Essex Manure
Management Club

Manure Management

Project Summary
1994-1997

Agriculture & Agri-Food Canada's
Rural Conservation Clubs Program

ESSEX MANURE MANAGEMENT CLUB

Project Summary Report *March 1997*

Introduction

The Essex Manure Management Club conducted a four year study determining the feasibility of irrigating 3rd.stage lagoon effluent for intensive pasture management. Funding was received through Agriculture and Agri-Food Canada's Rural Conservation Clubs Program, part of the Canada-Ontario Agriculture Green Plan.

This report summarizes the results of the study conducted by the Essex Manure Management Club.

Project Need

Proper manure management is of concern to both fanning and non-farming communities. Farmers are looking for more efficient methods to make use of manure throughout the growing season while non-farming communities want to see sound environmental practices being used.

The application window for applying manure during the cropping season is limited by crop rotation and weather conditions. Data from other liquid manure application studies has revealed that if not used properly, liquid manure can enter field tiles and adjacent watercourses within a few minutes. The Essex Manure Management Club felt there was a need to explore alternatives to the conventional methods of applying liquidmanure before and after the cropping season while doing so in a sound environmental manner.

A four year manure management project was conducted at Gemus Farms, Oldcastle, Ontario. The farm is a 400 sow farrow to finish and cash crop farming operation.

Project Highlights

MANURE REDUCTION RATES	
NITROGEN	**79%**
PHOSPHOROUS	**75%**
POTASSIUM	**25%**

- Establishment of a 8 ha. (20 acre) Rotational Pasture 1993-1994
- Average Daily Gains.
  - -1 pound 1995
  - -2 pounds 1996

Methods

A preliminary soils investigation was conducted by Dr. IanVan Weesenbeek, Agriculture and Agri-Food Canada. Harrow to determine site suitability based on soil texture analysis.

A three stage lagoon system for liquid swine manure was established. Manure was pumped from an underground storage facility from the barn into lagoon # I. The liquid manure was then allowed to flow into lagoon # 2 and # 3 respectively. Total combined manure storage is 365 days. Manure was pumped onto a 8 ha. (20 acre) pasture using a 4" Wade Rain pump powered by a 60 horsepower tractor. Manure was applied through a 4" hard hose reel irrigation system which was moved from paddock to paddock following a 28 day rotation pattern.

Four different grass mixtures were established following recommended rates in separate 2 ha (5 acre) blocks to assess their effectiveness in handling liquid manure and cattle grazing.

Grass Mixtures

1) Orchard Grass, Perennial Ryegrass, Reed Canarygrass & White Clover

2) Ryegrass, Tall Fescue, Reed Canary Grass a*nd* White Dutch

3) Birdsfoot Trefoil & Creeping Red Fescue

4) Reed CanaryGrass, White Clover & BirdsfootTrefoil

Table 1: Grass Mixture Seeding Rates

Mixture	Seeding Rate
1	**17.5 lbs./acre**
2	**20.0 lbs./acre**
3	**14.0 lbs./acre**
4	**18.0 lbs./acre**

The objectives of the project were as follows:

I) To evaluate the environmental/economic sustainability of irrigating 3rd. stage lagoon effluent on an intensive rotational pasture system.

II) To monitor the impacts of the manure management system on environmental aspects such as water quality on adjacent watercourses.

III) monitor economic Impacts such as pasture species, yield responses, effluent application rate and grazing capacity.

Manure Application Program:

- Manure was applied from May to September (180 days).
- Application rates were 4.000-4.500 gallons/acre.
- The 8 ha. pasture was split into 4 paddocks.
- Manure was applied perpendicular to the planting direction in each of the four paddocks. This allowed for distribution of manure across the different grass mixtures at the same time.
- Manure was applied in paddock 1 on the 1st day followed by a second application on the seventh day.
- The irrigation equipment was then moved to paddock 2 on day 8. A 7 day irrigation pattern was followed similar to paddock one.
- Cattle were introduced to the pasture on day 21 in paddock I and completed a grazing rotation cycle over a 28 day period.
- Cattle were allowed to graze a 2 ha. block which had all four different grass mixtures located inside the fenced off boundary. This allowed for observation of which grass mixture the cattle preferred the most.

