix

Y	Z	AA	AB	AC	AD	AE
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Appendix D

	Y	Z	AA	AB	AC	AD	AE
228	=10years\I216\Y222	=10years\I216\Z222	=AA216\AA222	=AB216\AB222	=10years\AO24	=AD216\AD222	=AE216\AE222
230	=10years\I217\Y222	=10years\I217\Z222	=AA217\AA222	=AB217\AB222	=10years\AO25	=AD217\AD222	=AE217\AE222
231	=10years\I218\Y222	=10years\I218\Z222	=AA218\AA222	=AB218\AB222	=10years\AO26	=AD218\AD222	=AE218\AE222
232	=10years\I219\Y222	=10years\I219\Z222	=AA219\AA222	=AB219\AB222	=10years\AO27	=AD219\AD222	=AE219\AE222
233	=10years\I220\Y222	=10years\I220\Z222	=AA220\AA222	=AB220\AB222	=10years\AO28	=AD220\AD222	=AE220\AE222
234	=1-SUM(Y228\Y233)	=1-SUM(Z228\Z233)	=1-SUM(AA228\AA233)	=1-SUM(AB228\AB233)	=1-SUM(AC228\AC233)	=1-SUM(AD228\AD233)	=1-SUM(AE228\AE233)
235	=Y222\Y222	=Z222\Z222	=AA222\AA222	=AB222\AB222	=1	=AD222\AD222	=AE222\AE222
236							
237	=SUM(Y216\Y220)\Y222	=SUM(Z216\Z220)\Z222	=SUM(AA216\AA220)\AA222	=SUM(AB216\AB220)\AB222	=SUM(AC216\AC220)\AC222	=SUM(AD216\AD220)\AD222	=SUM(AE216\AE220)\AE222
238	=SUM(Y216\Y217)\SUM(Y216\Y220)	=SUM(Z216\Z217)\SUM(Z216\Z220)	=SUM(AA216\AA217)\SUM(AA216\AA220)	=SUM(AB216\AB217)\SUM(AB216\AB220)	=SUM(AC216\AC217)\SUM(AC216\AC220)	=SUM(AD216\AD217)\SUM(AD216\AD220)	=SUM(AE216\AE217)\SUM(AE216\AE220)
240							
241							
242	Perm Mix	Bleed 9	Perm 9	Perm Mix	Bleed 10	Perm 10	Perm Mix
243		25	26	27	28	29	30
244							
245	=X246\Y246	=Z246\Z246	=W246\Z246	=AA246\AE246	=AC246\AE246	=AD246\AE246	=AE246\AE246
247	=X247\Y247	=Z247\Z247	=W247\Z247	=AA247\AE247	=AC247\AE247	=AD247\AE247	=AE247\AE247
248	=X248\Y248	=Z248\Z248	=W248\Z248	=AA248\AE248	=AC248\AE248	=AD248\AE248	=AE248\AE248
249	=X249\Y249	=Z249\Z249	=W249\Z249	=AA249\AE249	=AC249\AE249	=AD249\AE249	=AE249\AE249
250	=X250\Y250	=Z250\Z250	=W250\Z250	=AA250\AE250	=AC250\AE250	=AD250\AE250	=AE250\AE250
251	=X251\Y251	=Z251\Z251	=W251\Z251	=AA251\AE251	=AC251\AE251	=AD251\AE251	=AE251\AE251
252	=X252\Y252	=Z252\Z252	=W252\Z252	=AA252\AE252	=AC252\AE252	=AD252\AE252	=AE252\AE252
253	=X253\Y253	=Z253\Z253	=W253\Z253	=AA253\AE253	=AC253\AE253	=AD253\AE253	=AE253\AE253
254							
255	=X256\Y256	=Z256\Z256	=W256\Z256	=AA256\AE256	=AC256\AE256	=AD256\AE256	=AE256\AE256
257							
258	=X246\Y246	=Z246\Z246	=W246\Z246	=AA246\AE246	=AC246\AE246	=AD246\AE246	=AE246\AE246
259	=X247\Y247	=Z247\Z247	=W247\Z247	=AA247\AE247	=AC247\AE247	=AD247\AE247	=AE247\AE247
260	=X248\Y248	=Z248\Z248	=W248\Z248	=AA248\AE248	=AC248\AE248	=AD248\AE248	=AE248\AE248
261	=X249\Y249	=Z249\Z249	=W249\Z249	=AA249\AE249	=AC249\AE249	=AD249\AE249	=AE249\AE249
262	=X250\Y250	=Z250\Z250	=W250\Z250	=AA250\AE250	=AC250\AE250	=AD250\AE250	=AE250\AE250
263	=X251\Y251	=Z251\Z251	=W251\Z251	=AA251\AE251	=AC251\AE251	=AD251\AE251	=AE251\AE251
264	=X252\Y252	=Z252\Z252	=W252\Z252	=AA252\AE252	=AC252\AE252	=AD252\AE252	=AE252\AE252
265	=X253\Y253	=Z253\Z253	=W253\Z253	=AA253\AE253	=AC253\AE253	=AD253\AE253	=AE253\AE253
266							
267	=SUM(Y246\Y250)\Y252	=SUM(Z246\Z250)\Z252	=SUM(AA246\AA250)\AA252	=SUM(AB246\AB250)\AB252	=SUM(AC246\AC250)\AC252	=SUM(AD246\AD250)\AD252	=SUM(AE246\AE250)\AE252
268	=SUM(Y246\Y247)\SUM(Y246\Y250)	=SUM(Z246\Z247)\SUM(Z246\Z250)	=SUM(AA246\AA247)\SUM(AA246\AA250)	=SUM(AB246\AB247)\SUM(AB246\AB250)	=SUM(AC246\AC247)\SUM(AC246\AC250)	=SUM(AD246\AD247)\SUM(AD246\AD250)	=SUM(AE246\AE247)\SUM(AE246\AE250)
269							
270							
271							
272	Perm Mix	Bleed 9	Perm 9	Perm Mix	Bleed 10	Perm 10	Perm Mix
273		25	26	27	28	29	30
274							
275	=X276\Y276	=Z276\Z276	=W276\Z276	=AA276\AE276	=AC276\AE276	=AD276\AE276	=AE276\AE276
276	=X277\Y277	=Z277\Z277	=W277\Z277	=AA277\AE277	=AC277\AE277	=AD277\AE277	=AE277\AE277
277	=X278\Y278	=Z278\Z278	=W278\Z278	=AA278\AE278	=AC278\AE278	=AD278\AE278	=AE278\AE278
278	=X279\Y279	=Z279\Z279	=W279\Z279	=AA279\AE279	=AC279\AE279	=AD279\AE279	=AE279\AE279
279	=X280\Y280	=Z280\Z280	=W280\Z280	=AA280\AE280	=AC280\AE280	=AD280\AE280	=AE280\AE280
280	=X281\Y281	=Z281\Z281	=W281\Z281	=AA281\AE281	=AC281\AE281	=AD281\AE281	=AE281\AE281
281	=X282\Y282	=Z282\Z282	=W282\Z282	=AA282\AE282	=AC282\AE282	=AD282\AE282	=AE282\AE282
282	=X283\Y283	=Z283\Z283	=W283\Z283	=AA283\AE283	=AC283\AE283	=AD283\AE283	=AE283\AE283
283							
284							
285	=X286\Y286	=Z286\Z286	=W286\Z286	=AA286\AE286	=AC286\AE286	=AD286\AE286	=AE286\AE286
286							
287							
288	=SUM(Y276\Y280)\Y282	=SUM(Z276\Z280)\Z282	=SUM(AA276\AA280)\AA282	=SUM(AB276\AB280)\AB282	=SUM(AC276\AC280)\AC282	=SUM(AD276\AD280)\AD282	=SUM(AE276\AE280)\AE282
289	=SUM(Y276\Y277)\SUM(Y276\Y280)	=SUM(Z276\Z277)\SUM(Z276\Z280)	=SUM(AA276\AA277)\SUM(AA276\AA280)	=SUM(AB276\AB277)\SUM(AB276\AB280)	=SUM(AC276\AC277)\SUM(AC276\AC280)	=SUM(AD276\AD277)\SUM(AD276\AD280)	=SUM(AE276\AE277)\SUM(AE276\AE280)
290							
291							
292							
293	=Y280\Y282	=Z280\Z282	=W280\Z282	=AA280\AE282	=AC280\AE282	=AD280\AE282	=AE280\AE282
294	=Y281\Y283	=Z281\Z283	=W281\Z283	=AA281\AE283	=AC281\AE283	=AD281\AE283	=AE281\AE283
295	=Y282\Y282	=Z282\Z282	=W282\Z282	=AA282\AE282	=AC282\AE282	=AD282\AE282	=AE282\AE282
296							
297	=SUM(Y276\Y280)\Y282	=SUM(Z276\Z280)\Z282	=SUM(AA276\AA280)\AA282	=SUM(AB276\AB280)\AB282	=SUM(AC276\AC280)\AC282	=SUM(AD276\AD280)\AD282	=SUM(AE276\AE280)\AE282
298	=SUM(Y276\Y277)\SUM(Y276\Y280)	=SUM(Z276\Z277)\SUM(Z276\Z280)	=SUM(AA276\AA277)\SUM(AA276\AA280)	=SUM(AB276\AB277)\SUM(AB276\AB280)	=SUM(AC276\AC277)\SUM(AC276\AC280)	=SUM(AD276\AD277)\SUM(AD276\AD280)	=SUM(AE276\AE277)\SUM(AE276\AE280)
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Appendix D

	AF	AG	AH	AI	AJ	AK	AL
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Appendix D

	AF	AG	AH	AI	AJ	AK	AL
77							
78	=AC79						
79	=AC80						
80	=AC81						
81	=AC82						
82	=AC83						
83	=AC84						
84	=AC85						
85							
86							
87	=AC87						
88	=AF66+AF67/SUM(AF66:AF70)						
89							
90							
91							
92							
93							
94							
95							
96	=AF\$102*AF109						
97	=AF\$102*AF110						
98	=AF\$102*AF111						
99	=AF\$102*AF112						
100	=AF\$102*AF113						
101	=AF\$102*AF114						
102	=AF103/AF117						
103	=1*1\$10pl.1\$E6						
104							
105							
106	=AF102/6.5						
107							
108							
109	=AD109						
110	=AD110						
111	=AD111						
112	=AD112						
113	=AD113						
114	=AD114						
115							
116							
117	=AC117						
118	=AF98+AF97/SUM(AF96:AF100)						
119							
120							
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124							
125	=AF\$132*AF139						
126	=AF\$132*AF140						
127	=AF\$132*AF141						
128	=AF\$132*AF142						
129	=AF\$132*AF143						
130	=AF\$132*AF144						
131	=AF\$132*AF145						
132	=AF133/AF147						
133	=1*1\$10pl.1\$E7						
134							
135							
136	=AF132/6.5						
137							
138							
139	=AC139						
140	=AC140						
141	=AC141						
142	=AC142						
143	=AC143						
144	=AC144						
145							
146							
147	=AC147						
148	=AF126+AF127/SUM(AF126:AF130)						
149							
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Appendix D

	AF	AG	AH	AI	AJ	AK	AL
153	31	32	33	34	35	36	37
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Appendix D

	AF	AG	AH	AI	AJ	AK	AL
228	=AC228	=AB229	=10-55% IJ25	=AI216/AJ222	=AJ216/AJ222	=AK216/AK222	0
230	=AC230	=AB231	=10-55% IJ26	=AI217/AJ222	=AJ217/AJ222	=AK217/AK222	0
231	=AC231	=AB232	=10-55% IJ27	=AI218/AJ222	=AJ218/AJ222	=AK218/AK222	0
232	=AC232	=AB233	=10-55% IJ28	=AI219/AJ222	=AJ219/AJ222	=AK219/AK222	0
233	=AC233	=AB234	=10-55% IJ29	=AI220/AJ222	=AJ220/AJ222	=AK220/AK222	0
234	=AC234	=AB235	=AH235-SUM(AH229-AH233)	=AI235-SUM(AI228-AI233)	=AJ235-SUM(AJ228-AJ233)	=AK235-SUM(AK228-AK233)	=1-SUM(AL228-AL233)
235	1	1	1	1	1	1	=AL222/AJ222
237	=AC237	=AB238	=10-55% IJ30	=AI237/AJ222	=AJ237/AJ222	=AK237/AK222	0
238	=AF216+AF217/SUM(AF216-217)	=AG216+AG217/SUM(AG216-217)	=AH216+AH217/SUM(AH216-217)	=AI216+AI217/SUM(AI216-217)	=AJ216+AJ217/SUM(AJ216-217)	=AK216+AK217/SUM(AK216-217)	=SUM(AL216-AL220)
239							=SUM(AL216-AL220)
240							
241							
242							
243							
244							
245							
246	=AF252/8.5	=AG252/8.5	=AH252/8.5	=AI252/8.5	=AJ252/8.5	=AK252/8.5	=10-55% IJ37
247							
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Appendix D

	AM	AN	AO	AP	AQ	AR	AS
	Diag. 1 Bled	Diag. 1 Perm	Perm. Mix	75% Wet	Diag. 2	Diag. 2 Feed	H2O Feed
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AM	AN	AO	AP	AQ	AR	AS
77						
78	=AN69/AN572					
79	=10-55%ID41					
80	=10-55%ID42					
81	=10-55%ID43					
82	=10-55%ID44					
83	=10-55%ID45					
84	=1-SUM(AM79/AM83)					
85	=AM72/AM572					
86						
87	=SUM(AM66/AM70/AM72)					
88	=SUM(AM66/AM70/AM72)					
89	=SUM(AM66/AM70/AM72)					
90						
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AM	AN	AO	AP	AO	AP	AO	AR	AS
153	39	40	41	42	43	44	45	46
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Appendix D

