Deep Drainage Assessment

Monitoring Report

Prepared for

The Yarra Yarra Catchment Group

November 2004

Prepared by

Regeneration Technology Pty Ltd

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Cover photo by Georgina Nielssen

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INTRODUCTION

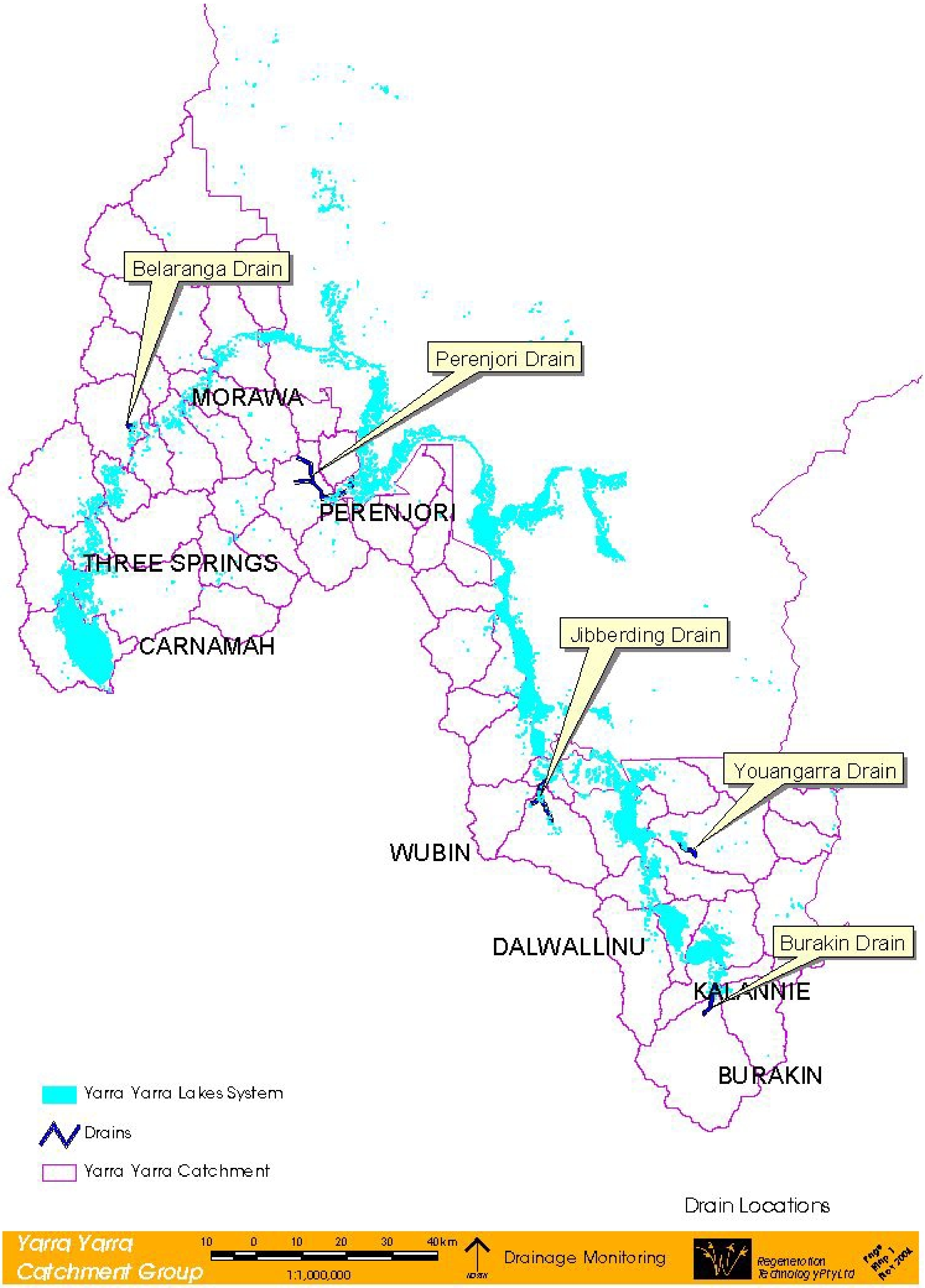
The Yarra Yarra catchment covers an area of 4,258,102ha with approximately 1,000,000 ha being agricultural land. The catchment is internally drained into the Yarra Yarra lakes system, which cover 220,800 ha and stretch over 300 km. It is an ephemeral saline playa system. The main lakes only occasionally (ie once every several years) contain free surface water. The lake system was saline pre-clearing. The smaller tributary wetlands and low points in the catchment contain chains of salt lakes linked by samphire-dominated depressions while the larger expanses of the main system have a thick salt layer.

Deep drainage is being used across the wheatbelt of Western Australia as a means to lower the groundwater aquifer and reclaim arable land. Saline ground water in the Yarra Yarra catchment is a result of clearing deep-rooted native perennial vegetation for agriculture. Ground water levels have risen over time resulting in salt scalds on the landscape and localized deaths of low lying vegetation. Annual recharge of the ground water in the Yarra Yarra is extremely low due to low rainfalls and high evaporation rates. The ancient geology of the area also means that the ground water aquifer is restricted in some areas. The Yarra Yarra Catchment Group is undertaking an extensive program of drilling and monitoring bores across the catchment that will provide some insight into the movement (and containment) of groundwater in the catchment.

This evaluation has utilised the guidelines for assessment of saline drainage developed by Regeneration Technology and Actis Environmental for the Department of Conservation Land Management. The guidelines were developed specifically for the Nyabing catchment with the view that they could be used to evaluate drainage proposals elsewhere in the wheat belt of Western Australia. The assessment guidelines used for the Nyabing catchment were developed to examine the downstream impacts of saline drainage on nature conservation. The Nyabing impact assessment requires the identification of both the primary and final receiving wetland, which for most areas in the south west of Western Australia will be a river system.

In the Yarra Yarra catchment the primary receiving wetland for drainage discharge are low lying valley floors which are a series of ephemeral lakes and samphire depressions. The final receiving wetland are the 300km of salt lakes of the Yarra Yarra lakes system. Large volumes of water have been recorded as being discharged from the drains, however with the exception of small areas of localized flooding there is no evidence that the water is transported any distance beyond the discharge point of the drain. Low rain fall (334mm) and high evaporation rates recorded to be in excess of 2.5m per annum (Bureau of

Meteorology) in the Yarra Yarra Catchment results in the discharge water not being transported beyond the valley floors.



Five deep drains in the Yarra Yarra Catchment were targeted for this study. Locations of the drains are shown in Map 1 they are a representative sample of drains being constructed within the Yarra Yarra catchment. The five drains are:

1) Youangarra (Stanley) in the Goodlands area. this drain was the subject of previous monitoring that was undertaken in 2003.
2) Belaranga (Sasse and Moffitt).
3) Burakin (Nixon);
4) Perenjori (Solomon) At the time of monitoring this drain had not yet been dug and soil and water samples were taken from the end point (ie the lake) and from monitoring bores further up in the catchment.
5) Jibberding. This drain was constructed to remove ground water that had risen to the surface the flooded Jibberding Hall Rd that was impassable for a number of years.

MONITORING METHODS

VEGETATION

Vegetation type along the length of the drain was recorded using dominant species as the indicator. A 500m buffer along the entire length of the drain was mapped for vegetation using field notes and aerial photography in Arcview.

All mapped areas were calculated from shape files held by the Yarra Yarra Catchment Group in Arcview. Climatic data was down loaded from the Bureau of Meteorology web site. All sampling points were located using a hand held GPS.