Manure Sampling Program

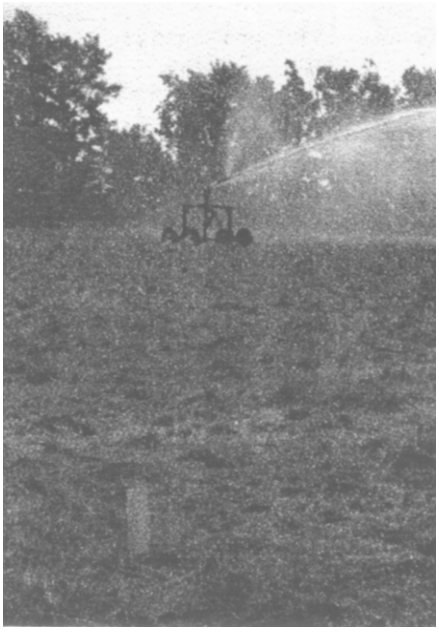
Grab manure samples were taken from each lagoon throughout the growing season following the Ontario Ministry of Agriculture, Food and Rural Affair's guidelines. Samples were shipped to the University of Guelph for laboratory analysis.

Water Sampling Program

Tile lines within each paddock were intercepted for water sampling purposes. Catch basins were installed using 4-foot plastic drums. Tiles were cut off inside the drum which allowed for continuous tile flow and water sampling. A sampling protocol was established following similar procedures used by other Conservation Authority and Ontario Ministry of Agriculture, Food and Rural Affairs research projects in Ontario. Samples were shipped following Ontario Ministry of Environment and Energy guidelines to the London laboratory for analysis.

Tiles were sampled as follows:

- Tile outlets were monitored for flow after manure application at 15 minute intervals over a 6 hour period.
- If flows were present, samples were taken at 15 min., 30 min., 1 hour, 3 hour and 6 hour intervals.



Irrigation Equipment

Results

Weather:

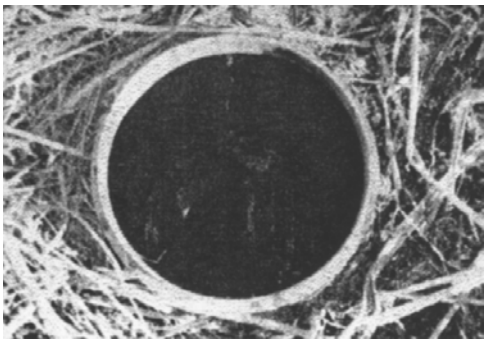
The following is a brief summary of weather:

Year	Spring	
	Temp	**Rain**
`94	Below average	Below average
'95	Above average	Below average
'96	Below average	Above average

Year	Fall	
	Temp.	**Rain**
'94	Above average	Above average
`95	Above average	Below average
'96	Below average	Below average

Table 2: Seasonal weather differences for Gemus Farms.

Climatic conditions were by far the most dramatic in 1995. Summer temperatures were above normal which greatly influenced weight gains. One particular week saw temperatures exceeding 50 ºC which resulted in the loss of livestock. Temperatures remained above normal for two weeks.



Catch basins were installed to monitor tile flow.

Manure Analysis Results

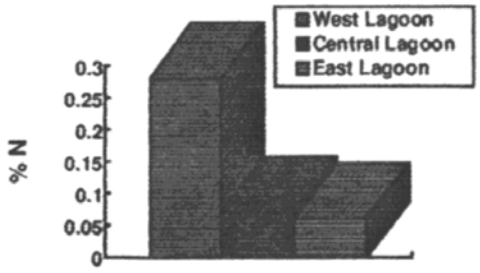


Figure 1: % N per manure sample weight (wet).

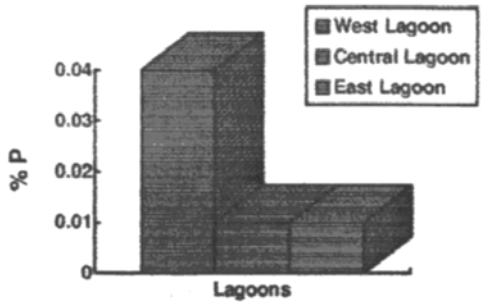


Figure 2: % P per manure sample weight (wet).

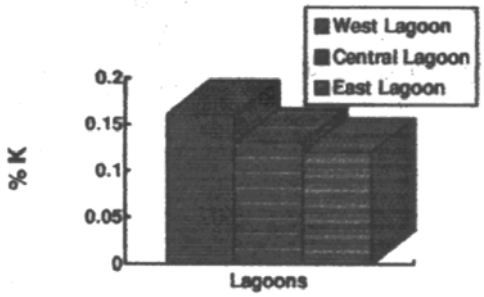


Figure 3: % K per manure sample weight (wet).

