

YARRA YARRA CATCHMENT REGIONAL COUNCIL

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| Morawa | Perenjori |
| Three Springs | Wongan-Ballidu |

ESTABLISHING PRIORITIES FOR DEEP DRAINAGE IN THE YARRA YARRA CATCHMENT



Yarra Yarra Catchment Management Group

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Part One – Overview

Background

1. In the early 2000's YYCMG carried out an investigation to evaluate the status of the drainage network in their designated management area. This area includes the agricultural area in Catchment Basin 618 and agricultural land in Catchment Basin 619 west of Lake Moore (west of the clearing line). These catchment basins are registered as part of the National South West Drainage division.
2. During these investigations topographical data provided by the Department of Land Information was analyzed resulting in the identification of 61 sub catchments discharging directly or indirectly into the Yarra Yarra Lake chain. (see figure 1)
3. For ease of management these sub catchments were grouped into eleven 2nd order catchments, which we recognize as Administrative Zones. Generally these zones are made up of five or six sub catchments.
4. Following the NACC community consultation strategy workshops during 2004, Yarra Yarra staff conducted additional hands-on workshops with interested farmers from each of the 11 zones. Discussions took place at each of these workshops to ascertain the most urgent needs of land managers in each of the zones. Without exception, the main concerns were the effect of rising groundwater in the valley floors and the inability of farmers higher in the landscape to access satisfactory discharge points for deep drainage.
5. At the workshops, 82 farmers identified 522 km of waterway that required deep drainage to relieve groundwater build-up. YYCMG carried out desktop investigations using GIS software with rectified aerial photos and contour maps to follow up on the information gathered from the workshops.
6. From the desktop study, using topographical data and rectified aerial photography it was discovered that most of the drainage problems land managers face could be addressed by rehabilitating the main delivery waterway in each of the zones.
YYCMG were able to ascertain where the primary streamlines were located and which ones would provide the most relief to farmers within each zone.
7. To further assist in identifying which of these streamlines are most suitable for deep drainage the following processes were developed and have been carried out in the field.

Field Program

1. Boreholes

- Drill bores at 1km intervals, to an average depth of 5m, along the full length of each proposed waterway.
- Install casing to prevent movement
- Record depth to water, basic soil characteristics, presence of hardpans, ease of drilling.

There are currently 957 bores recorded in our data base.

2. Observation Pits

- Excavate backhoe pits at 2 km intervals along the first stage of each proposed waterway.
- Describe the soil profile, take samples of soil and water, measure the rate of inflow (as a way of estimating drawdown), record the presence of any hardpans and the ease of excavation.

3. Real time kinematic (RTK) surveying

Once the initial desk-top study has been completed, precision surveys (to at least 50mm accuracy) are required to determine accurate grades. Contours and gradients determined in the survey will govern the drain design, including the precise location and the drain effectiveness.

4. Resource assessment at Sub Catchment level

Data gathered at Zone level will be processed and tables and graphs will be devised so that decisions can be made about the viability of drainage in particular situations. From this information sub catchments within the Zones are then prioritized for implementation. (See Zone Attributes Table and Drainage Prioritisation Policy)

5. Local workshops

A series of mini workshops are then held with land managers from the selected sub catchments that will:

- Review disposal and management options, in the light of local geochemical and biological conditions.
- Provide some design options and discuss local conditions and precedents in flood events.
- Establish drain design, road crossings and paddock crossings.

6. Work with engineers

Liaise with engineers regarding culverts and floodways, overland flows and predictions.

7. Final Pegging

Work with land managers to peg out and map the drainage network (at this stage a further RTK survey will be carried out).

Prepare tender documents and invite EOIs for implementation of plans.

Governance

Having established which drainage lines are of highest priority, the governance, maintenance and legal issues must be addressed.

Maintenance issues

- For a prioritised waterway to be approved for development all land holders affected by the construction of both groundwater and surface-water drains must sign and adhere to an agreement with the Yarra Yarra Catchment Management Group. This agreement is known as a Memorandum of Understanding (MOU). This document also includes an agreement for covering maintenance costs of the drain after its completion.

Legal issues

- All legal requirements must be identified and necessary permits and permissions sought. This includes the Notice of Intent to Drain, Indigenous Assessment and Native Vegetation Clearing permits.

Governance issues

- The amalgamation of existing Landcare Districts (LCDs) into a single regional body. Each zone to form a committee, which will become a subcommittee within the new Yarra Yarra Land Conservation District Committee (LCDC)
- Establishment of a statutory Regional local government council to regulate and manage the affairs of the Yarra Yarra catchment basin.
- Funded waterways becoming “Declared Waterways” under the control of the local government council.
- The establishment of an easement or similar legal control.
- Ascertain what infrastructure, both private and public, is at risk.