SOIL AND WATER SAMPLES

Each of the drains was visited on at least two occasions during the winter of 2004. Water samples were collected from three locations along the drain, 1) the starting point of the drain, 2) a midway point along the drain, and 3) from the end point of the drain and if possible a sample was also taken from the receiving wetland. Soil samples were taken from the shoreline of the primary receiving wetland near the end point of the drain from the surface and a depth of 30cm, which represented a change in the soil structure/type (the b horizon). All soil and water samples were stored in a refrigerated container and delivered to SGS Environmental (NATA accredited laboratory) within 2 day of collection for analysis.

All samples were analysed for the following:

pH,

Conductivity,

Sodium (Na),

Calcium (Ca),

Magnesium (Mg),

Chloride (Cl),

Sulphate (SO_4),

Total nitrogen (N), and

Total Phosphorus (P).

Estimates of the discharge volumes from the drains were calculated by recording the flow rates. Flow rates were estimated by timing and measuring the distance traveled by a cork down the drain and calculating a cross sectional area of the drain.

Photo: Collecting water samples from deep drain in Burakin.

BORE MONITORING DATA

Bore monitoring is s separate project being undertaken by the Yarra Yarra Catchment Group and to date the data has not been compiled and analysed. For the purpose of comparison the results form 18 bores in the Perenjori subcatchment and 24 bores from the Belaranga subcatchment have been include in this report. Information recorded form each bore was depth to ground water pH and salinity. The bores were monitored in August 2004.

RESULTS AND DISCUSSION

The results show a considerable variation between the volumes of water and the water quality being discharged via the deep drains in the Yarra Yarra (Table 1). Belaranga the most northern drain has very high volumes of discharge from a short length of drain and although the water quality appears to be better than that from the other drains the discharge water is still hypersaline. The salinity of the all the primary receiving wetlands is within similar range to that of the drain water being discharged.

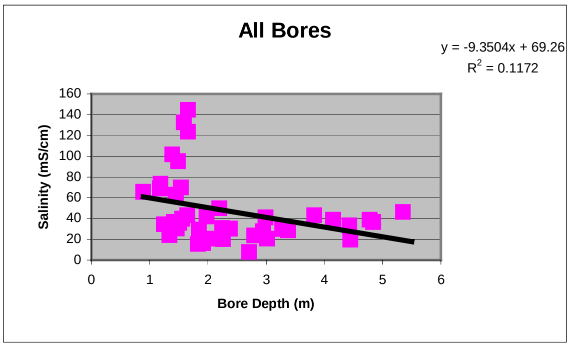
The most serious issue with regards to water quality from the drains is the decrease in the pH (increase in acidity) of the ground water being drained compared to the water in the receiving wetland. A decrease in the pH of the water will result in the mobilization of heavy metals that would otherwise remain bound in the soils this can have a negative impact on flora and fauna, however given the salinity of the water there is very little that lives in the water or the salt lakes. Analysis of the soils in the receiving wetland gives an indication of the buffering capacity (ie the ability to neutralize pH) of the wetland soils. Nutrients (nitrogen and phosphorus) in the discharge water were at very low levels and are not considered an issue for any of the drains monitored.

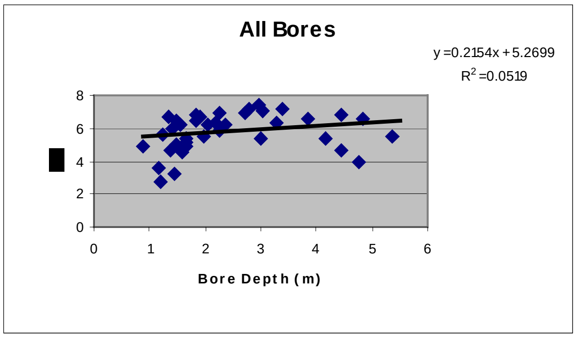
Table 1 Summary of information used for this assessment

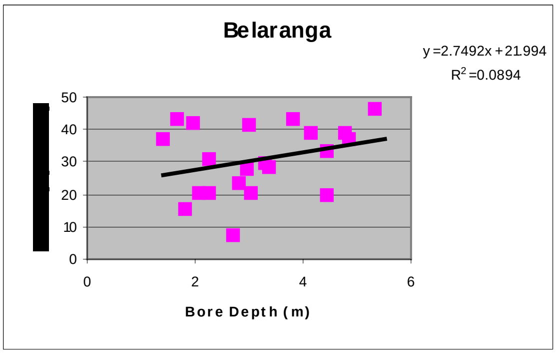
	Drain Name					
	Youangarra (2003)	Youangarra (2004)	Belaranga	Burakin	Jibberding	Perenjori (not constructed)
Sub catchment name	Goodlands (20)	Goodlands (20)	Belaranga (39)	Burakin (27)	Jibberding (2)	Perenjori (9)
Sub catchment size (ha)	32794	32794	21708	44911	27623	19738
Type of drain	deep open drain	deep open drain	deep open drain	deep open drain	open drain	deep open drain
Length of drain (km)	2.72	2.72	2.76	7.13	12.70	24
Area to be drained (ha)	27.2	27.2	27.6	71.3	127	240
Estimated time of construction	November 2000	November 2000		2000	2002	
Estimate drain discharge (m^3 per year)	107222	10512	136875	47304	685382	
Primary receiving wetland name and type	samphire depression	samphire depression	Valley floor salt lake chain	Valley floor salt lake chain	Valley floor salt lake chain	Valley floor salt lake chain
Width depth and slope or fall of primary receiving wetland at discharge point	nil	nil	nil	nil	nil	nil
Area of primary receiving wetland (ha)	290	290	Joins wetland system	Joins wetland system	Joins wetland system	Joins wetland system
Final receiving wetland name and type	Yarra Yarra Lakes	Yarra Yarra Lakes	Yarra Yarra Lakes	Yarra Yarra Lakes	Yarra Yarra Lakes	Yarra Yarra Lakes
Area of final receiving wetland (ha)	12293	12293	12293	12293	12293	12293
Total area of wetland in the system (ha)	795625	795625	795625	795625	795625	795625
turnover factor (years)	50+	50+	50+	50+	50+	50+
average yearly rainfall (mm)	360	360	334	360	334	360
average yearly evaporation (m)	2.5	2.5	2.5	2.5	2.5	2.5
ionic concentration of drain water (uS/cm)	65,000 -100,000	76,000 – 86,000	34,000 - 42000	53,000 – 120,000	49,000 – 90,000	33,000 (from monitoring bore)
pre-drainage ionic concentration of receiving wetland (uS/cm)	14,000 (only have figure for soil)		42,000	110,000	90,000	29,000
pH of groundwater to be drained	3.2 - 4	3.4 – 3.5	7.7	3.2 – 3.4	3.3 – 4.2	7.1 (from monitoring bore)
pH of receiving wetland for open drain systems	7.2 (only have figure for soil)		7.7	7.6	4.8	7.3
average concentrations of nitrogen and phosphorus in drain water (mg/l)	N 26mg/l P <0.05	14 – 16 0.05	18 – 23 <0.05 – 0.07	<0.2 – 4.2 <0.05	3.9 <0.05	2.8 <0.05
average concentrations of nitrogen and phosphorus receiving wetland (mg/l)	N 210mg/kg P 56 mg/kg (figure for soil no free water in the wetland)		4.5 <0.05	<0.02 0.1	3.1 <0.05	7.7 0.12