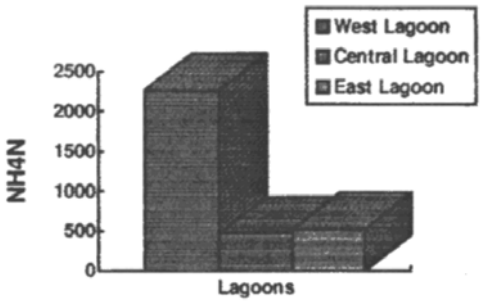


Figure 4: % NH_4N per manure sample weight (wet).

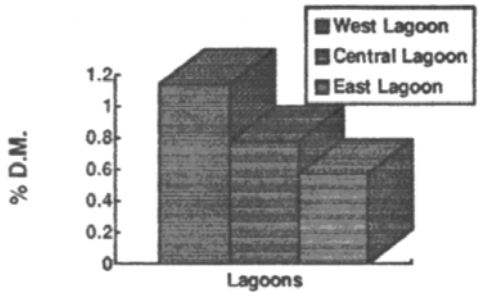


Figure 5: % dry matter per manure sample weight (wet).

Tile Results

Tile flows were observed over a six hour period immediately following manure application. No tile flows were observed. Background tile results were taken prior to application. Average geometric means were calculated for all tile outlets. Results for various parameters are as follows:

1994

E. coli	Nitrate	Total P	S.S.
32.74	26.63	139	28.68

1995

E. coli	Nitrate	Total P	S.S.
32.25	5.44	0.5	6.45

OMOEE Surface Water Guidelines

E. coli	Nitrate	Total P	S.S.
100	10	0.03	NA

Note: E. coli #/100 ml
Nitrate & Total P mg/L

Communication activities

Communication activities included: sharing information with farm organizations, report highlights in newsletters, media involvement and one on one personal contact. The following is a list of activities undertaken:

- ★ Essex Region Conservation Authority Board of Directors/Municipal Tour 1995
- ★ Kent County Municipal Tour 1995
- ★ Essex Soil & Crop Improvement Association & Essex Conservation Club Twi-Light Tour 1995
- ★ Provincial Clean Up Rural Beaches Staff Tour 1996
- ★ Newspaper articles in Windsor Star, local newspapers and Ontario Farmer.

Conclusions and Discussion

This section will provide insight for other farmers who may be interested in utilizing liquid manure on a rotational grazing system.

Which mixtures did the cattle prefer the best?

The cattle preferred mixture # I. This mixture was the most constantly grazed and was consumed the most.

Mixture # 3 contained creeping red fescue grass which the cattle preferred to rest in throughout the day.

Mixture # 4 was trampled the most. This specific grass mixture grew faster than the cattle would eat.

Which grass mixture held up the best to the liquid manure application?

All four mixtures seemed to stand up to the manure applications. Depending on temperatures during application, some legumes showed signs of nitrogen burn. These plants were set back a few days but did not die.

What is a good average daily gain I can expect on a rotational grazing system using liquid manure?

Daily gains averaged I pound in 1995 and 2 pounds in 1996. This was heavily influenced by weather. In 1995, severe hot temperatures were experienced which lowered daily gains. Cattle on pasture in 1995 did not receive implants or lice control as compared to cattle put on test in 1996.

How did weather influence irrigation patterns?

Weather patterns were watched closely to determine irrigation patterns. Manure was irrigated 2 days after a rainfall. Irrigation was postponed if heavy rain was forecasted.

Are there other benefits to spreading liquid manure other than rotational grazing?

Prior to cattle grazing the pasture, a first cut of hay was removed. This netted approximately 70-800 lb. round bales from the 20 acres which can be used during the fall/winter months to help supplement feeding.

What is the average number of cattle you would recommend per acre?

Thirty cattle were grazed in 1995 & 1996 weighing in at an average of 600 lbs. The farm co-operator feels that 2-600 pound stockers could be grazed per acre for a total of 40 stockers.

This will ensure constant grazing and elimination of waste as was found in paddock #4.

According to OMAFRA, the following animal units per acre can be used:

grass pasture (not fertilized)	3/4
legume	2
orchard grass (fertilized)	>2

(Joan McKinlay-OMAFRA personal communication 1996)

Can you irrigate "fresh" manure out of the third stage lagoon?

The ideas behind a third stage lagoon is to reduce the nitrogen concentration of the liquid manure. This avoids nitrogen burning on the crop and potential nitrate poisoning of the cattle.

On one occasion, "fresh" manure was pumped from the underground barn storage into lagoon one. This caused manure to flow into lagoons # 2 & # 3. At the same time, manure was irrigated from lagoon # 3 onto the pasture. More nitrogen burning was noted following the application than at other times. This suggests that ample storage time is required to allow for ammonia losses prior to application.

How does a third stage lagoon affect levels of N-P-K?