Independent evaluation

Towards the end of our prioritisation process the engineering company GHD were commissioned by the department of water and NACC to do a “Yarra Yarra Regional Drainage Evaluation” this was separate from the \$1,000,000 of public funds spent by Yarra Yarra carrying out “in house” investigations. This GHD project cost in excess of \$250,000. The only useful finding from this investigation was that there is insufficient scientific and economic data available to reach meaningful conclusions on the effects of deep drainage in the wheat belt landscape.

Apart from the enormous investment by the federal and state government in this exercise, a great deal of Yarra Yarra resources was also devoted to meetings and preparation of reports which were not provided for in the Yarra Yarra Regional Drainage program.

In consultation with the Department of Water it was resolved that it was imperative that an in depth monitoring program should be built into the Yarra Yarra Regional Drainage initiative.

Having identified the drainage lines in each Zone that were in most need of rehabilitation it was decided to use these for the research program. The data collected from this monitoring and investigatory program will provide invaluable information that will enable other regions to conduct meaningful Catchment evaluations and assessments.

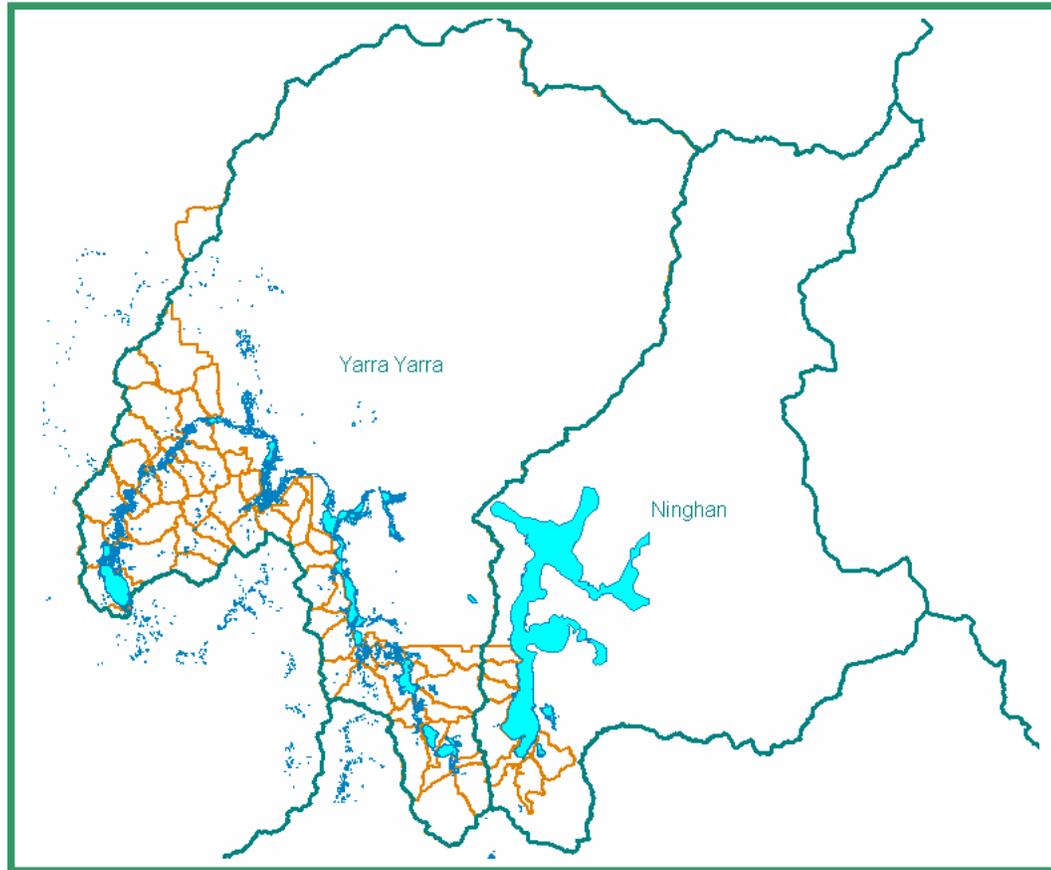


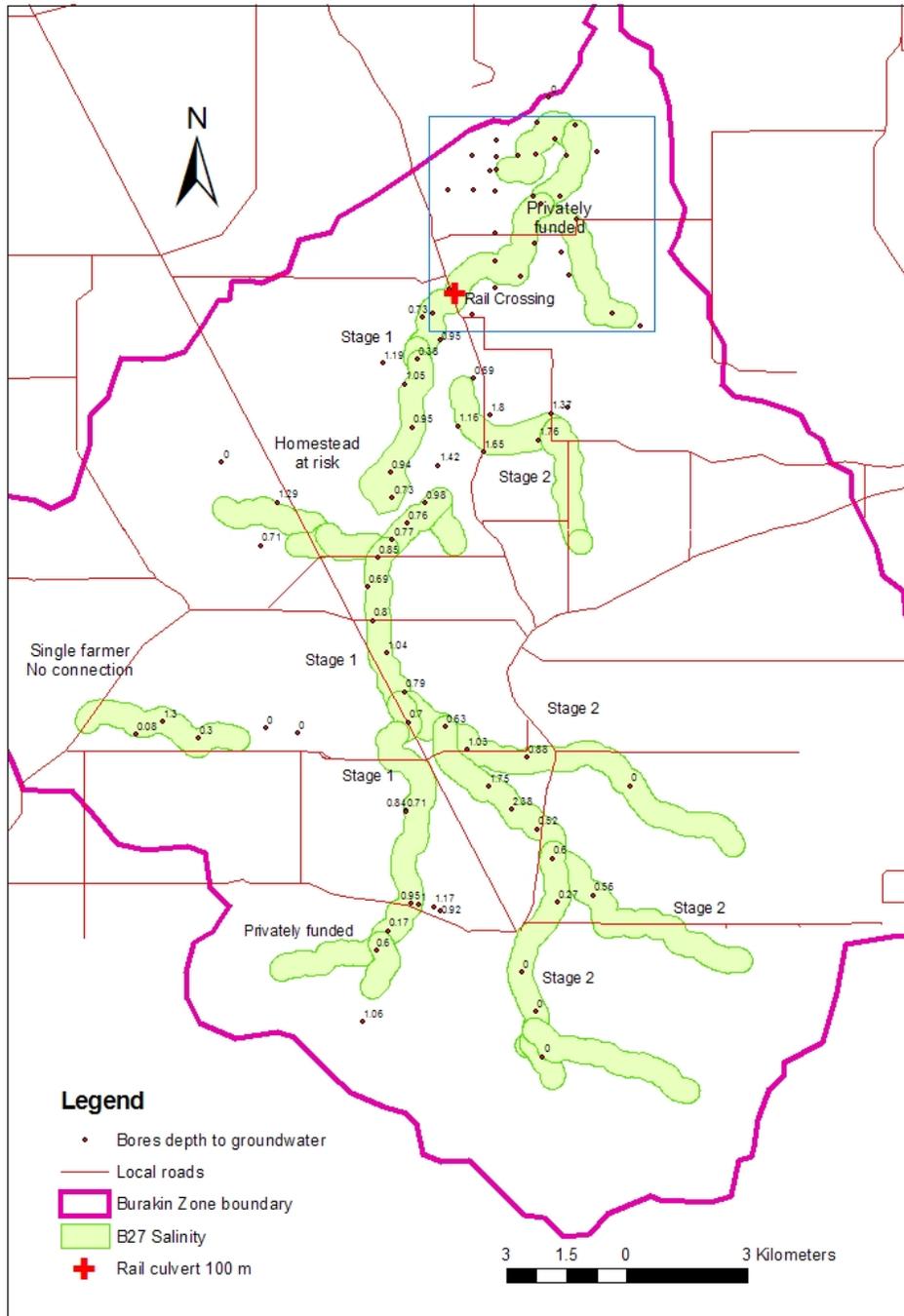
Fig. 1

Part Two – Sub Catchment Assessments

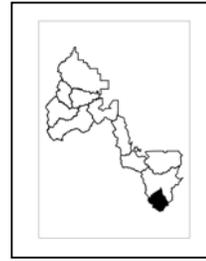
The following maps and comments give a snap shot of the prioritization process that preceded the development of the Yarra Yarra Regional Drainage schedule

**Prepared by Max Hudson, Project Manager
Technical information provided by Dr. Ian Fordyce, resident soil scientist**

BURAKIN ZONE



Burakin Zone



The Burakin drainage system creates the headwaters of the whole Yarra Yarra Lake chain and discharges into Lake Hillman. In extremely high rainfall events it may overtop into Lake DeCoursey, however the lake has not linked up with Goorly and Mongers in living memory.

The total area of the Burakin Zone Catchment is 45,000 hectares; within this the total area of farm land affected by salinity is 6,247 hectares. Within the Burakin Zone there are four homesteads under threat to salt encroachment, the Dowerin to Kalannie railway and road are at risk and so are six other Shire roads. As can be seen by the bore readings on the above map, the water table in the valley floor is very close to the surface, probably more so than in any of the other catchments in the system with a range of depths between 0.2 to 1.6 metres.