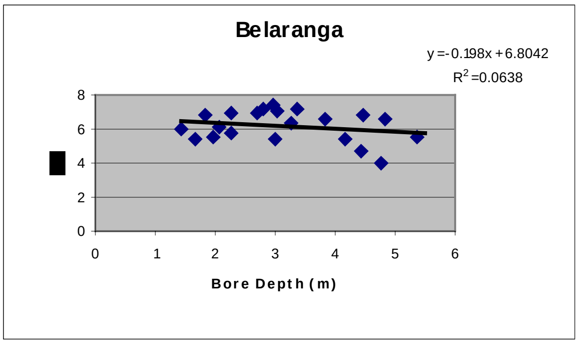
BORE MONITORING RESULTS

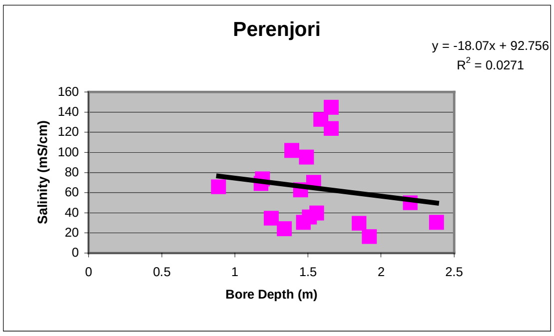
The bore monitoring data shows that the salinity of the ground water increases the closer the water is to the surface. This is not a surprising result as the salt in the soil closer to the surface is being dissolved back into solution resulting in higher salinity in the water closer to the surface. However when we look at the data from Belaranga the correlation is not evident and the salinity of the ground water is lower in this catchment than the Perenjori catchment. There appears to be no correlation between bore depth and pH however in the Perenjori catchment the correlation is stronger between increasing bore depth and increasing pH.

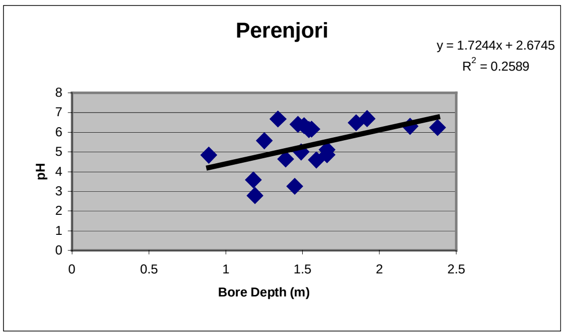


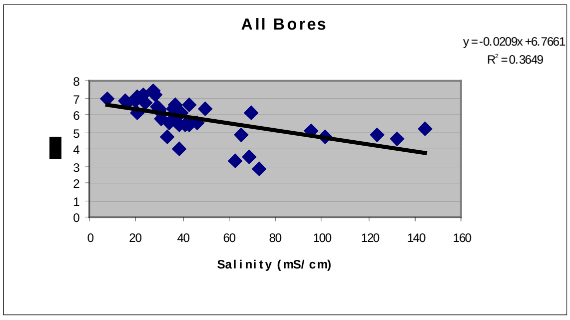


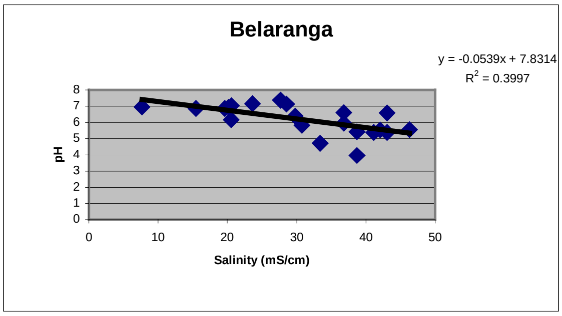


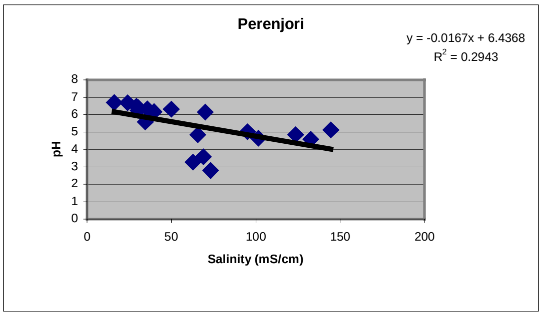












The correlation between salinity and pH is apparent for all bores as well as the individual catchments with the trend being increasing salinity resulting in lowered pH. This may have downstream implications and will be discussed in more detail later in this report.

YOUANGARRA DRAIN

Monitoring data from the Youangarra drain has been collected on three occasions since 2001.

Vegetation

Vegetation mapped along the length of the drain shows that a great deal of the area through which the drain passes is agricultural land. The drain passes through a small section of remnant vegetation that contains York gum and melaleucas before passing directly through lowlying samphire (Map 2).

Vegetation health along the length of the drain was recorded over the 3 year study period and appears to not have altered. On the northern side of the road the drain runs along the outer edge of a stand of native vegetation. The vegetation to the east of the drain at this point consists of occasional trees with a sparse understorey of Melaleuca. The vegetation at this site was in poor condition at the commencement of the study and 3 years on there is no evidence of further decline in the vegetation (ie no evidence of recent tree deaths). The presence of the drain appears to have no effect on the woody vegetation.

The vegetation on the western side of the drain is typically samphire and joins with the receiving wetland.

Receiving wetland area and Zone of influence

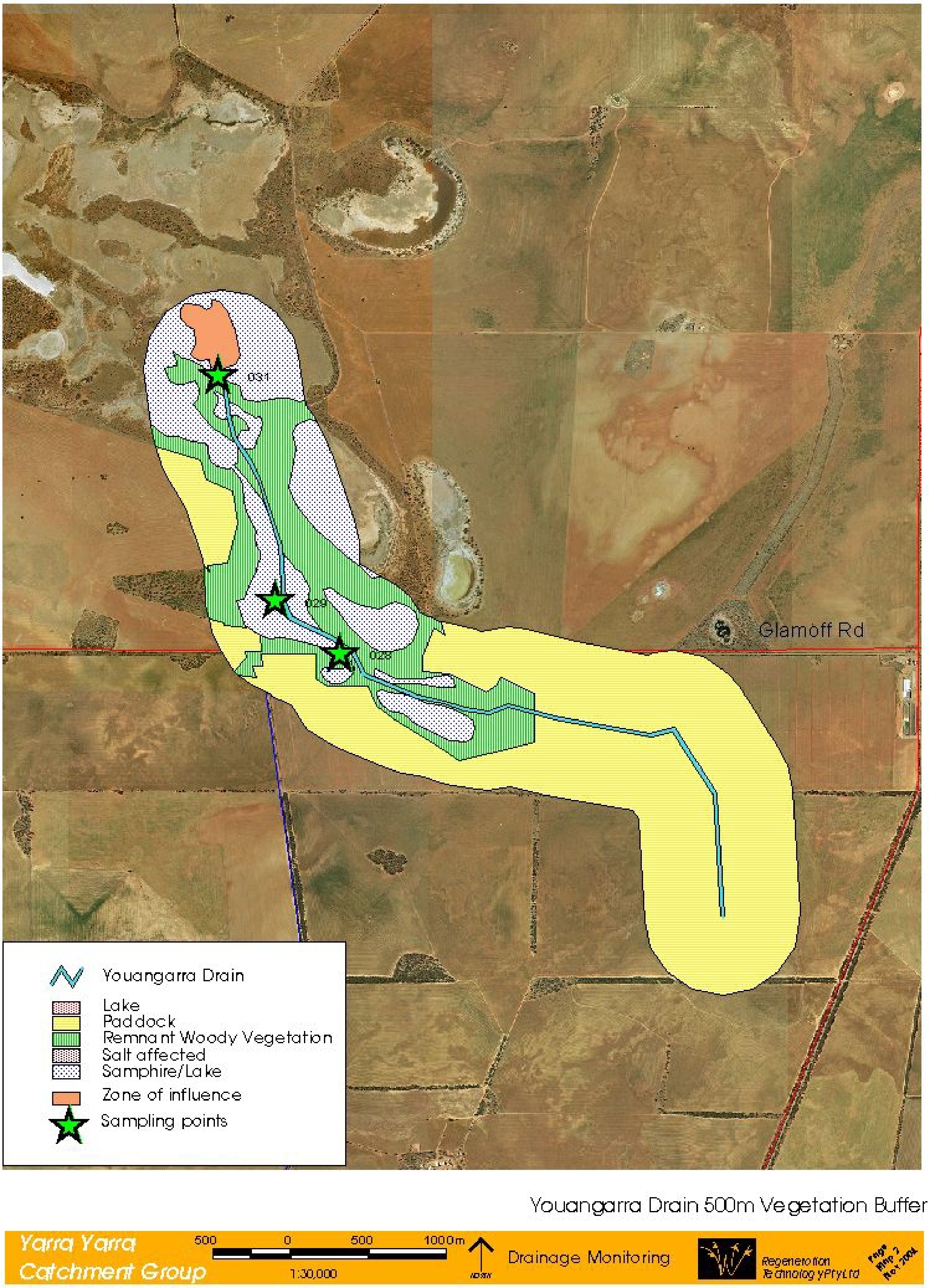
The receiving wetland is an ephemeral depression covered in samphire. No open or standing water has been noted in this wetland since the commencement of this study. The primary receiving wetland is part of the Yarra Yarra Lakes system and is 290ha in size.