The following reduction rates were achieved:

Lagoon # 2

N	P	K	NH_4N	DM
75%	*75%*	19%	79%	32%

Lagoon # 3

N	P	K	NH_4N	DM
79%	75%	25%	77%	53%

There was a significant difference between levels found in the I st lagoon compared to the 2nd and 3rd lagoons. However, the differences between lagoon # 2 and #3 suggests a two-stage lagoon would be adequate from a nutrient reduction standpoint.

Did you notice any effluent coming out of the tiles after irrigation?

No tile flow was observed during the sampling periods. Weather patterns were watched closely and irrigation schedules were adjusted accordingly. Manure applications rates being used were moderate (Environmental Farm Plan).

When manure was applied, the pasture seemed to act as a "mat" holding the liquid on top of the soil surface for an extended period of time. This allowed for slow absorption and evaporation.

The soil moisture levels were kept up throughout the summer due as a result of the 28 day irrigation cycle. This, combined with the permanent sod cover reduced soil cracking which can act as a pathway for manure to reach the tile drains.

Plant uptake helped absorb liquid which reduced potential leaching. The high concentration of root mass in the soil created a "curved" pathway to the tiles as compared to a straight pathway found in cracked soil.

What pre-treatment would you recommend for cattle before they are put on pasture?

We recommend some form of lice control and hormone implants. Cattle put on pasture in 1995 did not receive any pre-treatment (no lice control or hormone implants).. Cattle in 1996 did receive lice control and hormone implants. Daily average gains were 1 lb./day in 1995 compared to 2 lb./day in 1996. This could be attributed to the cooler temperatures in 1996 compared to 1995 as well as the pre-conditioning received in 1996.

How does location of watering facilities affect pasture yields?

Four watering stations were located per paddock. The cattle tended to collect around the watering heavily trampled. Based on observations, it would be advantageous to have more watering bowls located in each paddock. This which help reduce cattle travel time.

Homemade watering bowls.

What pasture management techniques would you recommend?

After the cattle were moved to a new paddock a rotary mower was used to clip off mature grasses. This served as a means to establish good root development with the grasses and helped to control weed pressures. Older grass was removed which allowed for regeneration of younger grasses. This reduced waste as a result of tramping excess grass and ensured more even grazing the next time the cattle entered the paddock.

Can rotational grazing using irrigated manure be profitable?

This depends on your farm operation. The Gemus' look at manure as being a by product they have to handle on a daily basis. A lot of labour is required to move irrigation equipment. This is a cost that is not included in an overall cost benefit analysis.

For this particular operation, the costs of establishing a pasture, putting up fencing, watering and handling facilities and livestock costs have to be taken into account.

Using the 1996 daily average gain of 2 pounds per day for 180 days for 30 animals, the gross revenues is approximately $ 8,640 (assuming .80/lb sale price).

The total cost of establishing the project was:

• **Fencing**	**$ 10,559**
• **Grass Seed**	**$ 848**
• **Penning Area**	**$ 3,000**
• **Watering Devices**	**$ 4,965**
Total	**$ 19,412**

In-kind costs were not included (e.g. planting costs, assisting with fencing, putting in watering devices etc.) These numbers serve as a rough estimate of what a farmer may be looking at to establish a rotational grazing system.

The farmer's cost of irrigation equipment is also not included nor is his time managing the cattle.

What cattle handling techniques would you recommend?

Cattle handling facilities were constructed on site which consisted of a loading chute and crowding/penning area. This served as an area were cattle that were being introduced on pasture could be held a few days prior to being put on pasture. It also served as an area to treat livestock, if needed. Properly designed facilities help reduce cattle stress while making handling time easier.

Thank You

Special thanks goes out to Gemus farms for their initiative in undertaking this research project. Their assistance and ideas proved to be invaluable.

The Essex Manure Management Club would like to thank Agriculture and Agri-Food Canada and the Rural Conservation Clubs Program for their support in helping fund the Essex Manure Management Club.

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CANADA-ONTARIO
AGRICULTURE GREEN PLAN