AM	AN	AO	AP	AQ	AR	AS
226 =10-55%IK41	=AN216/AN\$222	=AO216/AQ\$222	=10-55%IK41	=AQ216/AQ\$222	=AR216/AR\$222	0
230 =10-55%IK42	=AN217/AN\$222	=AO217/AQ\$222	=10-55%IK42	=AQ217/AQ\$222	=AR217/AR\$222	0
231 =10-55%IK43	=AN218/AN\$222	=AO218/AQ\$222	=10-55%IK43	=AQ218/AQ\$222	=AR218/AR\$222	0
232 =10-55%IK44	=AN219/AN\$222	=AO219/AQ\$222	=10-55%IK44	=AQ219/AQ\$222	=AR219/AR\$222	0
233 =10-55%IK45	=AN220/AN\$222	=AO220/AQ\$222	=10-55%IK45	=AQ220/AQ\$222	=AR220/AR\$222	0
234 =1-SUM(AM228;AM233)	=1-SUM(AO228;AO233)	=1-SUM(AQ228;AQ233)	=AP235-SUM(AP228;AP233)	=1-SUM(AQ228;AQ233)	=1-SUM(AR228;AR233)	1
235 =AM222/AM\$222	=AO222/AO\$222	=AQ222/AQ\$222	=AG235	=AQ222/AQ\$222	=AR222/AR\$222	1
236						
237 =SUM(AM216;AM220;AM222)	=SUM(AO216;AO220;AO222)	=SUM(AQ216;AQ220;AQ222)	=AM237	=SUM(AQ216;AQ220;AQ222)	=SUM(AR216;AR220;AR222)	=SUM(AS216;AS220;AS222)
238 =AM216*AM217/SUM(AM216;AM220)	=AM216*AM217/SUM(AO216;AO220)	=AM216*AM217/SUM(AQ216;AQ220)				
240						
241						
242	Dir. 1 Feed	Permi-Mix	75% Wt	Dir. 2	Dir. 2 Feed	H <sub>2</sub> O Feed
243 36	39	40	41	42	43	44
244						
245 =AM\$252*AM259	=AK246-AM246	=AN246+AM246	=AP\$252*AP259	=AM246-AP246	=AQ246+AS246	0
247 =AM\$252*AM260	=AK247-AM247	=AN247+AM247	=AP\$252*AP260	=AM247-AP247	=AQ247+AS247	0
248 =AM\$252*AM261	=AK248-AM248	=AN248+AM248	=AP\$252*AP261	=AM248-AP248	=AQ248+AS248	0
249 =AM\$252*AM262	=AK249-AM249	=AN249+AM249	=AP\$252*AP262	=AM249-AP249	=AQ249+AS249	0
250 =AM\$252*AM263	=AK250-AM250	=AN250+AM250	=AP\$252*AP263	=AM250-AP250	=AQ250+AS250	0
251 =AM\$252*AM264	=AK251-AM251	=AN251+AM251	=AP\$252*AP264	=AM251-AP251	=AQ251+AS251	=AS256*8.345
252 =AM259*6.5	=AK252-AM252	=AN252+AM252	=AP259/AP267	=AM252-AP252	=AQ252+AS252	=AS256*8.345
253 =SUM(AM246;AM250)	=AK253-AM253	=AN253+AM253	=10-10%IKF11	=AM253-AP253	=AQ253+AS253	1
254						
255						
256 =10-55%IK36	=AK256-AM256	=AN256+AM256	=AP252/6.5	=AM256-AP256	=AQ256+AS256	=10-85%IK7
257						
258						
259 =10-55%IK41	=AN246/AN\$252	=AO246/AQ\$252	=10-55%IK41	=AQ246/AQ\$252	=AR246/AR\$252	0
260 =10-55%IK42	=AN247/AN\$252	=AO247/AQ\$252	=10-55%IK42	=AQ247/AQ\$252	=AR247/AR\$252	0
261 =10-55%IK43	=AN248/AN\$252	=AO248/AQ\$252	=10-55%IK43	=AQ248/AQ\$252	=AR248/AR\$252	0
262 =10-55%IK44	=AN249/AN\$252	=AO249/AQ\$252	=10-55%IK44	=AQ249/AQ\$252	=AR249/AR\$252	0
263 =10-55%IK45	=AN250/AN\$252	=AO250/AQ\$252	=10-55%IK45	=AQ250/AQ\$252	=AR250/AR\$252	0
264 =1-SUM(AM259;AM263)	=1-SUM(AO259;AO263)	=1-SUM(AQ259;AQ263)	=AP265-SUM(AP259;AP263)	=1-SUM(AQ259;AQ263)	=1-SUM(AR259;AR263)	1
265 =AM252/AM\$252	=AO252/AO\$252	=AQ252/AQ\$252	=AG265	=AQ252/AQ\$252	=AR252/AR\$252	1
266						
267 =SUM(AM246;AM250;AM252)	=SUM(AO246;AO250;AO252)	=SUM(AQ246;AQ250;AQ252)	=AM267	=SUM(AQ246;AQ250;AQ252)	=SUM(AR246;AR250;AR252)	=SUM(AS246;AS250;AS252)
268 =AM246*AM247/SUM(AM246;AM250)	=AM246*AM247/SUM(AO246;AO250)	=AM246*AM247/SUM(AQ246;AQ250)				
269						
270						
271						
272	Dir. 1 Feed	Permi-Mix	75% Wt	Dir. 2	Dir. 2 Feed	H <sub>2</sub> O Feed
273 36	39	40	41	42	43	44
274						
275						
276 =AM\$282*AM289	=AK276-AM276	=AN276+AM276	=AP\$282*AP289	=AM276-AP276	=AQ276+AS276	0
277 =AM\$282*AM290	=AK277-AM277	=AN277+AM277	=AP\$282*AP290	=AM277-AP277	=AQ277+AS277	0
278 =AM\$282*AM291	=AK278-AM278	=AN278+AM278	=AP\$282*AP291	=AM278-AP278	=AQ278+AS278	0
279 =AM\$282*AM292	=AK279-AM279	=AN279+AM279	=AP\$282*AP292	=AM279-AP279	=AQ279+AS279	0
280 =AM\$282*AM293	=AK280-AM280	=AN280+AM280	=AP\$282*AP293	=AM280-AP280	=AQ280+AS280	0
281 =AM\$282*AM294	=AK281-AM281	=AN281+AM281	=AP\$282*AP294	=AM281-AP281	=AQ281+AS281	=AS286*8.345
282 =AM286*6.5	=AK282-AM282	=AN282+AM282	=AP283/297	=AM282-AP282	=AQ282+AS282	=AS286*8.345
283 =SUM(AM276;AM280)	=AK283-AM283	=AN283+AM283	=10-10%IKF12	=AM283-AP283	=AQ283+AS283	1
284						
285						
286 =10-55%IK36	=AK286-AM286	=AN286+AM286	=AP282/6.5	=AM286-AP286	=AQ286+AS286	=10-85%IK7
287						
288						
289 =10-55%IK41	=AN276/AN\$282	=AO276/AQ\$282	=10-55%IK41	=AQ276/AQ\$282	=AR276/AR\$282	0
290 =10-55%IK42	=AN277/AN\$282	=AO277/AQ\$282	=10-55%IK42	=AQ277/AQ\$282	=AR277/AR\$282	0
291 =10-55%IK43	=AN278/AN\$282	=AO278/AQ\$282	=10-55%IK43	=AQ278/AQ\$282	=AR278/AR\$282	0
292 =10-55%IK44	=AN279/AN\$282	=AO279/AQ\$282	=10-55%IK44	=AQ279/AQ\$282	=AR279/AR\$282	0
293 =10-55%IK45	=AN280/AN\$282	=AO280/AQ\$282	=10-55%IK45	=AQ280/AQ\$282	=AR280/AR\$282	0
294 =1-SUM(AM289;AM293)	=1-SUM(AO289;AO293)	=1-SUM(AQ289;AQ293)	=AP285-SUM(AP289;AP293)	=1-SUM(AQ289;AQ293)	=1-SUM(AR289;AR293)	1
295 =AM282/AM\$282	=AO282/AO\$282	=AQ282/AQ\$282	=AG285	=AQ282/AQ\$282	=AR282/AR\$282	1
296						
297 =SUM(AM276;AM280;AM282)	=SUM(AO276;AO280;AO282)	=SUM(AQ276;AQ280;AQ282)	=AM297	=SUM(AQ276;AQ280;AQ282)	=SUM(AR276;AR280;AR282)	=SUM(AS276;AS280;AS282)
298 =AM276*AM277/SUM(AM276;AM280)	=AM276*AM277/SUM(AO276;AO280)	=AM276*AM277/SUM(AQ276;AQ280)				
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Appendix D

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AT	AU	AV	AW	AX	AY	AZ
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78	=AU66/AU\$72	=AV66/AV\$72	=AW66/AW\$72	=AX66/AX\$72	=AY66/AY\$72	=AZ66/AZ\$72
79	=AU67/AU\$72	=AV67/AV\$72	=AW67/AW\$72	=AX67/AX\$72	=AY67/AY\$72	=AZ67/AZ\$72
80	=AU68/AU\$72	=AV68/AV\$72	=AW68/AW\$72	=AX68/AX\$72	=AY68/AY\$72	=AZ68/AZ\$72
81	=AU69/AU\$72	=AV69/AV\$72	=AW69/AW\$72	=AX69/AX\$72	=AY69/AY\$72	=AZ69/AZ\$72
82	=AU70/AU\$72	=AV70/AV\$72	=AW70/AW\$72	=AX70/AX\$72	=AY70/AY\$72	=AZ70/AZ\$72
83	=AU71/AU\$72	=AV71/AV\$72	=AW71/AW\$72	=AX71/AX\$72	=AY71/AY\$72	=AZ71/AZ\$72
84	=AU72/AU\$72	=AV72/AV\$72	=AW72/AW\$72	=AX72/AX\$72	=AY72/AY\$72	=AZ72/AZ\$72
85	=AU73/AU\$72	=AV73/AV\$72	=AW73/AW\$72	=AX73/AX\$72	=AY73/AY\$72	=AZ73/AZ\$72
86	=AU74/AU\$72	=AV74/AV\$72	=AW74/AW\$72	=AX74/AX\$72	=AY74/AY\$72	=AZ74/AZ\$72
87	=SUM(AU66:AU70)/AU72	=SUM(AV66:AV70)/AV72	=SUM(AW66:AW70)/AW72	=SUM(AX66:AX70)/AX72	=SUM(AY66:AY70)/AY72	=SUM(AZ66:AZ70)/AZ72
88	=SUM(AU66:AU70)/SUM(AU66:AU70)	=SUM(AV66:AV70)/SUM(AV66:AV70)	=SUM(AW66:AW70)/SUM(AW66:AW70)	=SUM(AX66:AX70)/SUM(AX66:AX70)	=SUM(AY66:AY70)/SUM(AY66:AY70)	=SUM(AZ66:AZ70)/SUM(AZ66:AZ70)
89						
90						
91						
92	85% Wet	Total Perm	35% Prod	75% Prod	85% Prod	Evap H2O
93	46	47	48	49	50	51
94						
95	=AR95/AR109	=AV95/AV109	=AW95/AW109	=AX95/AX109	=AY95/AY109	=AZ95/AZ109
96	=AR96/AR110	=AV96/AV110	=AW96/AW110	=AX96/AX110	=AY96/AY110	=AZ96/AZ110
97	=AR97/AR111	=AV97/AV111	=AW97/AW111	=AX97/AX111	=AY97/AY111	=AZ97/AZ111
98	=AR98/AR112	=AV98/AV112	=AW98/AW112	=AX98/AX112	=AY98/AY112	=AZ98/AZ112
99	=AR99/AR113	=AV99/AV113	=AW99/AW113	=AX99/AX113	=AY99/AY113	=AZ99/AZ113
100	=AR100/AR114	=AV100/AV114	=AW100/AW114	=AX100/AX114	=AY100/AY114	=AZ100/AZ114
101	=AR101/AR115	=AV101/AV115	=AW101/AW115	=AX101/AX115	=AY101/AY115	=AZ101/AZ115
102	=AR102/AR116	=AV102/AV116	=AW102/AW116	=AX102/AX116	=AY102/AY116	=AZ102/AZ116
103	=AR103/AR117	=AV103/AV117	=AW103/AW117	=AX103/AX117	=AY103/AY117	=AZ103/AZ117
104						
105						
106	=AR106/AR118	=AV106/AV118	=AW106/AW118	=AX106/AX118	=AY106/AY118	=AZ106/AZ118
107						
108						
109	=AU98/AU\$102	=AV98/AV\$102	=AW98/AW\$102	=AX98/AX\$102	=AY98/AY\$102	=AZ98/AZ\$102
110	=AU99/AU\$102	=AV99/AV\$102	=AW99/AW\$102	=AX99/AX\$102	=AY99/AY\$102	=AZ99/AZ\$102
111	=AU100/AU\$102	=AV100/AV\$102	=AW100/AW\$102	=AX100/AX\$102	=AY100/AY\$102	=AZ100/AZ\$102
112	=AU101/AU\$102	=AV101/AV\$102	=AW101/AW\$102	=AX101/AX\$102	=AY101/AY\$102	=AZ101/AZ\$102
113	=AU102/AU\$102	=AV102/AV\$102	=AW102/AW\$102	=AX102/AX\$102	=AY102/AY\$102	=AZ102/AZ\$102
114	=SUM(AU109:AU113)	=SUM(AV109:AV113)	=SUM(AW109:AW113)	=SUM(AX109:AX113)	=SUM(AY109:AY113)	=SUM(AZ109:AZ113)
115						
116						
117	=SUM(AU106:AU109)/AU102	=SUM(AV106:AV109)/AV102	=SUM(AW106:AW109)/AW102	=SUM(AX106:AX109)/AX102	=SUM(AY106:AY109)/AY102	=SUM(AZ106:AZ109)/AZ102
118	=SUM(AU106:AU109)/SUM(AU106:AU109)	=SUM(AV106:AV109)/SUM(AV106:AV109)	=SUM(AW106:AW109)/SUM(AW106:AW109)	=SUM(AX106:AX109)/SUM(AX106:AX109)	=SUM(AY106:AY109)/SUM(AY106:AY109)	=SUM(AZ106:AZ109)/SUM(AZ106:AZ109)
119						
120						
121						
122	85% Wet	Total Perm	35% Prod	75% Prod	85% Prod	Evap H2O
123	45	46	47	48	49	50
124						
125	=AR125/AR132	=AV125/AV132	=AW125/AW132	=AX125/AX132	=AY125/AY132	=AZ125/AZ132
126	=AR126/AR133	=AV126/AV133	=AW126/AW133	=AX126/AX133	=AY126/AY133	=AZ126/AZ133
127	=AR127/AR134	=AV127/AV134	=AW127/AW134	=AX127/AX134	=AY127/AY134	=AZ127/AZ134
128	=AR128/AR135	=AV128/AV135	=AW128/AW135	=AX128/AX135	=AY128/AY135	=AZ128/AZ135
129	=AR129/AR136	=AV129/AV136	=AW129/AW136	=AX129/AX136	=AY129/AY136	=AZ129/AZ136
130	=AR130/AR137	=AV130/AV137	=AW130/AW137	=AX130/AX137	=AY130/AY137	=AZ130/AZ137
131	=AR131/AR138	=AV131/AV138	=AW131/AW138	=AX131/AX138	=AY131/AY138	=AZ131/AZ138
132	=AR132/AR139	=AV132/AV139	=AW132/AW139	=AX132/AX139	=AY132/AY139	=AZ132/AZ139
133	=AR133/AR140	=AV133/AV140	=AW133/AW140	=AX133/AX140	=AY133/AY140	=AZ133/AZ140
134						
135						
136	=AR136/AR141	=AV136/AV141	=AW136/AW141	=AX136/AX141	=AY136/AY141	=AZ136/AZ141
137						
138						
139	=AU126/AU\$132	=AV126/AV\$132	=AW126/AW\$132	=AX126/AX\$132	=AY126/AY\$132	=AZ126/AZ\$132
140	=AU127/AU\$132	=AV127/AV\$132	=AW127/AW\$132	=AX127/AX\$132	=AY127/AY\$132	=AZ127/AZ\$132
141	=AU128/AU\$132	=AV128/AV\$132	=AW128/AW\$132	=AX128/AX\$132	=AY128/AY\$132	=AZ128/AZ\$132
142	=AU129/AU\$132	=AV129/AV\$132	=AW129/AW\$132	=AX129/AX\$132	=AY129/AY\$132	=AZ129/AZ\$132
143	=AU130/AU\$132	=AV130/AV\$132	=AW130/AW\$132	=AX130/AX\$132	=AY130/AY\$132	=AZ130/AZ\$132
144	=SUM(AU139:AU143)	=SUM(AV139:AV143)	=SUM(AW139:AW143)	=SUM(AX139:AX143)	=SUM(AY139:AY143)	=SUM(AZ139:AZ143)
145						
146						
147	=SUM(AU126:AU130)/AU132	=SUM(AV126:AV130)/AV132	=SUM(AW126:AW130)/AW132	=SUM(AX126:AX130)/AX132	=SUM(AY126:AY130)/AY132	=SUM(AZ126:AZ130)/AZ132
148	=SUM(AU126:AU130)/SUM(AU126:AU130)	=SUM(AV126:AV130)/SUM(AV126:AV130)	=SUM(AW126:AW130)/SUM(AW126:AW130)	=SUM(AX126:AX130)/SUM(AX126:AX130)	=SUM(AY126:AY130)/SUM(AY126:AY130)	=SUM(AZ126:AZ130)/SUM(AZ126:AZ130)
149						
150						
151						
152	85% Wet	Total Perm	35% Prod	75% Prod	85% Prod	Evap H2O