The zone of influence was determined by mapping the edge of the wet area using a hand held GPS (Map 2). There is no free water in this wetland even in the middle of winter so the edge of the wet area was determined using a probe. The zone of influence in the receiving wetland was measured in August 2001, 9 months after the drain was constructed and again in October 2003 and July 2004. The zone of influence including the ponding area at the end of the drain was determined to be 11ha in 2003.

This 11ha represents less than 4% of the primary receiving wetland and after 3 years of the wetland receiving discharge from the drain there has been no increase in the area of the zone of influence from the drain. This indicates that the water flowing into the wetland is being discharged; most likely via evaporation at the same rate (if not faster than) it is moving into the wetland. This being the case it is reasonable to conclude that if water continues to enter the wetland system at the same rate the impact of the additional water on the wetland will be minimal.

Photo: End of Youangarra Drain (Primary receiving wetland

The samphire vegetation within the zone of influence appears to be greener than elsewhere in the wetland however without any tissue analysis of the vegetation it is not possible to determine if this is due to a luxurious uptake of water or nutrients. There appears to be a decreasing gradient of total nitrogen in the soils (See Table 2) from the drain end to outside the zone of influence. A more detailed study of the uptake of nitrogen by samphire is necessary to draw any conclusions as to the effect this gradient may be having on the vegetation.


031
029
028
Glamoff Rd
Youangarra Drain
Lake
Paddock
Remnant Woody Vegetation
Salt affected
Samphire/Lake
Zone of influence
Sampling points
Youangarra Drain 500m Vegetation Buffer
Yarra Yarra Catchment Group
500 0 500 1000m
1:30,000
Drainage Monitoring
Regeneration Technology Pty Ltd

Quantity of water discharging into the wetland

The quantity of water discharging into the wetland from this drain was estimated by Glen Biggins to be 107,222m^3 per annum in 2003. Discharge was estimated to be 10,512m^3 per annum in 2004. It was noted at the time of sampling in 2004 that the flow rates appeared to be considerably lower than on previous occasions. Bore monitoring data may show that the depth to the water table has decreased over the study period. Previous bore monitoring across the catchment showed a decrease from in the water table from an average depth of 1.42m below the surface in 1997 to 1.9m below the surface in 2003. This is a significant drop however it is not possible to determine why this has occurred. It is most likely to be due to a number of factors including the planting of deep-rooted perennials, drainage and climatic factors.

Depth of the drains and base flows

The drains were constructed in November 2000. There appears to be virtually no slumping along the length of the drain and no build up of sediment in the drain. Minor slumping is occurring towards the end of the drain. The depth of the drain (prior to Glamoff Rd) is approximately 2m after Glamoff Road the drain picks up surface runoff from the road and adjacent wet depressions. The base flow in the drain has been constant as indicated by a depth gauge at the Glamoff Road crossing since the drain was constructed in November 2000.

Region of Influence of the Drain

The region of influence the drain is having on the groundwater aquifer difficult to determine and is a contentious issue. The influence of the drain on groundwater levels declines with distance away from the drain but is related to the permeability of the soils. No detailed analysis of the soils along the length of the drain have been undertaken for this purpose though it has been observed that at depths greater than 1m especially in the upper reaches of the drain there is shale lying in horizontal sheets. It is possible the hydraulic conductivity of these sheets is greater than that of either sand or clay resulting in the zone of influence of the drain being greater than has been recorded elsewhere in WA where the soils are sandy loams or clays.

The yearly discharge from the drain has been estimated to be 107,222m^3 per annum or 321,666m^3 since the drain was constructed. Average annual rainfall in the region is 360mm, which would account for some recharge of the groundwater aquifer however with average annual evaporation being 2.5 m, recharge from rainfall is considered to be minimal.

The depth of the water in the drain is 10cm, the average width of the drain base is 150cm and the length is 2.72km. The water in the actual drain therefore accounts for 408m^3. In 2003 the estimated annual discharge from the drain was 107,222m^3, which is 263 times the volume in the drain. In 2004 the estimated annual discharge was 10,512m^3. This drop is significant with an estimated 7% of the volume of the water in the drain being added daily in 2004 compared to 71% in 2003.

These results show dramatic decline in the interception and removing ground water. This is most likely to be due to the aquifer within the region of the drain being drained to base level of the drain. Additional monitoring of the bores in the area and flows in the drain should confirm this.

Chemical analysis of water and soils

Table 2 shows the results of soil and water analysis undertaken in August 2001, October 2003 and 2004. Water samples collected in October 2003 were collected from 2 sites in the drain the one to the south of Glamoff Rd before the drain connects with surface runoff from Galmoff Rd and one at the drain end where it meets the wetland.

Soil samples were collected in October 2003 from 3 locations (the drain end, the zone of influence and outside of the zone of influence) 30-50cm below the surface in the receiving wetland.

Table 2 Ion concentrations of Water and Soils from the Youangarra drain.