Appendix A: Various Sampling Results

Field Tile Samples 1994-1996
1995 Field Tile Samples

First Paddock Catch Basin

DATE dd/mm/yr	Comments	E. coil	Faecal Strep	Pseudo-monas	Susp. Solids	Ammonia as N	Total Kjeldahl as N	Nitrite as N	Nitrate as N	Total Phosphorus as P	Diss. Reactive Phosphorus as P	pH	Conductivity	Chloride
26/1/95		10	610	4	1.50	0.08	0.70	0.01	1.00	0.14	0.05	7.27	721	13.10
8/6/95		30	810	4	2.90	0.17	1.48	0.08	20.80	0.17	0.24	7.07	710	13.60
18/7/95		70	1,460	324	13.20	0.14	1.85	2.01	28.80	0.79	0.58	7.13	950	51.00
12/9/95		170	260	10	5.40	1.35	4.58	0.98	2.78	0.86	0.66	7.69	1182	66.30
3/10/95		10	700	4	8.90	0.15	1.34	0.02	2.40	0.55	0.49	7.70	925	28.00
	MN:	10	250	4	1.50	0.08	0.70	0.01	1.00	0.14	0.05	7.07	710	13.10
	MAX:	170	1,460	324	13.20	1.35	4.58	2.01	28.80	0.86	0.66	7.70	1182	66.30
	GEO. MEAN:	32	661	12	4.88	0.21	1.64	0.13	5.25	0.39	0.30	7.37	881	27.89
	SAMPLE #:	5	5	5	5	5	5	5	5	5	5	5	5	5

Second Paddock Catch Basin

DATE dd/mm/yr	Comments	E. coil	Faecal Strep	Pseudo-monas	Sµsp. Solids	Ammonia as N	Total Kjeldahl as N	Dissolved Nitrite as N	Nitrate as N	Total Phosphorus as P	Diss. Reactive Phosphorus as P	pH	Conductivity	Chloride
26/1/95		10	30	4	9.40	0.07	1.00	0.01	1.10	0.22	0.15	7.15	712	20.40
8/6/95		10	120	4	4.20	0.13	0.82	0.03	0.40	0.27	0.31	7.19	682	17.80
18/7/95		130	1,290	84	20.60	0.52	2.92	1.09	53.00	0.90	0.66	7.19	1370	95.00
12/9/95		10	200	20	18.30	0.16	3.57	0.27	3.97	0.95	0.61	7.83	935	51.00
3/10/95		10	580	4	7.80	0.08	1.47	0.12	7.20	0.54	0.48	7.53	966	73.90
	MN:	10	30	4	4.20	0.07	0.82	0.01	0.40	0.22	0.15	7.15	682	17.80
	MAX:	130	1290	84	20.60	0.62	3.87	1.09	53.00	0.95	0.66	7.83	1370	95.00
	GEO. MEAN:	17	222	10	10.30	0.15	1.67	0.10	3.67	0.49	0.39	7.37	907	41.96
	SAMPLE #:	5	5	5	5	5	5	5	5	5	5	5	5	5

Third Paddock Catch Basin

DATE dd/mm/yr	Comments	E. coil	Faecal Strep	Pseudo-monas	Susp. Solids	Ammonia as N	Total Kjeldahl as N	Dissolved Nitrite as N	Nitrate as N	Total Phosphorus as P	Diss. Reactive Phosphorus as P	pH	Conductivity	Chloride
26/1/965		10	280	4	3.30	0.06	0.74	0.01	1.40	0.16	0.08	7.40	521	3.40
8/6/95		10	480	4	5.10	0.13	1.17	0.15	5.00	0.23	0.26	7.25	757	22.60
18/7/95		10	140	4	10.10	0.17	2.14	1.38	10.10	0.64	0.58	7.11	918	54.80
12/9,95		12	870	12	6.40	0.22	5.12		2.09	0.88	0.60	7.49	1209	78.10
3/10/95		60	130	420	8.60	0.07	2.83	0.11	3.50	1.17	1.15	7.78	928	51.30
	MN:	10	130	4	3.30	0.06	0.74	0.01	1.40	0.16	0.08	7.11	521	3.40
	MAX:	80	870	420	10.10	0.22	5.12	1.38	10.10	1.17	1.15	7.78	1209	78.10
	GEO. MEAN:	15	292	13	6.81	0.12	1.93	0.12	3.49	0.48	0.38	7.40	835	27.89
	SAMPLE #::	5	5	5	5	5	5	5	5	5	5	5	5	5

Fourth Paddock Catch Basin

DATE dd/mm/yr	Comments	E. coli	Faecal Strep	Pseudo-monas	Susp. Solids	Ammonia as N	Total Kjeldahl as N	Dissolved Nitrite as N	Nitrate as N	Total Phosphorus as P	Diss. Reactive Phosphorus as P	pH	Conductivity	Chloride
26/1/965		10	150	4	0.70	0.49	1.92	0.05	19.80	0.13	0.09	7.27	841	2420
8/6/95		10	10	4	5.00	0.13	1.59	0.09	35.60	2.51	2.38	7.26	975	21.50
18/7/95		380	780	4	6.00	0.80	3.01	127	13.40	0.82	0.75	7.21	1064	58.60
12/6/95		500	1,500	12	6.00	0.42	126	0.01	1.47	0.56	0.36	7.82	926	26.60
3/10195		60	410	172	8.90	0.57	1.73	0.13	5.10	0.70	0.58	7.87	1045	65.40
	MN:	10	10	4	0.70	0.13	126	0.01	1.47	0.13	0.09	7.21	841	21.50
	MAX:	500	1,500	172	8.90	0.80	3.01	1.27	35.60	2.51	2.38	7.87	1064	65.40
	GEO. MEAN:	86	235	11	3.79	0.41	1.82	0.09	9.33	0.64	0.51	7.48	967	35.07
	SAMPLE #::	5	5	5	5	5	5	5	5	5	5	5	5	5