	AT	AU	AV	AW	AX	AY	AZ
153	46	47	48	49	50	51	
154							
155	=AR156-AT169	=AB159+Y156	=AF156	=AP156	=AT156	0	
156	=AR157-AT170	=AB157+Y157	=AF157	=AP157	=AT157	0	
157	=AR158-AT171	=AB158+Y158	=AF158	=AP158	=AT158	0	
158	=AR159-AT172	=AB159+Y159	=AF159	=AP159	=AT159	0	
159	=AR160-AT173	=AB160+Y160	=AF160	=AP160	=AT160	0	
160	=AR161-AT174	=AB161+Y161	0	0	0	0	
161	=AR162-AT175	=SUM(AV156:AV160)	=SUM(AW156:AW160)	=SUM(AX156:AX160)	=SUM(AY156:AY160)	=AZ161	
162	=AR163-AT163	=AB163+Y163	=AF163	=AP163	=AT163	0	
163	=SUM(AV156:AV180)						
164							
165							
166	=AR166-AT166	=AB166+Y166	=AW162/8.5	=AX162/8.5	=AY162/8.5	=AZ162/8.5	
167							
168							
169	=AU156/AU\$162	=AV156/AV\$162	=AW156/AW\$162	=AX156/AX\$162	=AY156/AY\$162	=AZ156/AZ\$162	
170	=AU157/AU\$162	=AV157/AV\$162	=AW157/AW\$162	=AX157/AX\$162	=AY157/AY\$162	=AZ157/AZ\$162	
171	=AU158/AU\$162	=AV158/AV\$162	=AW158/AW\$162	=AX158/AX\$162	=AY158/AY\$162	=AZ158/AZ\$162	
172	=AU159/AU\$162	=AV159/AV\$162	=AW159/AW\$162	=AX159/AX\$162	=AY159/AY\$162	=AZ159/AZ\$162	
173	=AU160/AU\$162	=AV160/AV\$162	=AW160/AW\$162	=AX160/AX\$162	=AY160/AY\$162	=AZ160/AZ\$162	
174	=AU161/AU\$162	=AV161/AV\$162	=AW161/AW\$162	=AX161/AX\$162	=AY161/AY\$162	=AZ161/AZ\$162	
175	=AU162/AU\$162	=AV162/AV\$162	=AW162/AW\$162	=AX162/AX\$162	=AY162/AY\$162	=AZ162/AZ\$162	
176							
177	=SUM(AU156:AU160)/AU162	=SUM(AV156:AV160)/AV162	=SUM(AW156:AW160)/AW162	=SUM(AX156:AX160)/AX162	=SUM(AY156:AY160)/AY162	=SUM(AZ156:AZ160)/AZ162	
178	=AU156+AU157/SUM(AU156:AU160)	=AV156+AV157/SUM(AV156:AV160)	=AW156+AW157/SUM(AW156:AW160)	=AX156+AX157/SUM(AX156:AX160)	=AY156+AY157/SUM(AY156:AY160)	=AZ156+AZ157/SUM(AZ156:AZ160)	
179							
180							
181							
182							
183							
184							
185							
186	=AR186-AT186	=AB186+Y186	=AF186	=AP186	=AT186	0	
187	=AR187-AT187	=AB187+Y187	=AF187	=AP187	=AT187	0	
188	=AR188-AT188	=AB188+Y188	=AF188	=AP188	=AT188	0	
189	=AR189-AT189	=AB189+Y189	=AF189	=AP189	=AT189	0	
190	=AR190-AT190	=AB190+Y190	=AF190	=AP190	=AT190	0	
191	=AR191-AT191	=AB191+Y191	0	0	0	0	
192	=AR192-AT192	=AB192+Y192	=SUM(AW186:AW190)	=SUM(AX186:AX190)	=SUM(AY186:AY190)	=AZ191	
193	=SUM(AV186:AV190)						
194							
195							
196	=AR196-AT196	=AB196+Y196	=AW192/8.5	=AX192/8.5	=AY192/8.5	=AZ192/8.5	
197							
198							
199	=AU186/AU\$192	=AV186/AV\$192	=AW186/AW\$192	=AX186/AX\$192	=AY186/AY\$192	=AZ186/AZ\$192	
200	=AU187/AU\$192	=AV187/AV\$192	=AW187/AW\$192	=AX187/AX\$192	=AY187/AY\$192	=AZ187/AZ\$192	
201	=AU188/AU\$192	=AV188/AV\$192	=AW188/AW\$192	=AX188/AX\$192	=AY188/AY\$192	=AZ188/AZ\$192	
202	=AU189/AU\$192	=AV189/AV\$192	=AW189/AW\$192	=AX189/AX\$192	=AY189/AY\$192	=AZ189/AZ\$192	
203	=AU190/AU\$192	=AV190/AV\$192	=AW190/AW\$192	=AX190/AX\$192	=AY190/AY\$192	=AZ190/AZ\$192	
204	=AU191/AU\$192	=AV191/AV\$192	=AW191/AW\$192	=AX191/AX\$192	=AY191/AY\$192	=AZ191/AZ\$192	
205	=AU192/AU\$192	=AV192/AV\$192	=AW192/AW\$192	=AX192/AX\$192	=AY192/AY\$192	=AZ192/AZ\$192	
206							
207	=SUM(AU186:AU190)/AU192	=SUM(AV186:AV190)/AV192	=SUM(AW186:AW190)/AW192	=SUM(AX186:AX190)/AX192	=SUM(AY186:AY190)/AY192	=SUM(AZ186:AZ190)/AZ192	
208	=AU186+AU187/SUM(AU186:AU190)	=AV186+AV187/SUM(AV186:AV190)	=AW186+AW187/SUM(AW186:AW190)	=AX186+AX187/SUM(AX186:AX190)	=AY186+AY187/SUM(AY186:AY190)	=AZ186+AZ187/SUM(AZ186:AZ190)	
209							
210							
211							
212							
213							
214							
215							
216	=AR216-AT216	=AB216+Y216	=AF216	=AP216	=AT216	0	
217	=AR217-AT217	=AB217+Y217	=AF217	=AP217	=AT217	0	
218	=AR218-AT218	=AB218+Y218	=AF218	=AP218	=AT218	0	
219	=AR219-AT219	=AB219+Y219	=AF219	=AP219	=AT219	0	
220	=AR220-AT220	=AB220+Y220	=AF220	=AP220	=AT220	0	
221	=AR221-AT221	=AB221+Y221	0	0	0	0	
222	=AR222-AT222	=AB222+Y222	=SUM(AW216:AW220)	=SUM(AX216:AX220)	=SUM(AY216:AY220)	=AZ221	
223	=AR223-AT223	=AB223+Y223	=AF223	=AP223	=AT223	0	
224							
225							
226	=AR226-AT226	=AB226+Y226	=AW222/8.5	=AX222/8.5	=AY222/8.5	=AZ222/8.5	
227							
228							