Sample Code	Date Collected	Type	pH	*u*S/cm	Na mg/L	Ca mg/l	Mg mg/l	Cl mg/l	SO4 mg/l	Total N mg/l	Total P mg/l
A	12/10/2003	soil	7.1	14000	16000	5700	1600	32000	20000	350	98
B	14/10/2003	soil	7.2	12000	11000	4200	930	19000	13000	210	56
C	12/10/2003	soil	6.5	9800	8800	4800	820	19000	16000	420	96
3030	1/07/2004	soil	4.4	5400	3300	3500	410	7900	13000	170	59
30s	1/07/2004	soil	5.1	5500	4600	4300	410	7100	13000	190	100
3130	1/07/2004	soil	5.4	6900	6500	4300	650	13000	15000	220	50
31s	1/07/2004	soil	5.8	12000	15000	5000	1500	26000	17000	470	59
IS2 52	17/08/2001	water	3.4	70000	12000	120	1200	25000	3000		<0.05
IS2 53	17/08/2001	water	4.1	77000	17000	180	1300	24000	3500		<0.05
IS2 54	17/08/2001	water	3.3	92000	15000	150	1600	29000	4500		<0.05
IS2 55	17/08/2001	water	3.4	65000	20000	260	1900	20000	3300		<0.05
IS2 56	17/08/2001	water	4	58000	98000	220	1100	18000	3100		<0.05
28	1/07/2004	water	3.4	76000	15000	670	1200	25000	3000	16	0.05
30	1/07/2004	water	3.5	86000	14000	780	1500	30000	3600	14	0.05

A = Within the zone of influence

B = Outside the zone of influence

C = Drain end

These results show:

pH and Ionic Concentrations

The discharge in the drain is acidic with readings of between pH 3.2 and 4. There appears to be no change in the acidity of the discharge over the 3 sample periods. The pH of the wetland soil is slightly lower at the end of the drain however the acidic discharge appears to have no influence on the pH of the soils within the "zone of influence", which was recorded to have the same pH as the soil sampled from outside of the zone of influence.

The buffering capacity of the soil at the end of the drain appears to have been saturated with the pH of the soil samples from the end of the drain decreasing from pH 6.5 to pH 5.8 over that last year. It is reasonable to assume the initial pH of the soil at the end of the drain would have been similar to that elsewhere in the wetland (ie between 7.1 and 7.2). At the drain end where the soil has been saturated by discharge for a period of 4 years the soil has been capable of neutralizing most of the acidy from the discharge with the soil pH dropping by a pH of 1.4. This is a very interesting result given the estimated quantities of water (332,178m^3) discharged at this point since the drain was built. The drop in pH in soil at the point of discharge while it is significant the pH is still within the medium acidic range (Hunt and Gilkes, 1992) and is not considered toxic. With the quantity of water being discharged from the drain dropping from 100,000m^3 per annum to 10,000m^3 per annum the moderate acidification of the soil will not spread beyond the drains end. The zone of influence in the wetland will decrease over time as the wetland dries.

BELARANGA DRAIN

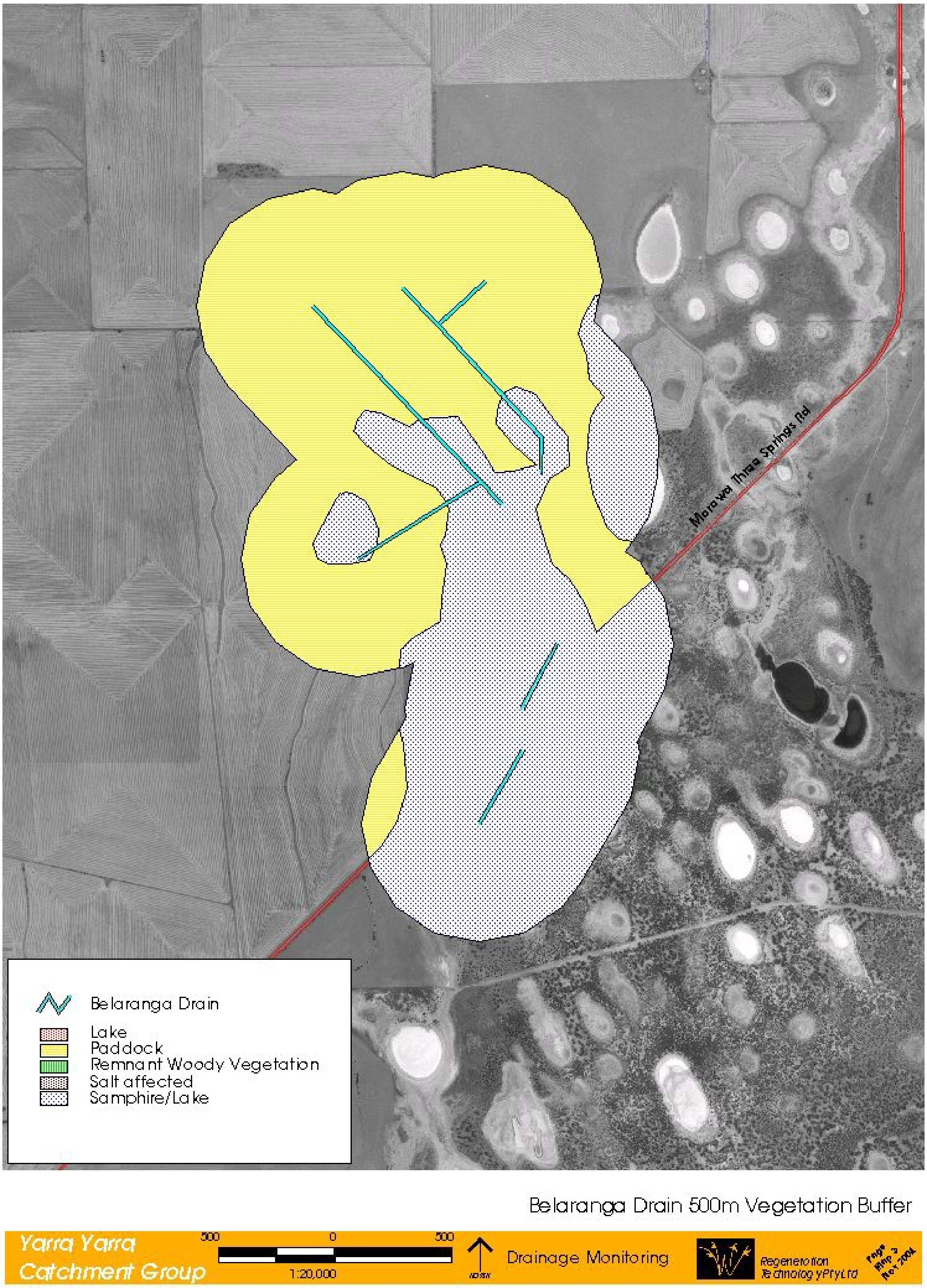
The Belaranga drain is the most northern drain monitored for this report. It consists of 2 parallel drains that link into the salt lakes of the valley floor.

Vegetation

The vegetation within a 500m buffer of the drain consists of paddocks and the samphire lake system of the valley floor (Map 3). The drain links into a lake that is part of a chain of lakes in the valley floor. The health of the vegetation surrounding the lake appears to not have changed in recent times, as there is no evidence of recent flooding of dryland vegetation or tree deaths.

Primary receiving wetland

The primary receiving wetland is a chain of lakes that currently have standing water that attracts bird life. There is no obvious change in the shoreline of the lake indicating the volumes of water discharging into the wetland from the drain are not impacting on the water levels in the lake.



Quantity of water discharging into the wetland

An estimate of the annual volume of water entering the primary wetland was calculated to be 136,875m^3 per annum which represents a considerable draw down of the water table, however there is no evidence to indicate this volume of water is having even a minor impact on water levels in the lakes further downstream. This drain was constructed 2002,over time it is expected that the volumes of water being discharged will decrease as has been recorded for the Youangarra drain.

Chemical analysis of water and soils

Table 3 Shows the results of soil and water analysis undertaken in August 2004.

These results show:

The soils and water samples collected all show a slightly alkaline pH. With pH values being close to neutral there is very little concern for the mobilization of metals from the soil into solution. The water quality entering the lake from the drain is not too different from the water that already exists in the lake and it is therefore unlikely to have an impact on the ecological functioning of the primary wetland or those further down stream.