1994 Field Tile Samples

1st Paddock Catch Basin

DATE dd/mm/yr	E. coli	Faecal	Pseud.	Sus. Sol.	Ammonia	Kjeldahl	Nitrite	Nitrate	Total P	Diss. P	pH	Cond.	Chloride
26/05/94	10	20	4	68.00	0.05	0.91	0.05	10.90	0.36	0.23	7.51	872	19.10
16/06/94	0	320	40	276.00	0.20	4.06	0.16	30.00	0.88	0.39	7.75	721	20.10
14/07/94	10	2,500	10	341.00	0.45	2.36	0.05	0.50	0.67	0.14	7.36	752	13.10
11/08/94	10	3,300	4	51.60	0.06	0.84	0.07	0.10	0.14	0.00	7.12	322	2.00
08/09/94	10	600	4	5.80	0.08	1.03	0.02	0.10	0.20	0.07	7.90	679	15.20
01/11/94	30	310	4	12.50	0.16	1.10	0.02	0.30	0.14	0.10	7.60	696	15.30
22/11/94	10	210	4	6.60	0.14	1.17	0.01	2.70	0.16	0.13	7.39	666	13.70
06/12/94	10	200	4	3.50	0.40	1.02	0.02	3.70	0.17	0.14	7.66	639	13.50
MIN	10	20	4	3.50	0.05	0.84	0.01	0.10	0.14	0.00	7.12	322	2.00
MAX	30	3,300	40	341.00	0.45	4.06	0.16	30.00	0.88	0.39	7.90	872	20.10
GEO. MEAN:	6.45	377.51	5.98	29.37	0.14	1.33	0.03	1.22	0.26	0.08	7.53	646.77	12.01
SAMPLE:	7	8	8	8	8	8	8	8	8	8	8	8	8

2nd Paddock Catch Basin

DATE dd/mm/yr	E. coli	Faecal	Pseud.	Sus. Sol.	Ammonia	Kjeldahl	Nitrite	Nitrate	Total P	Diss. P	pH	Cond.	Chloride
26/05/94	10	30	4	34.20	0.03	1.12	0.02	9.60	0.32	0.29	7.40	862	32.40
16/06/94	10	590	10	11.00	0.11	2.30	0.12	21.00	0.39	0.25	7.90	663	15.00
14/07/94	10	6,200	10	1582.00	0.33	5.55	0.07	4.50	2.30	0.51	7.30	711	11.60
08/09/94	10	6,000	4	7.10	0.07	1.21	0.02	0.10	0.26	0.14	7.70	741	19.20
01/11/94	10	1,500	4	35.40	0.15	2.37	0.02	0.80	0.25	0.10	7.60	779	19.10
22/11/94	10	20	4	13.20	0.17	1.20	0.01	1.40	0.18	0.13	7.50	803	19.20
06/12/94	10	300	4	54.50	0.93	3.20	0.04	1.70	0.47	0.18	7.60	823	18.70
MIN	10	20	4	7.10	0.03	1.12	0.01	0.10	0.18	0.10	7.30	663	11.60
MAX	10	6,200	10	1582.00	0.93	5.55	0.12	21.00	2.30	0.51	7.90	862	32.40
GEO. MEAN:	10.00	480.64	5.20	37.67	0.15	2.06	0.03	2.09	0.40	0.20	7.57	766.19	18.50
SAMPLE:	7	7	7	7	7	7	7	7	7	7	7	7	7