	AT	AU	AV	AW	AX	AY	AZ
228	=10.85%*H11	=AU216/AU222	=AV216/AV222	=AW216/AW222	=AX216/AX222	=AY216/AY222	=AZ216/AZ222
229	=10.85%*H12	=AU217/AU222	=AV217/AV222	=AW217/AW222	=AX217/AX222	=AY217/AY222	=AZ217/AZ222
230	=10.85%*H13	=AU218/AU222	=AV218/AV222	=AW218/AW222	=AX218/AX222	=AY218/AY222	=AZ218/AZ222
231	=10.85%*H14	=AU219/AU222	=AV219/AV222	=AW219/AW222	=AX219/AX222	=AY219/AY222	=AZ219/AZ222
232	=10.85%*H15	=AU220/AU222	=AV220/AV222	=AW220/AW222	=AX220/AX222	=AY220/AY222	=AZ220/AZ222
233	=10.85%*H16	=AU221/AU222	=AV221/AV222	=AW221/AW222	=AX221/AX222	=AY221/AY222	=AZ221/AZ222
234	=10.85%*H17	=AU222/AU222	=AV222/AV222	=AW222/AW222	=AX222/AX222	=AY222/AY222	=AZ222/AZ222
235	=10.85%*H18	=AU223/AU222	=AV223/AV222	=AW223/AW222	=AX223/AX222	=AY223/AY222	=AZ223/AZ222
236	=10.85%*H19	=AU224/AU222	=AV224/AV222	=AW224/AW222	=AX224/AX222	=AY224/AY222	=AZ224/AZ222
237	=SUM(A12:G16:A1220)/A1222	=SUM(AU216:AU220)/AU222	=SUM(AV216:AV220)/AV222	=SUM(AW216:AW220)/AW222	=SUM(AX216:AX220)/AX222	=SUM(AY216:AY220)/AY222	=SUM(AZ216:AZ220)/AZ222
238	=SUM(A12:G16:A1277)/SUM(A12:G16:A1280)	=SUM(AU216:AU217)/SUM(AU216:AU220)	=SUM(AV216:AV217)/SUM(AV216:AV220)	=SUM(AW216:AW217)/SUM(AW216:AW220)	=SUM(AX216:AX217)/SUM(AX216:AX220)	=SUM(AY216:AY217)/SUM(AY216:AY220)	=SUM(AZ216:AZ217)/SUM(AZ216:AZ220)
239	=10.85%*I1	=AU276/AU282	=AV276/AV282	=AW276/AW282	=AX276/AX282	=AY276/AY282	=AZ276/AZ282
240	=10.85%*I12	=AU277/AU282	=AV277/AV282	=AW277/AW282	=AX277/AX282	=AY277/AY282	=AZ277/AZ282
241	=10.85%*I13	=AU278/AU282	=AV278/AV282	=AW278/AW282	=AX278/AX282	=AY278/AY282	=AZ278/AZ282
242	=10.85%*I14	=AU279/AU282	=AV279/AV282	=AW279/AW282	=AX279/AX282	=AY279/AY282	=AZ279/AZ282
243	=10.85%*I15	=AU280/AU282	=AV280/AV282	=AW280/AW282	=AX280/AX282	=AY280/AY282	=AZ280/AZ282
244	=10.85%*I16	=AU281/AU282	=AV281/AV282	=AW281/AW282	=AX281/AX282	=AY281/AY282	=AZ281/AZ282
245	=10.85%*I17	=AU282/AU282	=AV282/AV282	=AW282/AW282	=AX282/AX282	=AY282/AY282	=AZ282/AZ282
246	=10.85%*I18	=AU283/AU282	=AV283/AV282	=AW283/AW282	=AX283/AX282	=AY283/AY282	=AZ283/AZ282
247	=10.85%*I19	=AU284/AU282	=AV284/AV282	=AW284/AW282	=AX284/AX282	=AY284/AY282	=AZ284/AZ282
248	=10.85%*I20	=AU285/AU282	=AV285/AV282	=AW285/AW282	=AX285/AX282	=AY285/AY282	=AZ285/AZ282
249	=10.85%*I21	=AU286/AU282	=AV286/AV282	=AW286/AW282	=AX286/AX282	=AY286/AY282	=AZ286/AZ282
250	=10.85%*I22	=AU287/AU282	=AV287/AV282	=AW287/AW282	=AX287/AX282	=AY287/AY282	=AZ287/AZ282
251	=10.85%*I23	=AU288/AU282	=AV288/AV282	=AW288/AW282	=AX288/AX282	=AY288/AY282	=AZ288/AZ282
252	=10.85%*I24	=AU289/AU282	=AV289/AV282	=AW289/AW282	=AX289/AX282	=AY289/AY282	=AZ289/AZ282
253	=10.85%*I25	=AU290/AU282	=AV290/AV282	=AW290/AW282	=AX290/AX282	=AY290/AY282	=AZ290/AZ282
254	=10.85%*I26	=AU291/AU282	=AV291/AV282	=AW291/AW282	=AX291/AX282	=AY291/AY282	=AZ291/AZ282
255	=10.85%*I27	=AU292/AU282	=AV292/AV282	=AW292/AW282	=AX292/AX282	=AY292/AY282	=AZ292/AZ282
256	=10.85%*I28	=AU293/AU282	=AV293/AV282	=AW293/AW282	=AX293/AX282	=AY293/AY282	=AZ293/AZ282
257	=10.85%*I29	=AU294/AU282	=AV294/AV282	=AW294/AW282	=AX294/AX282	=AY294/AY282	=AZ294/AZ282
258	=10.85%*I30	=AU295/AU282	=AV295/AV282	=AW295/AW282	=AX295/AX282	=AY295/AY282	=AZ295/AZ282
259	=10.85%*I31	=AU296/AU282	=AV296/AV282	=AW296/AW282	=AX296/AX282	=AY296/AY282	=AZ296/AZ282
260	=10.85%*I32	=AU297/AU282	=AV297/AV282	=AW297/AW282	=AX297/AX282	=AY297/AY282	=AZ297/AZ282
261	=10.85%*I33	=AU298/AU282	=AV298/AV282	=AW298/AW282	=AX298/AX282	=AY298/AY282	=AZ298/AZ282
262	=10.85%*I34	=AU299/AU282	=AV299/AV282	=AW299/AW282	=AX299/AX282	=AY299/AY282	=AZ299/AZ282
263	=10.85%*I35	=AU300/AU282	=AV300/AV282	=AW300/AW282	=AX300/AX282	=AY300/AY282	=AZ300/AZ282
264	=10.85%*I36	=AU301/AU282	=AV301/AV282	=AW301/AW282	=AX301/AX282	=AY301/AY282	=AZ301/AZ282
265	=10.85%*I37	=AU302/AU282	=AV302/AV282	=AW302/AW282	=AX302/AX282	=AY302/AY282	=AZ302/AZ282
266	=10.85%*I38	=AU303/AU282	=AV303/AV282	=AW303/AW282	=AX303/AX282	=AY303/AY282	=AZ303/AZ282
267	=10.85%*I39	=AU304/AU282	=AV304/AV282	=AW304/AW282	=AX304/AX282	=AY304/AY282	=AZ304/AZ282
268	=10.85%*I40	=AU305/AU282	=AV305/AV282	=AW305/AW282	=AX305/AX282	=AY305/AY282	=AZ305/AZ282
269	=10.85%*I41	=AU306/AU282	=AV306/AV282	=AW306/AW282	=AX306/AX282	=AY306/AY282	=AZ306/AZ282
270	=10.85%*I42	=AU307/AU282	=AV307/AV282	=AW307/AW282	=AX307/AX282	=AY307/AY282	=AZ307/AZ282
271	=10.85%*I43	=AU308/AU282	=AV308/AV282	=AW308/AW282	=AX308/AX282	=AY308/AY282	=AZ308/AZ282
272	=10.85%*I44	=AU309/AU282	=AV309/AV282	=AW309/AW282	=AX309/AX282	=AY309/AY282	=AZ309/AZ282
273	=10.85%*I45	=AU310/AU282	=AV310/AV282	=AW310/AW282	=AX310/AX282	=AY310/AY282	=AZ310/AZ282
274	=65%*J46						
275	=10.85%*J1	=AU246/AU252	=AV246/AV252	=AW246/AW252	=AX246/AX252	=AY246/AY252	=AZ246/AZ252
276	=10.85%*J2	=AU247/AU252	=AV247/AV252	=AW247/AW252	=AX247/AX252	=AY247/AY252	=AZ247/AZ252
277	=10.85%*J3	=AU248/AU252	=AV248/AV252	=AW248/AW252	=AX248/AX252	=AY248/AY252	=AZ248/AZ252
278	=10.85%*J4	=AU249/AU252	=AV249/AV252	=AW249/AW252	=AX249/AX252	=AY249/AY252	=AZ249/AZ252
279	=10.85%*J5	=AU250/AU252	=AV250/AV252	=AW250/AW252	=AX250/AX252	=AY250/AY252	=AZ250/AZ252
280	=10.85%*J6	=AU251/AU252	=AV251/AV252	=AW251/AW252	=AX251/AX252	=AY251/AY252	=AZ251/AZ252
281	=10.85%*J7	=AU252/AU252	=AV252/AV252	=AW252/AW252	=AX252/AX252	=AY252/AY252	=AZ252/AZ252
282	=10.85%*J8	=AU253/AU252	=AV253/AV252	=AW253/AW252	=AX253/AX252	=AY253/AY252	=AZ253/AZ252
283	=10.85%*J9	=AU254/AU252	=AV254/AV252	=AW254/AW252	=AX254/AX252	=AY254/AY252	=AZ254/AZ252
284	=10.85%*J10	=AU255/AU252	=AV255/AV252	=AW255/AW252	=AX255/AX252	=AY255/AY252	=AZ255/AZ252
285	=10.85%*J11	=AU256/AU252	=AV256/AV252	=AW256/AW252	=AX256/AX252	=AY256/AY252	=AZ256/AZ252
286	=10.85%*J12	=AU257/AU252	=AV257/AV252	=AW257/AW252	=AX257/AX252	=AY257/AY252	=AZ257/AZ252
287	=10.85%*J13	=AU258/AU252	=AV258/AV252	=AW258/AW252	=AX258/AX252	=AY258/AY252	=AZ258/AZ252
288	=10.85%*J14	=AU259/AU252	=AV259/AV252	=AW259/AW252	=AX259/AX252	=AY259/AY252	=AZ259/AZ252
289	=10.85%*J15	=AU260/AU252	=AV260/AV252	=AW260/AW252	=AX260/AX252	=AY260/AY252	=AZ260/AZ252
290	=10.85%*J16	=AU261/AU252	=AV261/AV252	=AW261/AW252	=AX261/AX252	=AY261/AY252	=AZ261/AZ252
291	=10.85%*J17	=AU262/AU252	=AV262/AV252	=AW262/AW252	=AX262/AX252	=AY262/AY252	=AZ262/AZ252
292	=10.85%*J18	=AU263/AU252	=AV263/AV252	=AW263/AW252	=AX263/AX252	=AY263/AY252	=AZ263/AZ252
293	=10.85%*J19	=AU264/AU252	=AV264/AV252	=AW264/AW252	=AX264/AX252	=AY264/AY252	=AZ264/AZ252
294	=10.85%*J20	=AU265/AU252	=AV265/AV252	=AW265/AW252	=AX265/AX252	=AY265/AY252	=AZ265/AZ252
295	=10.85%*J21	=AU266/AU252	=AV266/AV252	=AW266/AW252	=AX266/AX252	=AY266/AY252	=AZ266/AZ252
296	=10.85%*J22	=AU267/AU252	=AV267/AV252	=AW267/AW252	=AX267/AX252	=AY267/AY252	=AZ267/AZ252
297	=10.85%*J23	=AU268/AU252	=AV268/AV252	=AW268/AW252	=AX268/AX252	=AY268/AY252	=AZ268/AZ252
298	=10.85%*J24	=AU269/AU252	=AV269/AV252	=AW269/AW252	=AX269/AX252	=AY269/AY252	=AZ269/AZ252
299	=10.85%*J25	=AU270/AU252	=AV270/AV252	=AW270/AW252	=AX270/AX252	=AY270/AY252	=AZ270/AZ252
300	=10.85%*J26	=AU271/AU252	=AV271/AV252	=AW271/AW252	=AX271/AX252	=AY271/AY252	=AZ271/AZ252
301	=10.85%*J27	=AU272/AU252	=AV272/AV252	=AW272/AW252	=AX272/AX252	=AY272/AY252	=AZ272/AZ252
302	=10.85%*J28	=AU273/AU252	=AV273/AV252	=AW273/AW252	=AX273/AX252	=AY273/AY252	=AZ273/AZ252
303	=10.85%*J29	=AU274/AU252	=AV274/AV252	=AW274/AW252	=AX274/AX252	=AY274/AY252	=AZ274/AZ252
304	=10.85%*J30	=AU275/AU252	=AV275/AV252	=AW275/AW252	=AX275/AX252	=AY275/AY252	=AZ275/AZ252
305	=10.85%*J31	=AU276/AU252	=AV276/AV252	=AW276/AW252	=AX276/AX252	=AY276/AY252	=AZ276/AZ252
306	=10.85%*J32	=AU277/AU252	=AV277/AV252	=AW277/AW252	=AX277/AX252	=AY277/AY252	=AZ277/AZ252
307	=10.85%*J33	=AU278/AU252	=AV278/AV252	=AW278/AW252	=AX278/AX252	=AY278/AY252	=AZ278/AZ252
308	=10.85%*J34	=AU279/AU252	=AV279/AV252	=AW279/AW252	=AX279/AX252	=AY279/AY252	=AZ279/AZ252
309	=10.85%*J35	=AU280/AU252	=AV280/AV252	=AW280/AW252	=AX280/AX252	=AY280/AY252	=AZ280/AZ252