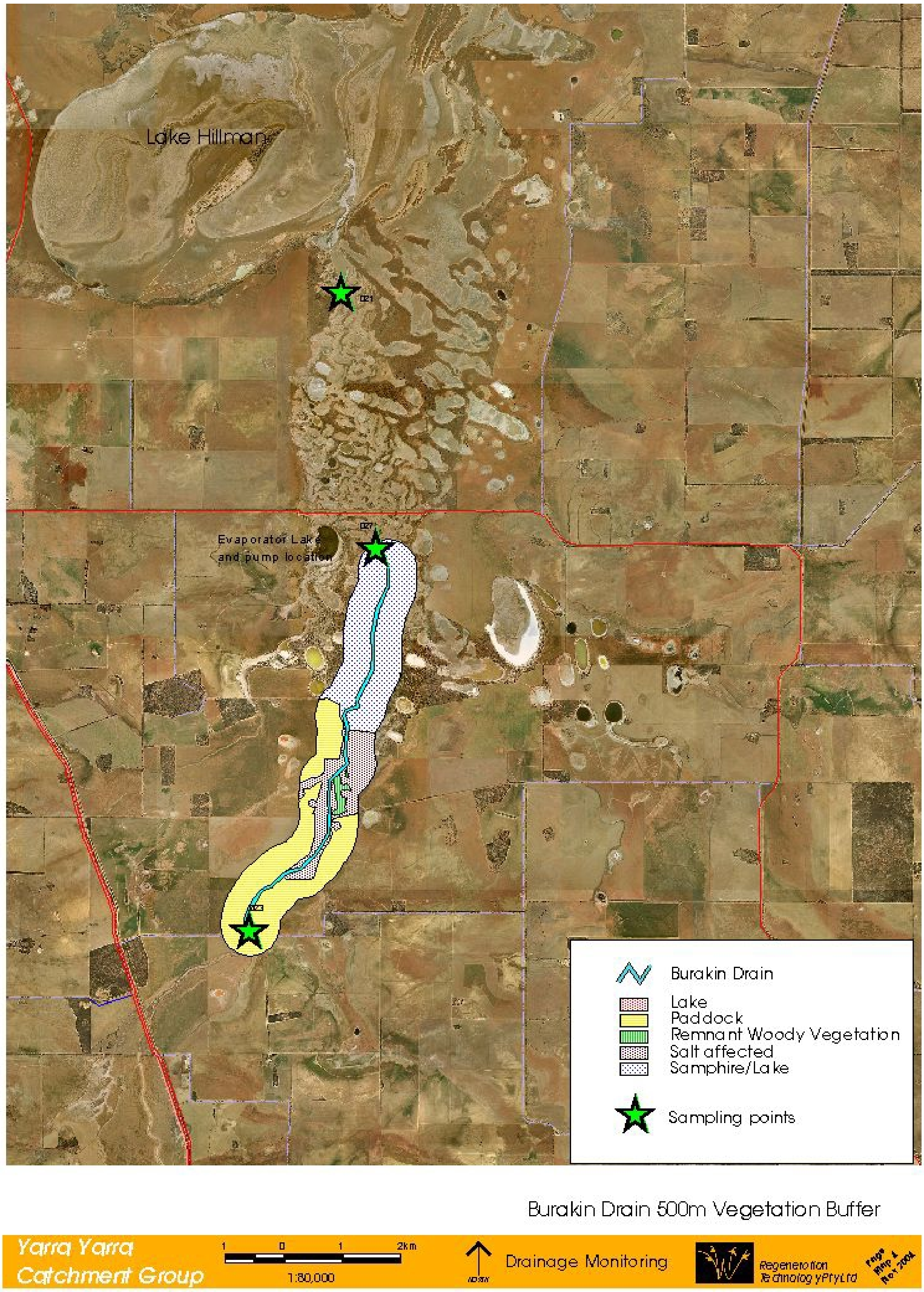
The results of the water quality testing of the discharge water and the water in lake are consistent with the results from the bore monitoring in the area (See previous section) that also indicated a neutral pH and comparably low salinity in the ground water in the catchment.

Table 3 Ion concentrations of Water and Soils from the Belaranga drain.

Sample Code	Date Collected	Type	pH	*u*S/cm	Na mg/L	Ca mg/l	Mg mg/l	Cl mg/l	SO4 mg/l	Total N mg/l	Total P mg/l
4230	81/08/2004	soil	7.8	12000	13000	280	2200	25000	2600	4500	8
42s	18/08/2004	soil	8.8	6200	7200	100	700	8300	1800	1300	46
39	18/08/2004	water	7.6	42000	10000	270	1100	6300	2300	23	0.07
38	18/08/2004	water	7.7	34000	7400	160	760	12000	1900	18	<0.05
42	18/08/2004	water	7.7	42000	9400	180	1100	6200	2200	4.5	<0.05

BURAKIN DRAIN

The Burakin drain was constructed along a natural watercourse during 2000, which is the same year the drain at Youangarra was constructed. This is the first year this drain has been monitored and it is likely if we are to base assumptions on the monitoring results from the Youangarra drain that the volume of the discharge from this drain is also decreasing from when it was constructed. Other methods within the vicinity of the drain have also been used to lower the ground water in the area including the use of a bore pump and evaporation lake to dispose of the water.



Vegetation

A 500m buffer of vegetation was mapped either side of the drain (Map 4). Vegetation along the natural watercourse is samphire with Melaleucas in the higher areas. There is a small patch of remnant woody vegetation within the buffer zone.

Receiving wetland area

The primary receiving wetland for the Burakin Drain is a chain of lakes along the valley floor that drain into Lake Hillman. Lake Hillman covers an area of approximately 3717ha and is only ever partially inundated. The photo below is taken from the middle of the lake.

Photo: Lake Hillman primary receiving wetland for the Burakin Drain

Quantity of water discharging into the wetland

The quantity of water currently being discharged from the Burakin drain is estimated to be 47,304m^3 per annum. If the area of the receiving wetland, Lake Hillman (3,717ha) and annual evaporation rates (2.5m) are taken into account it is clear to see why the water from this drain never makes it beyond the primary receiving wetland.

Chemical analysis of water and soils

Table 4 Shows the results of soil and water analysis undertaken in August 2004.

Table 4 Ion concentrations of Water and Soils from the Burakin drain.

Sample Code	Date Collected	Type	pH	uS/cm	Na mg/L	Ca mg/l	Mg mg/l	Cl mg/l	SO4 mg/l	Total N mg/l	Total P mg/l
2130	01/07/2004	soil	5.6	13000	14000	220	2900	24000	3200	50	79
2730	01/07/2004	soil	5.7	5900	6200	140	720	13000	1500	54	33
21s	01/07/2004	soil	6.4	9900	9800	3300	1700	22000	13000	420	110
27s	01/07/2004	soil	4.3	600	6200	140	720	10000	1500	71	4321
12	01/07/2004/	water	3.1	77000	1800	180	2100	30000	4400	3.2	<0.05
23	01/07/2004	water	3.2	53000	11000	220	1200	17000	2300	.02	10
27	01/07/2004	water	3.4	120000	23000	450	2100	43000	5100	4.2	0.05
21	01/07/2004	water	7.6	110000	21000	1600	2300	41000	5800	<0.02	0.1

These results show:

The pH of the discharge water is very low and the salinity is correspondently high. The pH of the water in the receiving wetland is neutral with a value of 7.6 however the salinity of the water is extremely high. The soil samples taken from the receiving wetland are also acidic however it is likely they would have a reasonably high capacity to buffer the low pH from the discharge as large expanses of Lake Hillman contain gypsum deposits, which is used as a soil amendment to help neutralize acidic soils. There are surprisingly high levels of nitrogen and phosphorus found in the surface soil of the receiving wetland this is most likely to be due to a localized natural effect as there is no direct runoff from the adjacent farming land into this area.