3rd Paddock Catch Basin

DATE dd/mm/yr	E. coli	Faecal	Pseud.	Sus. Sol.	Ammonia	Kjeldahl	Nitrite	Nitrate	Total P	Diss. P	pH	Cond.	Chloride
26/05/94	10	100	4	17.90	0.04	0.90	0.05	10.40	0.166		7.50	925	
16/06/94	3,000	5,600	20	3975.00	0.17	7.90	0.11	0.90	3.2	0.12	7.50	498	4.40
14/07/94	100	100	220	61.80	0.15	0.89	0.02	0.80	0.21	0.05	7.40	668	5.10
11/08/94		26,000	4	48.40	0.01	0.95	0.01	1.40	0.15	0.05	7.40	384	1.90
08/09/94	1,000	9,000	4	22.50	0.07	1.71	0.03	1.20	0.29	0.15	8.20	454	6.60
01/11/94	10	60	4	25.00	0.15	1.13	0.03	2.70	0.18	0.15	7.70	500	8.20
22/11/94	160	770	4	8.10	0.14	1.52	0.02	3.60	0.255	0.20	7.50	506	7.60
06/12/94	10	80	4	6.50	0.41	0.97	0.02	3.00	0.21	0.18	7.80	516	6.20
MIN	10	60	4	6.50	0.01	0.89	0.01	0.80	0.05	0.05	7.40	384	1.90
MAX	3000	26,000	220	3975.00	0.41	7.90	0.11	10.40	0.20	0.20	8.20	925	8.20
GEO. MEAN:	90.05	684.92	8.07	39.81	0.09	1.43	0.03	2.09	0.11	0.11	7.62	537.85	5.24
SAMPLE:	7	8	8	8	8	8	8	8	8	7	8	8	7

4th Paddock Catch Basin

DATE dd/mm/yr	E. coli	Faecal	Pseud.	Sus. Sol.	Ammonia	Kjeldahl	Nitrite	Nitrate	Total P	Diss. P	pH	Cond.	Chloride
08/09/94		100	4	508.00	0.10	10.90	0.07	43.90	8.10	4.22	8.40	1410	31.70
22/11/94	60	120	4	0.80	0.17	0.93	0.02	167.00	4.80	3.80	7.10	2050	43.70
06/12/94	10	20	4	1.20	0.83	1.25	0.10	141.00	2.80	2.68	7.30	1830	40.10
MIN	10	20	4	0.80	0.10	0.93	0.02	43.90	2.80	2.68	7.10	1410	31.70
MAX	60	120	4	508.00	0.83	10.90	0.10	167.00	8.10	4.22	8.40	2050	43.70
GEO. MEAN:	24.49	62.14	4.00	7.87	0.24	2.33	0.05	101.11	4.77	3.50	7.58	1742.37	38.16
SAMPLE:	2	3	3	3	3	3	3	3	3	3	3	3	3

Lagoon Manure Analysis 1994 - 1996

Gemus 1 West

DATE dd/mm/yr	N %	P %	K %	NH4 -N mg/kg	Dry Matter %
4/7/94	0.26	0.02	0.13	2459	2.17
4/7/94	0.28	0.03	0.14	2350	2.01
18/07/94	0.25	0.03	0.14	2177	0.95
9/8/95	0.27	0.07	0.20	2020	1.14
26/09/95	0.21	0.02	0.15	1820	0.71
31/7/96	0.41	0.18	0.18	2506	0.59
9/8/96	0.30	0.03	0.19	2778	1.39
5/9/96	0.26	0.02	0.18	2140	1.04
MIN:	0.21	0.02	0.13	1820	0.59
MAX:	0.41	0.18	0.20	2778	2.17
GEO. MEAN:	0.28	0.04	0.16	2263	1.14
SAMPLE #:	8	8	8	8	8

Gemus 2 Central

DATE dd/mm/yr	N %	P %	K %	NH4 -N mg/kg	Dry Matter %
4/7/94	0.01	0.01	0.09	73.00	0.49
4/7/94	0.01	0.01	0.09	51.00	0.43
18/07/94	0.05	0.01	0.11	263.00	0.32
9/8/95	0.14	0.01	0.13	1220.00	0.64
26/09/95	0.10	0.01	0.14	880.00	0.57
31/7/96	0.20	0.02	0.16	1943.00	9.32
9/8/96	0.17	0.02	0.16	1473.00	0.77
5/9/96	0.15	0.01	0.17	825.00	0.76
MIN:	0.01	0.01	0.09	51.00	0.32
MAX:	0.20	0.02	0.17	1943.00	9.32
GEO. MEAN:	0.07	0.01	0.13	472.45	0.78
SAMPLE #.	8	8	8	8	8

Gemus 3 East

DATE dd/mm/yr	N %	P %	K %	NH4 -N mg/kg	Dry Matter %
18/07/94	0.02	0.01	0.10	112.00	0.47
9/8/95	0.09	0.01	0.10	806.00	0.81
26/09/95	0.05	0.01	0.11	440.00	0.42
31/7/96	0.10	0.01	0.13	884.00	0.57
9/8/96	0.08	0.01	0.13	675.00	0.59
5/9/96	0.10	0.01	0.15	820.00	0.63
MIN:	0.02	0.01	0.10	112.00	0.42
MAX:	0.10	0.01	0.15	884.00	0.81
GEO. MEAN:	0.06	0.01	0.12	518.52	0.57
SAMPLE #:	6	6	6	6	6