	BA	BB	BC	BD	BE	BF	BG
1	BA	BB	BC	BD	BE	BF	BG
2	Evap. Perm	Wet Perm	Perm Prod	Perm Feat	Perm Store	Perm Waste	Perm Milk
3	53	54	55	56	57	58	59
4	5	6	7	8	9	10	11
5	AV6-BB812/AV812	BB8-BAB	BD812-BD19	BD8+BB6	BAV6-BE6	BE6	BB6
6	AV7-BB812/AV812	BB7+BA7	BD7-BD20	BD7+BB7	BAV7-BE7	BE7	BB7
7	AV8-BB812/AV812	BB8+BA8	BD812-BD21	BD8+BB8	BAV8-BE8	BE8	BB8
8	AV9-BB812/AV812	BB9+BA9	BD912-BD22	BD9+BB9	BAV9-BE9	BE9	BB9
9	AV10-BB812/AV812	BB10+BA10	BD12-BD23	BD10+BB10	BAV10-BE10	BE10	BB10
10	AV11-BB812/AV812	BB11+BA11	BD12-BD24	BD11+BB11	BAV11-BE11	BE11	BB11
11	AV12-BB812/AV812	BB12+BA12	BD12-BD24	BD12+BB12	BAV12-BE12	BE12	BB12
12	AV13-BB812/AV812	BB13+BA13	SUM(BD6:BD10)	SUM(BE6:BE10)	BAV13-BE13	BE13	BB13
13	SUM(BA6:BA11)	SUM(BB6:BB10)					
14	BD13						
15							
16	BA12/8.5	BB12/8.5	BC12/8.5	BD12/8.5	BE12/8.5		BE16
17							
18							
19	BA6/BA812	BB6/BB812	BC6/BC812	BD6/BD8	BE6/BE812		BB6/BB812
20	BA7/BA812	BB7/BB812	BC7/BC812	BD7	BE7/BE812		BB7/BB812
21	BA8/BA812	BB8/BB812	BC8/BC812	BD8	BE8/BE812		BB8/BB812
22	BA9/BA812	BB9/BB812	BC9/BC812	BD9	BE9/BE812		BB9/BB812
23	BA10/BA812	BB10/BB812	BC10/BC812	BD10	BE10/BE812		BB10/BB812
24	BA25-SUM(BA19:BA23)	BB25-SUM(BB19:BB23)	BC25-SUM(BC19:BC23)	BD25	BE25-SUM(BE19:BE23)		BG25-SUM(BG19:BG23)
25	1	1	1	1	1		1
26							
27	SUM(BA6:BA10)/BA12	SUM(BB6:BB10)/BB12	SUM(BC6:BC10)/BC12	SUM(BD6:BD10)/BD12	SUM(BE6:BE10)/BE12		SUM(BG6:BG10)/BG12
28	(BA6-BA7)/SUM(BA6:BA10)	(BB6-BB7)/SUM(BB6:BB10)	(BC6-BC7)/SUM(BC6:BC10)	(BD6-BD7)/SUM(BD6:BD10)	(BE6-BE7)/SUM(BE6:BE10)		(BG6-BG7)/SUM(BG6:BG10)
29							
30							
31							
32	Evap. Perm	Wet Perm	Perm Prod	Perm Feat	Perm Store	Perm Waste	Perm Milk
33	53	54	55	56	57	58	59
34	35	36	37	38	39	40	41
35	AV36-BB842/AV842	BB836-BA36	BD842-BD48	BD836+BB36	BAV36-BE36	BE36	BB36
36	AV37-BB842/AV842	BB837-BA37	BD842-BD50	BD837+BB37	BAV37-BE37	BE37	BB37
37	AV38-BB842/AV842	BB838-BA38	BD842-BD51	BD838+BB38	BAV38-BE38	BE38	BB38
38	AV39-BB842/AV842	BB839-BA39	BD842-BD52	BD839+BB39	BAV39-BE39	BE39	BB39
39	AV40-BB842/AV842	BB840-BA40	BD842-BD53	BD840+BB40	BAV40-BE40	BE40	BB40
40	AV41-BB842/AV842	BB841-BA41	BD842-BD54	BD841+BB41	BAV41-BE41	BE41	BB41
41	AV42-BB842/AV842	BB842-BA42	BD842-BD54	BD842+BB42	BAV42-BE42	BE42	BB42
42	SUM(BA36:BA41)	SUM(BB36:BB41)	SUM(BC36:BC41)	SUM(BD36:BD41)	SUM(BE36:BE41)		SUM(BG36:BG41)
43	BD43						
44							
45							
46	BA42/8.5	BB42/8.5	BC42/8.5	BD42/8.5	BE42/8.5		BE46
47							
48							
49	BA36/BA842	BB36/BB842	BC36/BC842	BD36/BD842	BE36/BE842		BB36/BB842
50	BA37/BA842	BB37/BB842	BC37/BC842	BD37	BE37/BE842		BB37/BB842
51	BA38/BA842	BB38/BB842	BC38/BC842	BD38	BE38/BE842		BB38/BB842
52	BA39/BA842	BB39/BB842	BC39/BC842	BD39	BE39/BE842		BB39/BB842
53	BA40/BA842	BB40/BB842	BC40/BC842	BD40	BE40/BE842		BB40/BB842
54	BA55-SUM(BA48:BA53)	BB55-SUM(BB49:BB53)	BC55-SUM(BC48:BC53)	BD55	BE55-SUM(BE49:BE53)		BG55-SUM(BG49:BG53)
55	1	1	1	1	1		1
56							
57	SUM(BA36:BA40)/BA42	SUM(BB36:BB40)/BB42	SUM(BC36:BC40)/BC42	SUM(BD36:BD40)/BD42	SUM(BE36:BE40)/BE42		SUM(BG36:BG40)/BG42
58	(BA36-BA37)/SUM(BA36:BA40)	(BB36-BB37)/SUM(BB36:BB40)	(BC36-BC37)/SUM(BC36:BC40)	(BD36-BD37)/SUM(BD36:BD40)	(BE36-BE37)/SUM(BE36:BE40)		(BG36-BG37)/SUM(BG36:BG40)
59							
60							
61							
62	Evap. Perm	Wet Perm	Perm Prod	Perm Feat	Perm Store	Perm Waste	Perm Milk
63	53	54	55	56	57	58	59
64							
65							
66	AV66-BB867/AV867	BB66+BA66	BD867-BD78	BD66+BB66	BAV66-BE66	BE66	BB66
67	AV67-BB867/AV867	BB67+BA67	BD867-BD80	BD67+BB67	BAV67-BE67	BE67	BB67
68	AV68-BB867/AV867	BB68+BA68	BD867-BD81	BD68+BB68	BAV68-BE68	BE68	BB68
69	AV69-BB867/AV867	BB69+BA69	BD867-BD82	BD69+BB69	BAV69-BE69	BE69	BB69
70	AV70-BB867/AV867	BB70+BA70	BD867-BD83	BD70+BB70	BAV70-BE70	BE70	BB70
71	AV71-BB867/AV867	BB71+BA71	BD867-BD83	BD71+BB71	BAV71-BE71	BE71	BB71
72	SUM(BA66:BA71)	SUM(BB66:BB70)	SUM(BC66:BC70)	SUM(BD66:BD70)	SUM(BE66:BE70)		SUM(BG66:BG70)
73	BD73						
74							
75							
76	BA72/8.5	BB72/8.5	BC72/8.5	BD72/8.5	BE72/8.5		BE76

	BA	BB	BC	BD	BE	BF	BG
77							
78	BA126/BA132	BB26/BB32	BC66/BC72	BD79	BE66/BE72		BG66/BG72
79	BA127/BA133	BB27/BB33	BC67/BC73	BD80	BE67/BE73		BG67/BG73
80	BA128/BA134	BB28/BB34	BC68/BC74	BD81	BE68/BE74		BG68/BG74
81	BA129/BA135	BB29/BB35	BC69/BC75	BD82	BE69/BE75		BG69/BG75
82	BA130/BA136	BB30/BB36	BC70/BC76	BD83	BE70/BE76		BG70/BG76
83	BA131/BA137	BB31/BB37	BC71/BC77	BD84	BE71/BE77		BG71/BG77
84	BA132/BA138	BB32/BB38	BC72/BC78	BD85	BE72/BE78		BG72/BG78
85	BA133/BA139	BB33/BB39	BC73/BC79	BD86	BE73/BE79		BG73/BG79
86							
87	SUM(BA66:BA172)	SUM(BB66:BB172)	SUM(BC66:BC172)	SUM(BD66:BD172)	SUM(BE66:BE172)		SUM(BG66:BG172)
88	(BA66+BA67)/SUM(BA66:BA170)	(BB66+BB67)/SUM(BB66:BB170)	(BC66+BC67)/SUM(BC66:BC170)	(BD66+BD67)/SUM(BD66:BD170)	(BE66+BE67)/SUM(BE66:BE170)		(BG66+BG67)/SUM(BG66:BG170)
89							
90							
91							
92	Evap Perm	Wet Perm	Perm Prod	Perm Feed	Perm Store	Perm Waste	Perm Mix
93	53	54	55	56	57	58	
94							
95							
96	BA126/BA132	BB26/BB32	BC66/BC72	BD79	BE66/BE72		BG66/BG72
97	BA127/BA133	BB27/BB33	BC67/BC73	BD80	BE67/BE73		BG67/BG73
98	BA128/BA134	BB28/BB34	BC68/BC74	BD81	BE68/BE74		BG68/BG74
99	BA129/BA135	BB29/BB35	BC69/BC75	BD82	BE69/BE75		BG69/BG75
100	BA130/BA136	BB30/BB36	BC70/BC76	BD83	BE70/BE76		BG70/BG76
101	BA131/BA137	BB31/BB37	BC71/BC77	BD84	BE71/BE77		BG71/BG77
102	SUM(BA66:BA101)	SUM(BB66:BB101)	SUM(BC66:BC101)	SUM(BD66:BD101)	SUM(BE66:BE101)		SUM(BG66:BG101)
103	(BA66+BA67)/SUM(BA66:BA100)	(BB66+BB67)/SUM(BB66:BB100)	(BC66+BC67)/SUM(BC66:BC100)	(BD66+BD67)/SUM(BD66:BD100)	(BE66+BE67)/SUM(BE66:BE100)		(BG66+BG67)/SUM(BG66:BG100)
104							
105	BA102/8.5	BB102/8.5	BC102/8.5	BD102/8.5	BE102/8.5		BG106
106							
107							
108	BA96/BA102	BB96/BB102	BC96/BC102	BD109	BE96/BE102		BG96/BG102
109	BA97/BA102	BB97/BB102	BC97/BC102	BD110	BE97/BE102		BG97/BG102
110	BA98/BA102	BB98/BB102	BC98/BC102	BD111	BE98/BE102		BG98/BG102
111	BA99/BA102	BB99/BB102	BC99/BC102	BD112	BE99/BE102		BG99/BG102
112	BA100/BA102	BB100/BB102	BC100/BC102	BD113	BE100/BE102		BG100/BG102
113	BA115-SUM(BA108:BA113)	BB115-SUM(BB109:BB113)	BC115-SUM(BC109:BC113)	BD114	BE115-SUM(BE108:BE113)		BG115-SUM(BG109:BG113)
114	BA115	BB115	BC115	BD114	BE115		BG115
115							
116	SUM(BA96:BA100)	SUM(BB96:BB100)	SUM(BC96:BC100)	SUM(BD96:BD102)	SUM(BE96:BE102)		SUM(BG96:BG100)
117	(BA96+BA97)/SUM(BA96:BA100)	(BB96+BB97)/SUM(BB96:BB100)	(BC96+BC97)/SUM(BC96:BC100)	(BD96+BD97)/SUM(BD96:BD100)	(BE96+BE97)/SUM(BE96:BE100)		(BG96+BG97)/SUM(BG96:BG100)
118							
119							
120							
121							
122	Evap Perm	Wet Perm	Perm Prod	Perm Feed	Perm Store	Perm Waste	Perm Mix
123	57	58	59	60	61	62	
124							
125							
126	BD126	BB126/BB132	BC126/BC132	BD138	BE126/BE132		BG126
127	BD127	BB127/BB133	BC127/BC133	BD139	BE127/BE133		BG127
128	BD128	BB128/BB134	BC128/BC134	BD140	BE128/BE134		BG128
129	BD129	BB129/BB135	BC129/BC135	BD141	BE129/BE135		BG129
130	BD130	BB130/BB136	BC130/BC136	BD142	BE130/BE136		BG130
131	BD131	BB131/BB137	BC131/BC137	BD143	BE131/BE137		BG131
132	SUM(BA126:BA131)	SUM(BB126:BB131)	SUM(BC126:BC131)	SUM(BD131:BD143)	SUM(BE126:BE131)		SUM(BG126:BG131)
133	(BA126+BA127)/SUM(BA126:BA130)	(BB126+BB127)/SUM(BB126:BB130)	(BC126+BC127)/SUM(BC126:BC130)	(BD126+BD127)/SUM(BD126:BD130)	(BE126+BE127)/SUM(BE126:BE130)		(BG126+BG127)/SUM(BG126:BG130)
134							
135							
136	BA132/8.5	BB132/8.5	BC132/8.5	BD132/8.5	BE132/8.5		BG136
137							
138							
139	BA126/BA132	BB126/BB132	BC126/BC132	BD138	BE126/BE132		BG126/BG132
140	BA127/BA133	BB127/BB133	BC127/BC133	BD139	BE127/BE133		BG127/BG132
141	BA128/BA134	BB128/BB134	BC128/BC134	BD140	BE128/BE134		BG128/BG132
142	BA129/BA135	BB129/BB135	BC129/BC135	BD141	BE129/BE135		BG129/BG132
143	BA130/BA136	BB130/BB136	BC130/BC136	BD142	BE130/BE136		BG130/BG132
144	BA131/BA137	BB131/BB137	BC131/BC137	BD143	BE131/BE137		BG131/BG132
145	BA145-SUM(BA138:BA143)	BB145-SUM(BB139:BB143)	BC145-SUM(BC139:BC143)	BD145	BE145-SUM(BE139:BE143)		BG145-SUM(BG139:BG143)
146	BA145	BB145	BC145	BD145	BE145		BG145
147	SUM(BA126:BA130)	SUM(BB126:BB130)	SUM(BC126:BC130)	SUM(BD126:BD132)	SUM(BE126:BE132)		SUM(BG126:BG132)
148	(BA126+BA127)/SUM(BA126:BA130)	(BB126+BB127)/SUM(BB126:BB130)	(BC126+BC127)/SUM(BC126:BC130)	(BD126+BD127)/SUM(BD126:BD130)	(BE126+BE127)/SUM(BE126:BE130)		(BG126+BG127)/SUM(BG126:BG130)
149							
150							
151							
152	Evap Perm	Wet Perm	Perm Prod	Perm Feed	Perm Store	Perm Waste	Perm Mix