JIBBERDING DRAIN

The Jibberding drain was constructed primarily to relieve the permanent flooding of roads due to raised ground water levels. With the ground water being so close to the surface the prime function of this drain is the conveyance of water to a discharge into the low lying chain of lakes in the valley floor. The benefits of this drainage project have become immediately obvious with the water being cleared from the Jibberding Hall Rd. If this drain continues to function by draining ground water the problem of flooding is unlikely to occur again. Once the surface water has been drained the flows should slow down to a base level and eventually as seen elsewhere in the Yarra Yarra, drop off to virtually nothing.

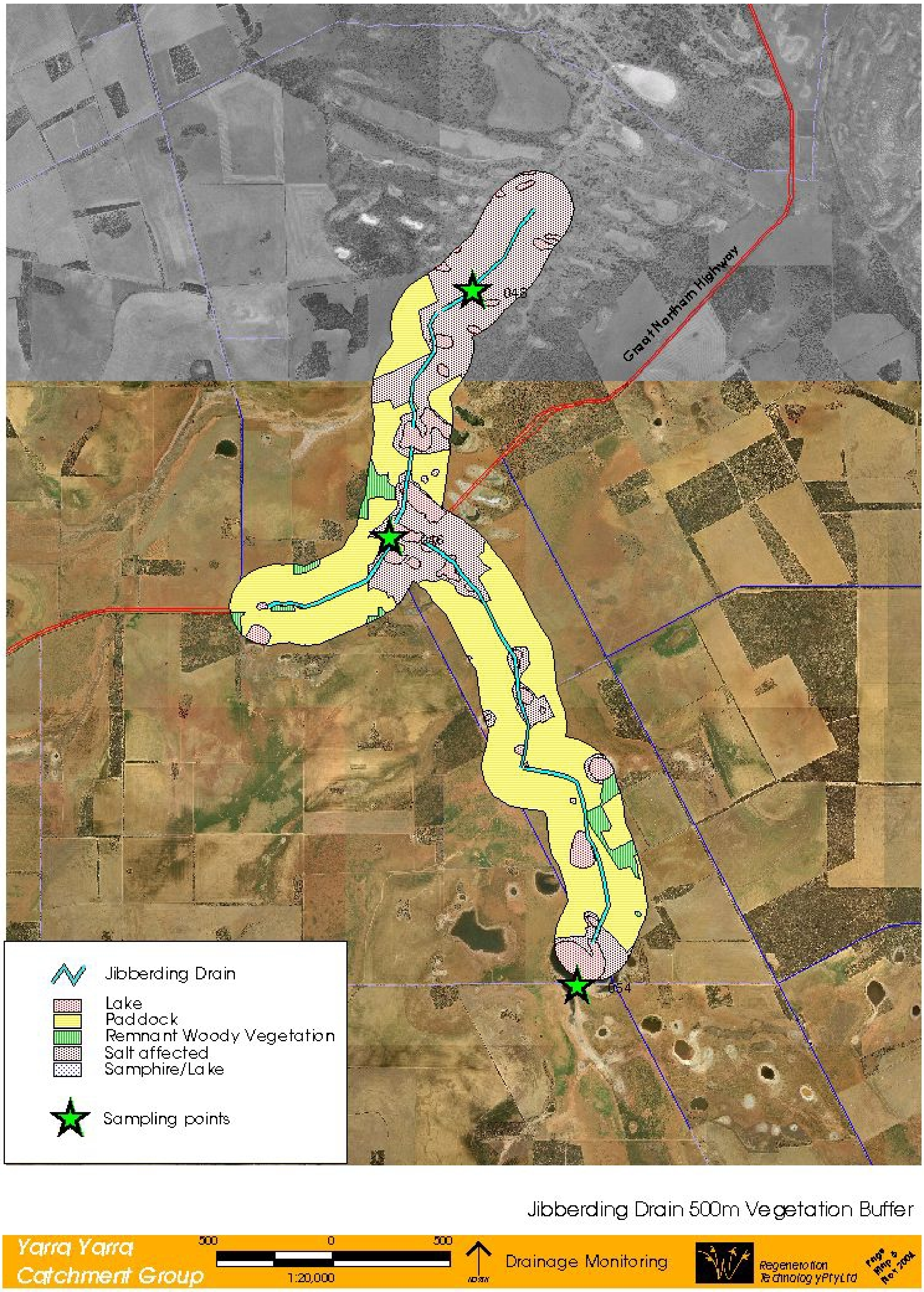
Photo: One of the series of lakes the Jibberding drain flows through

Vegetation

The vegetation mapped with a 500m buffer (Map 5) of this drain comprises of farmland, samphire in the low lying areas and some small remnants of woody vegetation.

Quantity of water discharging into the wetland

The quantity of water discharging being discharged from this drain is estimated to be 685,382m^3 per annum. This is a huge volume of water and currently represents the drainage of water that has been land locked for a number of years. Despite the volume of water discharging down this drain there appears to be no change in the water levels of the chain of lakes to the north of Great Northern Highway since the drain was constructed. Wetlands and lakes on the southern side of Great Northern Highway have decreased in volume and the shoreline of these lakes is gradually decreasing.



Receiving wetland area and Zone of influence

The receiving wetland for the Jibberding drain is an ephemeral depression covered in samphire similar in appearance to the Youangarra receiving wetland.

Chemical analysis of water and soils

Table 4 shows the results of soil and water analysis undertaken in August 2004.

These results show, that the pH of the discharge water is acidic and the soil of the receiving wetland slightly acidic to neutral indicating the wetland spoils may have the capacity to buffer the acidic groundwater. The salinity of the discharge water is moderate (for the Yarra Yarra Catchment) and it is interesting to note that the sample from the starting point of the drain was approximately half the salinity than the lower reaches of the drain. This indicate that once the groundwater that caused the flooding of lakes and roads to the south of Great Northern Highway have been turned over the new water entering the drainage and wetland system will have a slightly lower salinity level.

Table 5 Ion concentrations of Water and Soils from the Jibberding drain.