Gemus' First Lagoon- West

DATE dd/mm/yr	E.COLI	F.STREP	PSEUDO-MONAS	SUSPENDED SOLIDS	AMMONIA as N	TOTAL KJELDAHL as N	NITRITE as N	NITRATE as N	TOTAL PHOS-PHORUS	DISS REACTIVE PHOSPHOROUS as P	pH	CONDUCTIVITY µs/cm at 25C	CHLORIDE as Cl
03/10/95	1,000	28,000	1,000	905	1,800	1,620	1	1	137	123	8	15,100	643
09/10/96	20,000	2,400,000	1,000	3,580	1,976	2,129	<1.00	<1.00	483	N/A	8	18,900	498
09/10/96	20,000	2,400,000	1,000	5400	1548	1639	<1.00	<1.00	632.5	N/A	7.73	19100	500.5
MIN:	1,000	28,000	1,000	995	1,546	1,639	1	1	137	123	8	15,100	498
MAX:	20,000	2,400,000	1,000	5,400	1,976	2,129	1	1	633	123	8	19,100	643
GEO. MEAN:	7,368	544,327	1,000	2,879	1,606	1,852	1	1	347	123	8	17,599	543
SAMPLE #:	3	3	3	3	3	3	3	3	3	3	3	3	3

Gemus' Second Lagoon -Central

DATE dd/mm/yr	E.COLI	F.STREP	PSEUDO-MONAS	SUSPENDED SOLIDS	AMMONIA as N	TOTAL KJELDAHL as N	NITRITE as N	NITRATE as N	TOTAL PHOS-PHORUS	DISS REACTIVE PHOSPHOROUS as P	pH	CONDUCTIVITY µs/cm at 25C	CHLORIDE as Cl
03/10/95	1,000	120,000	34,000	513	961	1,174	1	0	109	91	8	11,870	633
09/10/96	N/A	N/A	N/A	1950	1,037	1,135	<1.00	<1.00	166	N/A	8	16,000	500
MIN:	1,000	120,000	34,000	513	961	1,135	1	0	109	91	8	11,870	500
MAX:	1,000	120,000	34,000	1,950	1,037	1,174	1	0	166	91	8	16,000	633
GEO. MEAN:	1,000	120,000	34,000	1,000	996	1,154	1	0	135	91	8	13,781	562
SAMPLE #:	1	1	1	2	2	2	2	2	2	1	2	2	2

Gemus' Third Lagoon -East

DATE dd/mm/yr	E. COLI	F. STREP	PSEUDO-MONAS	SUSPENDED SOLIDS	AMMONIA as N	TOTAL KJELDAHL as N	NITRITE as N	NITRATE as N	TOTAL PHOSPHORUS	DISS REACTIVE PHOSPHOROUS as P	pH	CONDUCTIVITY µs/cm at 25 C	CHLORIDE as Cl
03/10/95	1,000	1,100	24,000	730	622	877	1	0	71	50	8	8,370	459
09/10/96	10,000	44,000,000	1000	1067	741	831.5	<1.00	<1.00	97.5	N/A	7.97	6490	405.5
09/10/96	10,000	44,000,000	1000	1,283	659	748	<1.00	<1.00	90	N/A	8	17,400	421
MIN:	1,000	1,100	1,000	739	622	746	1	0	71	50	8	6,490	406
MAX	10,000	44,000,000	24,000	1,263	741	877	1	0	98	50	8	17,400	459
GEO. MEAN:	4,642	1,286,568	2,884	1,004	672	816	1	0	85	50	6	9,814	428
SAMPLE #:	3	3	3	3	3	3	3	3	3	1	3	3	3

Tissue Analysis-1994

Paddock	Week 0	Week 2	Week 4	Week 6
1a		29.0	39.4	33.3
1b		27.6	32.5	39.9
1c		30.1	33.4	34.9
Mean		28.9	35.1	36.0
2a		32.7	25.9	28.3
2b		28.5	25.9	31.9
2c		32.9	28.4	32.4
Mean		31.37	26.73	30.9
3a		37.9	33.6	29.6
3b		38.5	33.9	32.7
3c		32.4	31.2	34.8
Mean		36.27	32.9	32.4
3a		34.8	31.9	28.6
3b		35.3	36.8	32.5
3c		30.5	37.0	29.7
Mean		33.53	35.23	30.3

mg N/g tissue