	BA	BB	BC	BD	BE	BF	BG
153	=BA192/8.5						
154							
155							
156	=BA156/BA162	=BB156/BB162	=BC156/BC162	=BD156/BD162	=BE156/BE162	=BF156/BF162	=BG156/BG162
157	=BA157/BA162	=BB157/BB162	=BC157/BC162	=BD157/BD162	=BE157/BE162	=BF157/BF162	=BG157/BG162
158	=BA158/BA162	=BB158/BB162	=BC158/BC162	=BD158/BD162	=BE158/BE162	=BF158/BF162	=BG158/BG162
159	=BA159/BA162	=BB159/BB162	=BC159/BC162	=BD159/BD162	=BE159/BE162	=BF159/BF162	=BG159/BG162
160	=BA160/BA162	=BB160/BB162	=BC160/BC162	=BD160/BD162	=BE160/BE162	=BF160/BF162	=BG160/BG162
161	=BA161/BA162	=BB161/BB162	=BC161/BC162	=BD161/BD162	=BE161/BE162	=BF161/BF162	=BG161/BG162
162	=BA162/BA162	=BB162/BB162	=BC162/BC162	=BD162/BD162	=BE162/BE162	=BF162/BF162	=BG162/BG162
163	=BA163/BA162	=BB163/BB162	=BC163/BC162	=BD163/BD162	=BE163/BE162	=BF163/BF162	=BG163/BG162
164							
165							
166	=BA166/BA162	=BB166/BB162	=BC166/BC162	=BD166/BD162	=BE166/BE162	=BF166/BF162	=BG166/BG162
167							
168							
169	=BA169/BA162	=BB169/BB162	=BC169/BC162	=BD169/BD162	=BE169/BE162	=BF169/BF162	=BG169/BG162
170	=BA170/BA162	=BB170/BB162	=BC170/BC162	=BD170/BD162	=BE170/BE162	=BF170/BF162	=BG170/BG162
171	=BA171/BA162	=BB171/BB162	=BC171/BC162	=BD171/BD162	=BE171/BE162	=BF171/BF162	=BG171/BG162
172	=BA172/BA162	=BB172/BB162	=BC172/BC162	=BD172/BD162	=BE172/BE162	=BF172/BF162	=BG172/BG162
173	=BA173/BA162	=BB173/BB162	=BC173/BC162	=BD173/BD162	=BE173/BE162	=BF173/BF162	=BG173/BG162
174	=BA174/BA162	=BB174/BB162	=BC174/BC162	=BD174/BD162	=BE174/BE162	=BF174/BF162	=BG174/BG162
175	=BA175/BA162	=BB175/BB162	=BC175/BC162	=BD175/BD162	=BE175/BE162	=BF175/BF162	=BG175/BG162
176							
177	=BA177/BA162	=BB177/BB162	=BC177/BC162	=BD177/BD162	=BE177/BE162	=BF177/BF162	=BG177/BG162
178	=BA178/BA162	=BB178/BB162	=BC178/BC162	=BD178/BD162	=BE178/BE162	=BF178/BF162	=BG178/BG162
179	=BA179/BA162	=BB179/BB162	=BC179/BC162	=BD179/BD162	=BE179/BE162	=BF179/BF162	=BG179/BG162
180							
181							
182							
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225							
226							
227							
228							

BA	BB	BC	BD	BE	BF	BG
229	BBA216/BA\$222					
230	BBA217/BA\$222					
231	BBA218/BA\$222					
232	BBA219/BA\$222					
233	BBA220/BA\$222					
234	BBA225-SUM(BA225:BA233)					
235	BAQ235					
236						
237	SUM(BB216:BB220)/BB222					
238	(BA216:BA217)/SUM(BA216:BA220)					
239						
240						
241						
242	Expn Perm					
243						
244						
245						
246	BD246					
247	BD247					
248	BD248					
249	BD249					
250	BD250					
251						
252	SUM(BA246:BA251)					
253	BD253					
254						
255						
256	BA252/8.5					
257						
258	BA246/BA\$52					
259	BA247/BA\$52					
260	BA248/BA\$52					
261	BA249/BA\$52					
262	BA250/BA\$52					
263	BA250/BA\$52					
264	BA256-SUM(BA256:BA263)					
265						
266						
267	SUM(BA246:BA250)/BA252					
268	(BA246+BA247)/SUM(BA246:BA250)					
269						
270						
271						
272	Expn Perm					
273						
274						
275						
276	BD276					
277	BD277					
278	BD278					
279	BD279					
280	BD280					
281						
282	SUM(BA276:BA281)					
283	BD283					
284						
285						
286	BA282/8.5					
287						
288						
289	BA276/BA\$382					
290	BA277/BA\$382					
291	BA278/BA\$382					
292	BA279/BA\$382					
293	BA280/BA\$382					
294	BA285-SUM(BA285:BA293)					
295						
296						
297	SUM(BE276:BE280)/BE282					
298	(BA276+BA277)/SUM(BA276:BA280)					
299						
300						
301						



	BI	BI	BI	BK	BL	BM	BN	BO
77								
78								
79	=BH69/BH127		=B166/B127	=BK69/BK127	=BL69/BL127	=BM69/BM127	=BN69/BN127	
80	=BH67/BH122		=B167/B122	=BK67/BK122	=BL67/BL122	=BM67/BM122	=BN67/BN122	
81	=BH69/BH127		=B169/B127	=BK69/BK127	=BL69/BL127	=BM69/BM127	=BN69/BN127	
82	=BH69/BH127		=B169/B127	=BK69/BK127	=BL69/BL127	=BM69/BM127	=BN69/BN127	
83	=BH70/BH127		=B170/B127	=BK70/BK127	=BL70/BL127	=BM70/BM127	=BN70/BN127	
84	=BH65-SUM(BH79;BH83)		=B185-SUM(B179;B183)	=BK65-SUM(BK78;BK83)	=BL85-SUM(BL79;BL83)	=BM65-SUM(BM79;BM83)	=BN65-SUM(BN79;BN83)	
85								
86								
87	=SUM(BH66;BH70;BH72)		=SUM(BJ66;BJ70;BJ72)	=SUM(BK66;BK70;BK72)	=SUM(BL66;BL70;BL72)	=SUM(BM66;BM70;BM72)	=SUM(BN66;BN70;BN72)	
88	=SUM(BH66;BH70)		=SUM(BJ66;BJ70)	=SUM(BK66;BK70)	=SUM(BL66;BL70)	=SUM(BM66;BM70)	=SUM(BN66;BN70)	
89								
90								
91								
92								
93								
94								
95								
96	=AS96+AL96		=AZ96-BH96	=B196-BJ96	=BK96+BF96			
97	=AS97+AL97		=AZ97-BH97	=B197-BJ97	=BK97+BF97			
98	=AS98+AL98		=AZ98-BH98	=B198-BJ98	=BK98+BF98			
99	=AS99+AL99		=AZ99-BH99	=B199-BJ99	=BK99+BF99			
100	=AS100+AL100		=AZ100-BH100	=B100-BJ100	=BK100+BF100			
101	=AS101+AL101		=AZ101-BH101	=B101-BJ101	=BK101+BF101			
102	=AS102+AL102		=AZ102-BH102	=B102-BJ102	=BK102+BF102			
103	=AS103+AL103		=AZ103-BH103	=B103-BJ103	=BK103+BF103			
104								
105								
106	=BH102/8.345		=TimeW29	=BK102/8.345	=BK105+BF106	=TimeW28*7	=BN102/8.345	
107								
108								
109	=BH96/BH102		=B196/BJ102	=BK96/BK102	=BL96/BL102	=BM96/BM102	=BN96/BN102	
110	=BH97/BH102		=B197/BJ102	=BK97/BK102	=BL97/BL102	=BM97/BM102	=BN97/BN102	
111	=BH98/BH102		=B198/BJ102	=BK98/BK102	=BL98/BL102	=BM98/BM102	=BN98/BN102	
112	=BH99/BH102		=B199/BJ102	=BK99/BK102	=BL99/BL102	=BM99/BM102	=BN99/BN102	
113	=BH100/BH102		=B100/BJ102	=BK100/BK102	=BL100/BL102	=BM100/BM102	=BN100/BN102	
114	=BH115-SUM(BH109;BH113)		=B115-SUM(BJ109;BJ113)	=BK115-SUM(BK109;BK113)	=BL115-SUM(BL109;BL113)	=BM115-SUM(BM109;BM113)	=BN115-SUM(BN109;BN113)	
115								
116								
117	=SUM(BH96;BH100;BH102)		=SUM(BJ96;BJ100;BJ102)	=SUM(BK96;BK100;BK102)	=SUM(BL96;BL100;BL102)	=SUM(BM96;BM100;BM102)	=SUM(BN96;BN100;BN102)	
118	=SUM(BH96;BH100)		=SUM(BJ96;BJ100)	=SUM(BK96;BK100)	=SUM(BL96;BL100)	=SUM(BM96;BM100)	=SUM(BN96;BN100)	
119								
120								
121								
122								
123								
124								
125	=AS126+AL126		=AZ126-BH126	=B126-BJ126	=BK126+BF126			
126	=AS127+AL127		=AZ127-BH127	=B127-BJ127	=BK127+BF127			
127	=AS128+AL128		=AZ128-BH128	=B128-BJ128	=BK128+BF128			
128	=AS129+AL129		=AZ129-BH129	=B129-BJ129	=BK129+BF129			
129	=AS130+AL130		=AZ130-BH130	=B130-BJ130	=BK130+BF130			
130	=AS131+AL131		=AZ131-BH131	=B131-BJ131	=BK131+BF131			
131	=AS132+AL132		=AZ132-BH132	=B132-BJ132	=BK132+BF132			
132	=AS133+AL133		=AZ133-BH133	=B133-BJ133	=BK133+BF133			
133								
134								
135								
136								
137								
138								
139	=BH126/BH132		=B126/BJ132	=BK126/BK132	=BL126/BL132	=BM126/BM132	=BN126/BN132	
140	=BH127/BH132		=B127/BJ132	=BK127/BK132	=BL127/BL132	=BM127/BM132	=BN127/BN132	
141	=BH128/BH132		=B128/BJ132	=BK128/BK132	=BL128/BL132	=BM128/BM132	=BN128/BN132	
142	=BH129/BH132		=B129/BJ132	=BK129/BK132	=BL129/BL132	=BM129/BM132	=BN129/BN132	
143	=BH130/BH132		=B130/BJ132	=BK130/BK132	=BL130/BL132	=BM130/BM132	=BN130/BN132	
144	=BH145-SUM(BH139;BH143)		=B145-SUM(BJ139;BJ143)	=BK145-SUM(BK139;BK143)	=BL145-SUM(BL139;BL143)	=BM145-SUM(BM139;BM143)	=BN145-SUM(BN139;BN143)	
145								
146								
147	=SUM(BH126;BH130;BH132)		=SUM(BJ126;BJ130;BJ132)	=SUM(BK126;BK130;BK132)	=SUM(BL126;BL130;BL132)	=SUM(BM126;BM130;BM132)	=SUM(BN126;BN130;BN132)	
148	=SUM(BH126;BH130)		=SUM(BJ126;BJ130)	=SUM(BK126;BK130)	=SUM(BL126;BL130)	=SUM(BM126;BM130)	=SUM(BN126;BN130)	
149								
150								
151								
152								