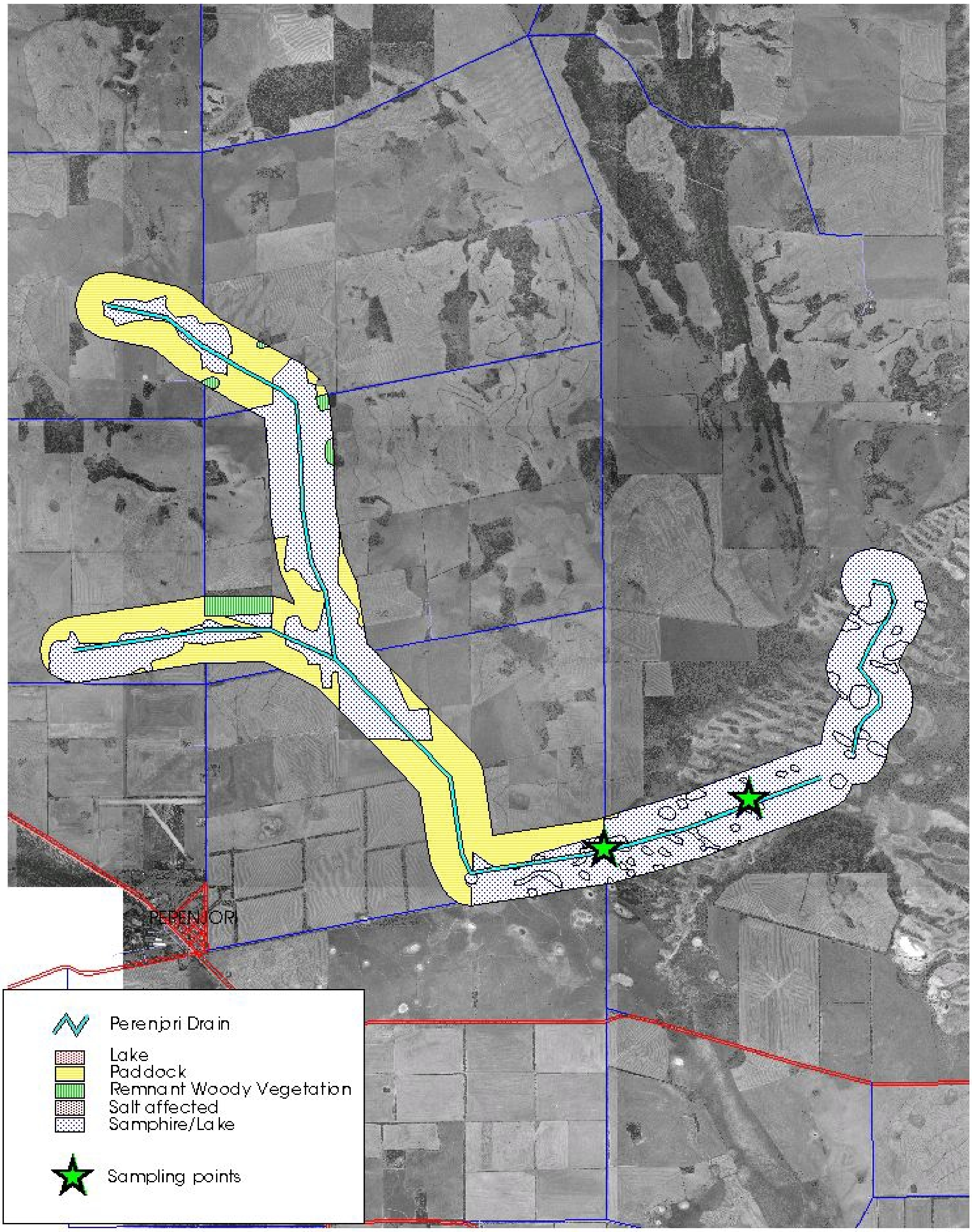
Sample Code	Date Collected	Type	pH	*u*S/cm	Na mg/L	Ca mg/l	Mg mg/l	Cl mg/l	SO4 mg/l	Total N mg/l	Total P mg/l
4630	18/08/2004	soil	4.8	2900	2900	21	110	4800	680	400	14
46s	18/08/2004	soil	5	6000	6300	86	630	11000	1600	310	11
48s	18/08/2004	soil	7	1300	1200	18	38	1800	230	210	19
4830	18/08/2004	soil	7.1	5000	5400	140	460	8300	1300	1300	30
46	18/08/2004	water	3.3	90000	21000	680	2200	37000	5500	4.2	<0.05
52	18/08/2004	water	3.5	80000	18000	360	1700	25000	4000	3.3	<0.05
54	18/08/2004	water	4.2	49000	12000	270	1200	10000	2400	3.9	<0.05
48	18/08/2004	water	4.8	98000	21000	1100	2300	39000	6700	3.1	<0.05

PERENJORI DRAIN

The Perenjori drain has not been constructed yet. It is being designed to combat rising ground water levels within proximity to the townsite. It will be approximately 24 km in length draining into the Yarra Yarra chain of wetlands in the valley floor.

Vegetation

The vegetation within a 500m buffer of the proposed Perenjori Drain is for the most part farm land and salt affected pastures in the lower reaches of the proposed drainage area there is samphire vegetation and chains of lakes with melaleucas on the higher ground. The Perenjori drain passes over the clearing line of the whaetbelt and ends in the pastoral country to the east.



Proposed Perenjori Drain 500m Vegetation Buffer

Yarra Yarra Catchment Group | 1000 0 1000 2000m | 1:75,000 | NORTH | Drainage Monitoring | Regeneration Technology Pty Ltd

Quantity of water discharging into the wetland

An estimate of the amount of discharge from this drain has been made based on discharge rates from the Youangarra Drain. When it was flowing at it's maximum capacity one year after it was constructed the 71% of the volume of water in the drain was being replaced daily. If we use this figure and make some assumptions on the drain width and water depth we can make an estimate of the volume of water this drain with discharge for the first 3 years after construction. If the drain is to be 24 km long 1.5 m wide and the water depth in the drain 10cm then the total volume of water in the drain will be 360m^3 of water, 71% of this is 255.6m^3 which is the daily input into the drain. Multiply by 365 gives and estimate of 93,294m^3 per annum being discharged from this drain.

Receiving wetland area

The receiving wetland is typical of others in the Yarra Yarra Catchment being a samphire depression that links ephemeral lakes.

Photo: Typical samphire vegetation associated with the salt lake chains on the valley floor.

Chemical analysis of water and soils

Table 4 Shows the results of soil and water analysis undertaken in August 2004.

These results show, that the water and soils collected from this area have a neutral to slightly alkaline pH. These results do not confer with those from the bore monitoring data that recorded pH of between pH 4.6 and pH 6.8. The soil pH indicates that the soils of the receiving wetland will have the capacity to buffer some of the acidity from the ground water discharging from the drain. The salinity levels are similar to those from the bore monitoring and are relatively low by comparison with salinity levels elsewhere in the Yarra Yarra.

Table 6 Ion concentrations of Water and Soils from the Perenjori drain.

Sample Code	Date Collected	Type	pH	*u*S/cm	Na mg/L	Ca mg/l	Mg mg/l	Cl mg/l	SO4 mg/l	Total N mg/l	Total P mg/l
3630	18/08/2004	soil	7.7	3100	3600	8	40	5000	1100	680	42
36s	18/08/2004	soil	7.8	2900	3300	18	47	4900	950	2400	380
34	18/08/2004	water	7.1	33000	5700	1300	1400	10000	1500	2.8	<0.05
36	18/08/2004	water	7.3	29000	6900	70	640	11000	1900	7.7	0.12

GENERAL DISCUSSION

Some of the key findings of this study are:

1) the volume of water being discharged over time decreases with the aquifer being drained;

2) Recharge of the aquifer in the region is minimal due to climatic conditions (ie low rainfall high evaporation)

3) The zone of influence the discharge waters have on the receiving wetlands are insignificant when the entire Yarra Yarra Lake system is taken into account.

4) Down stream discharge past the primary receiving wetland is highly unlikely given the high evaporation rates for the area. There is no free water connecting the lakes even in the lowest points of the catchment.

5) The wetland soils have the capacity to buffer the pH of the discharge water.

6) The salinity of the discharge water is generally higher than that of the lakes but all water measured was in the hyper-saline range.

7) The salt lakes do not support an abundance of flora and fauna.

There appears to be a general trend for pH to move to wards neutral and salinity levels in the water to decrease with the further north (and the further downstream in the Yarra Yarra lakes system).