	BH	BI	BJ	BK	BL	BM	BN	BO
153	99	60	61	62	63	64	65	
154								
155	-AS156+AL156	=AZ156-BH156	0	=B156-BJ156	=BK156+BF156		=BL156	
156	-AS157+AL157	=AZ157-BH157	0	=B157-BJ157	=BK157+BF157		=BL157	
157	-AS158+AL158	=AZ158-BH158	0	=B158-BJ158	=BK158+BF158		=BL158	
158	-AS159+AL159	=AZ159-BH159	0	=B159-BJ159	=BK159+BF159		=BL159	
159	-AS160+AL160	=AZ160-BH160	0	=B160-BJ160	=BK160+BF160		=BL160	
160	-AS161+AL161	=AZ161-BH161	0	=B161-BJ161	=BK161+BF161		=BL161	
161	-AS162+AL162	=AZ162-BH162	0	=B162-BJ162	=BK162+BF162		=BL162	
162	-AS163+AL163	=AZ163-BH163	0	=B163-BJ163	=BK163+BF163		=BL163	
163								
164								
165	-BH162/8.345	=B162/8.345	=TimeK37	=BK162/8.345	=BK166+BF166	=TimeL367	=BN162/8.345	
166								
167								
168								
169	-BH166/BH162	=B166/BH162	=B166/BL162	=BK166/BK162	=BL166/BL162	=BM166/BM162	=BN166/BN162	
170	-BH167/BH162	=B167/BH162	=B167/BL162	=BK167/BK162	=BL167/BL162	=BM167/BM162	=BN167/BN162	
171	-BH168/BH162	=B168/BH162	=B168/BL162	=BK168/BK162	=BL168/BL162	=BM168/BM162	=BN168/BN162	
172	-BH169/BH162	=B169/BH162	=B169/BL162	=BK169/BK162	=BL169/BL162	=BM169/BM162	=BN169/BN162	
173	-BH160/BH162	=B160/BH162	=B160/BL162	=BK160/BK162	=BL160/BL162	=BM160/BM162	=BN160/BN162	
174	-BH175-SUM(BH169:BH173)	=B175-SUM(BJ169:BJ173)	1	=BK175-SUM(BK169:BK173)	=BL175-SUM(BL169:BL173)	=BM175-SUM(BM169:BM173)	=BN175-SUM(BN169:BN173)	
175	1	1	1	1	1	1	1	
176								
177	-SUM(BH156:BH160)/BH162	=SUM(BJ156:BJ160)/BJ162	=SUM(BK156:BK160)/BK162	=SUM(BL156:BL160)/BL162	=SUM(BM156:BM160)/BM162	=SUM(BN156:BN160)/BN162		
178	=(BH156+BH157)/SUM(BH156:BH160)	=(BJ156+BJ157)/SUM(BJ156:BJ160)	=(BK156+BK157)/SUM(BK156:BK160)	=(BL156+BL157)/SUM(BL156:BL160)	=(BM156+BM157)/SUM(BM156:BM160)	=(BN156+BN157)/SUM(BN156:BN160)		
179								
180								
181								
182								
183								
184								
185								
186	-AS186+AL186	=AZ186-BH186	0	=B186-BJ186	=BK186+BF186		=BL186	
187	-AS187+AL187	=AZ187-BH187	0	=B187-BJ187	=BK187+BF187		=BL187	
188	-AS188+AL188	=AZ188-BH188	0	=B188-BJ188	=BK188+BF188		=BL188	
189	-AS189+AL189	=AZ189-BH189	0	=B189-BJ189	=BK189+BF189		=BL189	
190	-AS190+AL190	=AZ190-BH190	0	=B190-BJ190	=BK190+BF190		=BL190	
191	-AS191+AL191	=AZ191-BH191	0	=B191-BJ191	=BK191+BF191		=BL191	
192	-AS192+AL192	=AZ192-BH192	0	=B192-BJ192	=BK192+BF192		=BL192	
193	-AS193+AL193	=AZ193-BH193	0	=B193-BJ193	=BK193+BF193		=BL193	
194								
195								
196	-BH192/8.345	=B192/8.345	=TimeI037	=BK192/8.345	=BK196+BF196	=TimeJ367	=BN192/8.345	
197								
198								
199	-BH186/BH182	=B186/BH182	=B186/BL182	=BK186/BK182	=BL186/BL182	=BM186/BM182	=BN186/BN182	
200	-BH187/BH182	=B187/BH182	=B187/BL182	=BK187/BK182	=BL187/BL182	=BM187/BM182	=BN187/BN182	
201	-BH188/BH182	=B188/BH182	=B188/BL182	=BK188/BK182	=BL188/BL182	=BM188/BM182	=BN188/BN182	
202	-BH189/BH182	=B189/BH182	=B189/BL182	=BK189/BK182	=BL189/BL182	=BM189/BM182	=BN189/BN182	
203	-BH190/BH182	=B190/BH182	=B190/BL182	=BK190/BK182	=BL190/BL182	=BM190/BM182	=BN190/BN182	
204	-BH205-SUM(BH189:BH203)	=B1205-SUM(BJ189:BJ203)	1	=BK205-SUM(BK189:BK203)	=BL205-SUM(BL189:BL203)	=BM205-SUM(BM189:BM203)	=BN205-SUM(BN189:BN203)	
205	1	1	1	1	1	1	1	
206								
207	-SUM(BH186:BH190)/BH192	=SUM(BJ186:BJ190)/BJ192	=SUM(BK186:BK190)/BK192	=SUM(BL186:BL190)/BL192	=SUM(BM186:BM190)/BM192	=SUM(BN186:BN190)/BN192		
208	=(BH186+BH187)/SUM(BH186:BH190)	=(BJ186+BJ187)/SUM(BJ186:BJ190)	=(BK186+BK187)/SUM(BK186:BK190)	=(BL186+BL187)/SUM(BL186:BL190)	=(BM186+BM187)/SUM(BM186:BM190)	=(BN186+BN187)/SUM(BN186:BN190)		
209								
210								
211								
212								
213								
214								
215								
216	-AS216+AL216	=AZ216-BH216	0	=B216-BJ216	=BK216+BF216		=BL216	
217	-AS217+AL217	=AZ217-BH217	0	=B217-BJ217	=BK217+BF217		=BL217	
218	-AS218+AL218	=AZ218-BH218	0	=B218-BJ218	=BK218+BF218		=BL218	
219	-AS219+AL219	=AZ219-BH219	0	=B219-BJ219	=BK219+BF219		=BL219	
220	-AS220+AL220	=AZ220-BH220	0	=B220-BJ220	=BK220+BF220		=BL220	
221	-AS221+AL221	=AZ221-BH221	0	=B221-BJ221	=BK221+BF221		=BL221	
222	-AS222+AL222	=AZ222-BH222	0	=B222-BJ222	=BK222+BF222		=BL222	
223	-AS223+AL223	=AZ223-BH223	0	=B223-BJ223	=BK223+BF223		=BL223	
224								
225								
226								
227								
228								

	BH	BI	BJ	BK	BL	BM	BN	BO
229	=BH216/BH4322	=BI216/BI4322	=BJ216/BJ4322	=BK216/BK4322	=BL216/BL4322	=BM216/BM4322	=BN216/BN4322	
230	=BH217/BH4322	=BI217/BI4322	=BJ217/BJ4322	=BK217/BK4322	=BL217/BL4322	=BM217/BM4322	=BN217/BN4322	
231	=BH218/BH4322	=BI218/BI4322	=BJ218/BJ4322	=BK218/BK4322	=BL218/BL4322	=BM218/BM4322	=BN218/BN4322	
232	=BH219/BH4322	=BI219/BI4322	=BJ219/BJ4322	=BK219/BK4322	=BL219/BL4322	=BM219/BM4322	=BN219/BN4322	
233	=BH220/BH4322	=BI220/BI4322	=BJ220/BJ4322	=BK220/BK4322	=BL220/BL4322	=BM220/BM4322	=BN220/BN4322	
234	=BH235-SUM(BH229-BH233)	=BI235-SUM(BI229-BI233)	=BJ235-SUM(BJ229-BJ233)	=BK235-SUM(BK229-BK233)	=BL235-SUM(BL229-BL233)	=BM235-SUM(BM229-BM233)	=BN235-SUM(BN229-BN233)	
235	1	1	1	1	1	1	1	
236	=SUM(BH216:BH220)/BH222	=SUM(BI216:BI220)/BI222	=SUM(BJ216:BJ220)/BJ220	=SUM(BK216:BK220)/BK222	=SUM(BL216:BL220)/BL220	=SUM(BM216:BM220)/BM222	=SUM(BN216:BN220)/BN222	
237	=SUM(BH216+BH217)/SUM(BH216:BH220)	=SUM(BI216+BI217)/SUM(BI216:BI220)	=SUM(BJ216+BJ217)/SUM(BJ216:BJ220)	=SUM(BK216+BK217)/SUM(BK216:BK220)	=SUM(BL216+BL217)/SUM(BL216:BL220)	=SUM(BM216+BM217)/SUM(BM216:BM220)	=SUM(BN216+BN217)/SUM(BN216:BN220)	
238								
239								
240								
241								
242								
243								
244								
245								
246	=S246+AL246	=A246/BH246	0	=BI246-BI246	=BK246-BK246	=BL246-BL246	=BN246/BN4322	
247	=S247+AL247	=A247/BH247	0	=BI247-BI247	=BK247-BK247	=BL247-BL247	=BN247/BN4322	
248	=S248+AL248	=A248/BH248	0	=BI248-BI248	=BK248-BK248	=BL248-BL248	=BN248/BN4322	
249	=S249+AL249	=A249/BH249	0	=BI249-BI249	=BK249-BK249	=BL249-BL249	=BN249/BN4322	
250	=S250+AL250	=A250/BH250	0	=BI250-BI250	=BK250-BK250	=BL250-BL250	=BN250/BN4322	
251	=S251+AL251	=A251/BH251	0	=BI251-BI251	=BK251-BK251	=BL251-BL251	=BN251/BN4322	
252	=S252+AL252	=A252/BH252	0	=BI252-BI252	=BK252-BK252	=BL252-BL252	=BN252/BN4322	
253	=S253+AL253	=A253/BH253	1	=BI253-BI253	=BK253-BK253	=BL253-BL253	=BN253/BN4322	
254								
255	=BH252/8.345	=BI252/8.345	=TimeW37	=BK252/8.345	=BL252+BF256	=TimeX367	=BN252/8.345	
256								
257								
258	=BH246/BH4322	=BI246/BI4322	=BJ246/BJ4322	=BK246/BK4322	=BL246/BL4322	=BM246/BM4322	=BN246/BN4322	
259	=BH247/BH4322	=BI247/BI4322	=BJ247/BJ4322	=BK247/BK4322	=BL247/BL4322	=BM247/BM4322	=BN247/BN4322	
260	=BH248/BH4322	=BI248/BI4322	=BJ248/BJ4322	=BK248/BK4322	=BL248/BL4322	=BM248/BM4322	=BN248/BN4322	
261	=BH249/BH4322	=BI249/BI4322	=BJ249/BJ4322	=BK249/BK4322	=BL249/BL4322	=BM249/BM4322	=BN249/BN4322	
262	=BH250/BH4322	=BI250/BI4322	=BJ250/BJ4322	=BK250/BK4322	=BL250/BL4322	=BM250/BM4322	=BN250/BN4322	
263	=BH255-SUM(BH259-BH263)	=BI255-SUM(BI259-BI263)	=BJ255-SUM(BJ259-BJ263)	=BK255-SUM(BK259-BK263)	=BL255-SUM(BL259-BL263)	=BM255-SUM(BM259-BM263)	=BN255-SUM(BN259-BN263)	
264	1	1	1	1	1	1	1	
265	=SUM(BH246:BH250)/BH252	=SUM(BI246:BI250)/BI252	=SUM(BJ246:BJ250)/BJ250	=SUM(BK246:BK250)/BK252	=SUM(BL246:BL250)/BL252	=SUM(BM246:BM250)/BM252	=SUM(BN246:BN250)/BN252	
266	=SUM(BH246+BH247)/SUM(BH246:BH250)	=SUM(BI246+BI247)/SUM(BI246:BI250)	=SUM(BJ246+BJ247)/SUM(BJ246:BJ250)	=SUM(BK246+BK247)/SUM(BK246:BK250)	=SUM(BL246+BL247)/SUM(BL246:BL250)	=SUM(BM246+BM247)/SUM(BM246:BM250)	=SUM(BN246+BN247)/SUM(BN246:BN250)	
267								
268								
269								
270								
271								
272								
273								
274								
275								
276								
277								
278								
279								
280								
281								
282								
283								
284								
285								
286								
287								
288								
289								
290								
291								
292								
293								
294								
295								
296								
297								
298								
299								
300								
301								



	BP	BQ	BR
1			
2			
3			
4			
5			
6	=BM6+AV8+BK6		
7	=BM7+AV7+BK7		
8	=BM8+AV8+BK8		
9	=BM9+AV9+BK9		
10	=BM10+AV10+BK10		
11	=BM11+AV11+BK11-BD11		
12	=SUM(BP6:BP11)		
13			
14			
15			
16	=BP12/8.5		
17			
18			
19	=BP6/BP\$12		
20	=BP7/BP\$12		
21	=BP8/BP\$12		
22	=BP9/BP\$12		
23	=BP10/BP\$12		
24	=BP11/BP\$12		
25	=BP12/BP\$12		
26			
27	=SUM(BP6:BP10)/BP12		
28	0		
29	=8.5*(BP21)/342.3*453.592*1232*1000/3.785	mg/liter soln	300
30	=0.6*BP29	mg/liter soln	300
31	=BP30/1000*3.785/453.59	lb/gal	=BR30/1000*3.785/453.59
32			
33			
34			
35			
36	=BM36+AV36+BK36	=BP36-allyear3BP40	
37	=BM37+AV37+BK37	=BP37-allyear3BP41	
38	=BM38+AV38+BK38	=BP38-allyear3BP42	
39	=BM39+AV39+BK39	=BP39-allyear3BP43	
40	=BM40+AV40+BK40	=BP40-allyear3BP44	
41	=BM41+AV41+BK41-BD41		
42	=SUM(BP36:BP41)		
43			
44			
45			
46	=BP42/8.5	=242.485*7	
47			
48			
49	=BP36/BP\$42		
50	=BP37/BP\$42		
51	=BP38/BP\$42		
52	=BP39/BP\$42		
53	=BP40/BP\$42		
54	=BP41/BP\$42		
55	=BP42/BP\$42		
56			
57	=SUM(BP36:BP40)/BP42		
58	0		
59	=8.5*(BP61)/342.3*453.592*1232*1000/3.785	mg/liter soln	300
60	=0.6*BP59	mg/liter soln	300
61	=BP60/1000*3.785/453.59	lb/gal	=BR60/1000*3.785/453.59
62			
63			
64			
65			
66	=BM66+AV66+BK66		
67	=BM67+AV67+BK67		
68	=BM68+AV68+BK68		
69	=BM69+AV69+BK69		
70	=BM70+AV70+BK70		
71	=BM71+AV71+BK71-BD71		
72	=SUM(BP66:BP71)		
73			
74			
75			
76	=BP72/8.5		

	BP	BQ	BR
77			
78			
79	=BP96/BP72		
80	=BP97/BP72		
81	=BP98/BP72		
82	=BP99/BP72		
83	=BP100/BP72		
84	=BP101/BP72		
85	=BP102/BP72		
86	=SUM(BP96:BP101)/BP72		
87			
88			
89	=8.5*(BP81/342.3+453.592*12.32*1000/3.785	mg/liter soln	300
90	=0.6*BP89	mg/liter soln	=BR90/1000*3.785/453.59
91	=BP90/1000*3.785/453.59	lb/gal	
92			
93			
94			
95			
96	=BM96+AV96+BK96		
97	=BM97+AV97+BK97		
98	=BM98+AV98+BK98		
99	=BM99+AV99+BK99		
100	=BM100+AV100+BK100		
101	=BM101+AV101+BK101		
102	=SUM(BP96:BP101)		
103			
104			
105			
106	=BP102/8.5		
107			
108			
109	=BP96/BP102		
110	=BP97/BP102		
111	=BP98/BP102		
112	=BP99/BP102		
113	=BP100/BP102		
114	=BP101/BP102		
115	=BP102/BP102		
116			
117	=SUM(BP96:BP101)/BP102		
118			
119	=8.5*(BP111/342.3+453.592*12.32*1000/3.785	mg/liter soln	300
120	=0.6*BP119	mg/liter soln	=BR120/1000*3.785/453.59
121	=BP120/1000*3.785/453.59	lb/gal	
122			
123			
124			
125			
126	=BM126+AV126+BK126		
127	=BM127+AV127+BK127		
128	=BM128+AV128+BK128		
129	=BM129+AV129+BK129		
130	=BM130+AV130+BK130		
131	=BM131+AV131+BK131		
132	=SUM(BP126:BP131)		
133			
134			
135			
136	=BP132/8.5		
137			
138			
139	=BP129/BP132		
140	=BP127/BP132		
141	=BP128/BP132		
142	=BP129/BP132		
143	=BP130/BP132		
144	=BP131/BP132		
145	=BP132/BP132		
146			
147	=SUM(BP126:BP130)/BP132		
148			
149	=8.5*(BP141/342.3+453.592*12.32*1000/3.785	mg/liter soln	300
150	=0.6*BP149	mg/liter soln	=BR150/1000*3.785/453.59
151	=BP150/1000*3.785/453.59	lb/gal	
152			

	BP	BQ	BR
153			
154			
155	=BM156+AV156+BK156		
156	=BM157+AV157+BK157		
157	=BM158+AV158+BK158		
158	=BM159+AV159+BK159		
159	=BM160+AV160+BK160		
160	=BM161+AV161+BK161		
161	=SUM(BP156:BP161)		
162			
163			
164			
165			
166	=BP162/8.5		
167			
168			
169	=BP156/BP162		
170	=BP157/BP162		
171	=BP158/BP162		
172	=BP159/BP162		
173	=BP160/BP162		
174	=BP161/BP162		
175	=BP162/BP162		
176			
177	=SUM(BP156:BP160)/BP162		
178			
179	=8.5*(BP171/342.3+453.5927*12^32*1000/3.785	mg/liter soln	
180	=0.6*BP179	mg/liter soln	300
181	=BP180/1000*3.785453.59	lb/gal	=BR180/1000*3.785453.59
182			
183			
184			
185	=BM186+AV186+BK186		
186	=BM187+AV187+BK187		
187	=BM188+AV188+BK188		
188	=BM189+AV189+BK189		
189	=BM190+AV190+BK190		
190	=BM191+AV191+BK191		
191	=SUM(BP186:BP191)		
192			
193			
194			
195			
196	=BP192/8.5		
197			
198			
199	=BP186/BP192		
200	=BP187/BP192		
201	=BP188/BP192		
202	=BP189/BP192		
203	=BP190/BP192		
204	=BP191/BP192		
205	=BP192/BP192		
206			
207	=SUM(BP186:BP190)/BP192		
208			
209	=8.5*(BP201/342.3+453.5927*12^32*1000/3.785	mg/liter soln	
210	=0.6*BP208	mg/liter soln	300
211	=BP210/1000*3.785453.59	lb/gal	=BR210/1000*3.785453.59
212			
213			
214			
215			
216	=BM216+AV216+BK216		
217	=BM217+AV217+BK217		
218	=BM218+AV218+BK218		
219	=BM219+AV219+BK219		
220	=BM220+AV220+BK220		
221	=BM221+AV221+BK221		
222	=SUM(BP216:BP221)		
223			
224			
225			
226	=BP222/8.5		
227			
228			

	BP	BQ	BR
229	=BP216/BP222		
230	=BP217/BP222		
231	=BP218/BP222		
232	=BP219/BP222		
233	=BP220/BP222		
234	=BP221/BP222		
235	=BP222/BP222		
236			
237	=SUM(BP216:BP220)/BP222		
238	0		
239	=8.5*(BP231/342.3+453.592*12^32*1000/3.785	mg/liter soln	
240	=0.6*BP239	mg/liter soln	300
241	=BR240/1000*3.785/453.59	lb/gal	=BR240/1000*3.785/453.59
242			
243			
244			
245			
246	=BM246+AV246+BK246		
247	=BM247+AV247+BK247		
248	=BM248+AV248+BK248		
249	=BM249+AV249+BK249		
250	=BM250+AV250+BK250		
251	=BM251+AV251+BK251+BD251		
252	=SUM(BP246:BP251)		
253			
254			
255			
256	=BP252/8.5		
257			
258			
259	=BP246/BP252		
260	=BP247/BP252		
261	=BP248/BP252		
262	=BP249/BP252		
263	=BP250/BP252		
264	=BP251/BP252		
265	=BP252/BP252		
266			
267	=SUM(BP246:BP250)/BP252		
268	0		
269	=8.5*(BP261/342.3+453.592*12^32*1000/3.785	mg/liter soln	
270	=0.6*BP269	mg/liter soln	300
271	=BR270/1000*3.785/453.59	lb/gal	=BR270/1000*3.785/453.59
272			
273			
274			
275			
276	=BM276+AV276+BK276		
277	=BM277+AV277+BK277		
278	=BM278+AV278+BK278		
279	=BM279+AV279+BK279		
280	=BM280+AV280+BK280		
281	=BM281+AV281+BK281+BD281		
282	=SUM(BP276:BP281)		
283			
284			
285			
286	=BP282/8.5		
287			
288			
289	=BP276/BP282		
290	=BP277/BP282		
291	=BP278/BP282		
292	=BP279/BP282		
293	=BP280/BP282		
294	=BP281/BP282		
295	=BP282/BP282		
296			
297	=SUM(BP276:BP280)/BP282		
298	0		
299	=8.5*(BP291/342.3+453.592*12^32*1000/3.785	mg/liter soln	
300	=0.6*BP299	mg/liter soln	300
301	=BR300/1000*3.785/453.59	lb/gal	=BR300/1000*3.785/453.59

A	B	C	D	E	F	G	H	I
1	Residence Time < Holdup Volume/Bleed Rate	Holdup Volume (gal)	Eled Rate (gpd)	Time (days)	Time (hours)		Number of Cartridges	
2	Stage	# of Cartridges	Holdup Volume (gal)				Stage	
3	0.35						0.35	
4	1	22	=PI()*3*2*40/231*B4/4	=max35% K13	=C4/D4		1	=10years B3
5	2	22	=PI()*3*2*40/231*B5/4	=max35% K18	=C5/D5		2	=14
6	3	22	=PI()*3*2*40/231*B6/4	=max35% K23	=C6/D6		3	=15
7	4	22	=PI()*3*2*40/231*B7/4	=max35% K28	=C7/D7		4	=16
8	5	22	=PI()*3*2*40/231*B8/4	=max35% K33	=C8/D8		5	=17
9	6	22	=PI()*3*2*40/231*B9/4	=max35% K38	=C9/D9		6	=18
10	7	22	=PI()*3*2*40/231*B10/4	=max35% K43	=C10/D10		7	=19
11	8	22	=PI()*3*2*40/231*B11/4	=max35% K48	=C11/D11		8	=110
12	9	22	=PI()*3*2*40/231*B12/4	=max35% K60	=C12/D12		9	=111
13	10	20	=PI()*3*2*40/231*B13/4	=max35% K58	=C13/D13		10	=10years B57
14	Total Time				=SUM(F4:F13)		0.55	
15							1	=10.55% B5
16	1	12	=PI()*3*2*40/231*B16/4	=max55% B53	=C16/D16		0.75	
17	Total Time				=F16+F14		1	=10.55% B50
18	0.75						0.85	
19	1	20	=PI()*3*2*40/231*B19/4	=max55% B74	=C19/D19		1	=10.85% B20
20	Total Time				=F17+F19		Volume	=SUM(I4:I19)*PI()*3*2*40/231
21	0.85							
22	1	22	=PI()*3*2*40/231*B22/4	=max55% B4	=C22/D22			
23	Total Volume		=C22+C19+C16+SUM(C4:C13)	Total Time	=F22+F20			
24								
25	1	=2max55% C112	=PI()*3*2*40/231*B25/4	=max55% C63	=C25/D25		1	
26	2	=B25	=PI()*3*2*40/231*B26/4	=D25	=C26/D26		1	
27	Total Time				=F25+F14+F26			
28	0.75							
29	1	=2max55% C124	=PI()*3*2*40/231*B29/4	=max55% C74	=C29/D29			
30	Total Time				=E29*20			
31	0.85				=F27+F29			
32	1	8	=PI()*3*2*40/231*B32/4	=max55% C4	=C32/D32			
33	Total Volume		=C32+C29+C26*2+SUM(C4:C13)	Total Time	=F32+F30			
34								
35								
36								
37	0.35							
38	0.75							
39	0.85							
40								
41								
42								
43								
44								
45								
46								
47								
48								
49								

	J	K	L	M	N	O
1						
2						
3		=10years!D3	=10years!E3	=10years!F3	=10years!G3	=10years!H3
4	=10years!C3	=K4	=L4	=M4	=N4	=O4
5	=J4	=K5	=L5	=M5	=N5	=O5
6	=J5	=K6	=L6	=M6	=N6	=O6
7	=J6	=K7	=L7	=M7	=N7	=O7
8	=J7	=K8	=L8	=M8	=N8	=O8
9	=J8	=K9	=L9	=M9	=N9	=O9
10	=J9	=K10	=L10	=M10	=N10	=O10
11	=J10	=K11	=L11	=M11	=N11	=O11
12	=SUM(L4:L19)*P(0.3*2/4*40/231)	=SUM(K4:K19)*P(0.3*2/4*40/231)	=SUM(L4:L19)*P(0.3*2/4*40/231)	=SUM(M4:M19)*P(0.3*2/4*40/231)	=SUM(N4:N19)*P(0.3*2/4*40/231)	=SUM(O4:O19)*P(0.3*2/4*40/231)
13	=10.55%/C5	=10.55%/D5	=10.55%/E5	=10.55%/F5	=10.55%/G5	=10.55%/H5
14	=10.55%/C5	=10.55%/D5	=10.55%/E5	=10.55%/F5	=10.55%/G5	=10.55%/H5
15	=10.55%/C5	=10.55%/D5	=10.55%/E5	=10.55%/F5	=10.55%/G5	=10.55%/H5
16	=10.55%/C50	=10.55%/D50	=10.55%/E50	=10.55%/F50	=10.55%/G50	=10.55%/H50
17	=10.85%/C20	=10.85%/D20	=10.85%/E20	=10.85%/F20	=10.85%/G20	=10.85%/H20
18	=SUM(L4:L19)*P(0.3*2/4*40/231)	=SUM(K4:K19)*P(0.3*2/4*40/231)	=SUM(L4:L19)*P(0.3*2/4*40/231)	=SUM(M4:M19)*P(0.3*2/4*40/231)	=SUM(N4:N19)*P(0.3*2/4*40/231)	=SUM(O4:O19)*P(0.3*2/4*40/231)
19	=10.85%/C20	=10.85%/D20	=10.85%/E20	=10.85%/F20	=10.85%/G20	=10.85%/H20
20	=SUM(L4:L19)*P(0.3*2/4*40/231)	=SUM(K4:K19)*P(0.3*2/4*40/231)	=SUM(L4:L19)*P(0.3*2/4*40/231)	=SUM(M4:M19)*P(0.3*2/4*40/231)	=SUM(N4:N19)*P(0.3*2/4*40/231)	=SUM(O4:O19)*P(0.3*2/4*40/231)
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
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44						
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47						
48						
49						

	P	Q	R	S	T	U	V
1							
2							
3							
4	=10years/I13	21	21				
5	=P4	=Q5	=R5				
6	=P5	=Q6	=R6				
7	=P6	=Q7	=R7				
8	=P7	=Q8	=R8				
9	=P8	=Q9	=R9				
10	=P9	=Q10	=R10				
11	=P10	=Q11	=R11				
12	=P11	=Q12	=R12				
13	=10years/I157	=10years/I157	=10years/I157				
14							
15	=10.55%/I15	=10.55%/I15	=10.55%/I15				
16							
17	=10.55%/I150	=10.55%/I150	=10.55%/I150				
18							
19	=10.85%/I20	=10.85%/I20	=10.85%/I20				
20	=SUM(P4:P19)*P10^3*2/4^40/231	=SUM(Q4:Q19)*P10^3*2/4^40/231	=SUM(R4:R19)*P10^3*2/4^40/231	=SUM(S4:S19)			
21							
22							
23							
24							
25	=10.55%/I150	=10.55%/I150	=10.55%/I150				
26	=10.55%/I150	=10.55%/I150	=10.55%/I150				
27	=10.55%/I150	=10.55%/I150	=10.55%/I150				
28	=10.55%/I150	=10.55%/I150	=10.55%/I150				
29							
30							
31							
32							
33							
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							
45							
46							
47							
48							
49							

	W	X	Y	Z	AA	AB	AC	
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22	Year 4				Year 5			
23	H2O		60 day supply		Volume (gal/day)		H2O	
24	Total		=V25*60		=AB25*0.01		Total	
25	=X25-V25	=L\$20+85	=V25*60	=AB25-Z25	=M\$20+85	=Z25*60		
26	=X26-V26	=L\$20+85	=V26*60	=AB26-Z26	=M\$20+85	=Z26*60		
27	=X27-V27	=L\$20+85	=V27*60	=200*3.7854/1000*AB27/0.0525/6785	=M\$20+85	=Z27*60		
28	=X28	=L\$20+85		=AB28	=M\$20+85			
29	=W28*4+W27+W26+W25			=AA28*4+AA27+AA26+AA25				
30	Year 9				Year 10			
31	H2O		60 day supply		Volume (gal/day)		H2O	
32	Total		=V33*60		=AB33*0.01		Total	
33	=X33-V33	=L\$20+85	=V33*60	=AB33-Z33	=R\$20+85	=Z33*60		
34	=X34-V34	=L\$20+85	=V34*60	=AB34-Z34	=R\$20+85	=Z34*60		
35	=X35-V35	=L\$20+85	=V35*60	=200*3.7854/1000*AB35/0.0525/6785	=R\$20+85	=Z35*60		
36	=X36	=L\$20+85		=AB36	=R\$20+85			
37	=W36*4+W35+W34+W33			=AA36*4+AA35+AA34+AA33				
38								
39								
40								
41								
42								
43								
44								
45								
46								
47								
48								
49								