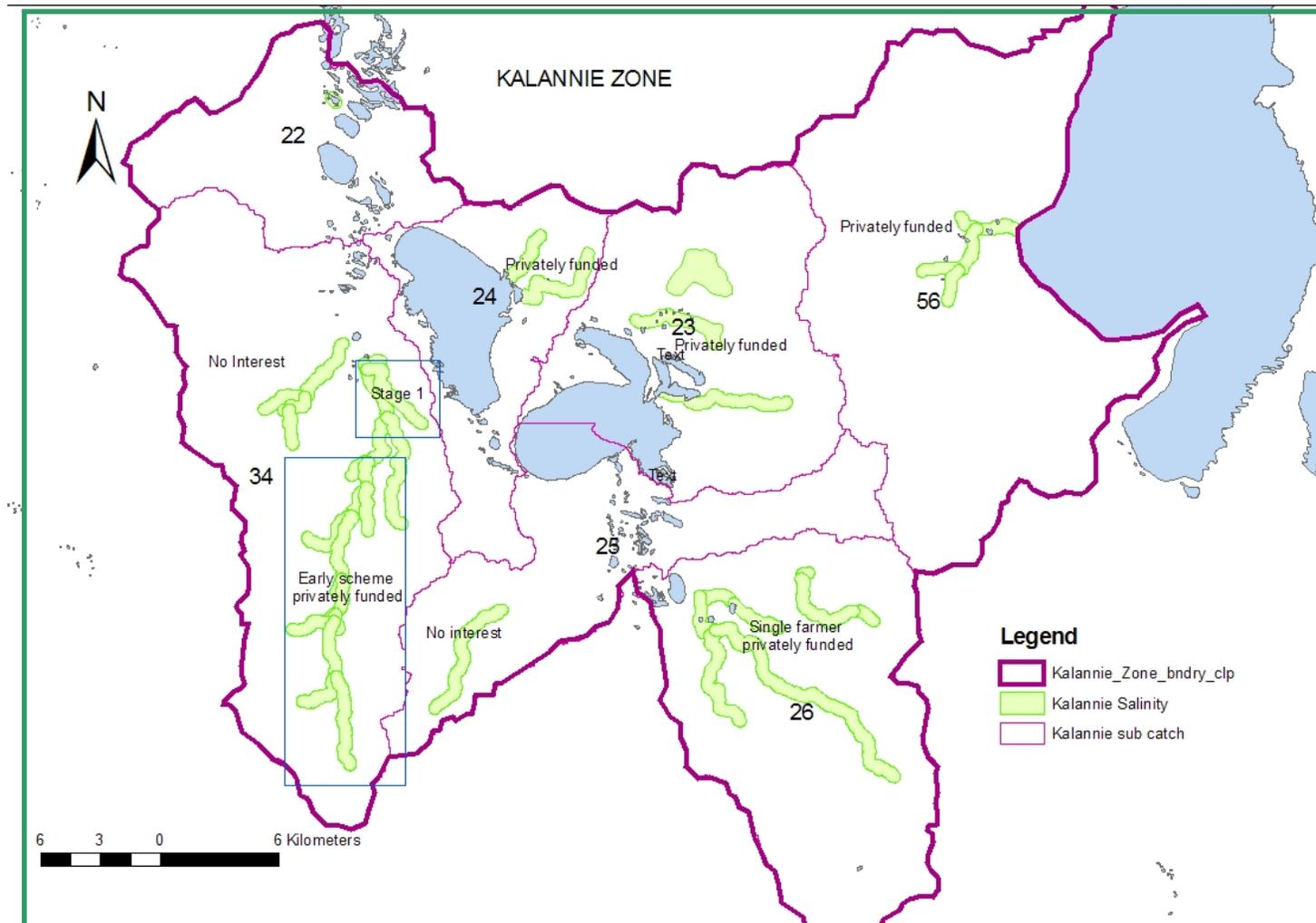
Obviously the farmers are concerned about the increasing salinity and have also observed that deep drainage in the area has been spectacularly successful. It is anticipated that all of the affected land within this area will be recoverable to some extent. It is for these reasons that the farmers within this zone are willing to participate in the Yarra Yarra regional drainage scheme, they have been very supportive with high participation levels in the workshops.

Technical Comments

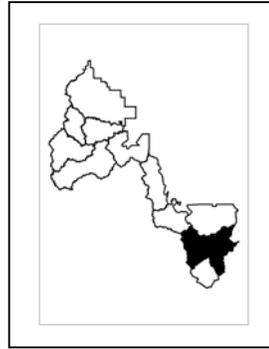
- YYCMG has negotiated with the Dalwallinu Shire and Westrail to construct a culvert under the railway line and the road where the excavation will cross.
- Soil pits and observation bores indicate that the top soil is shallow (37cm)
- Sub soil is quite easy to dig which will be an advantage for excavation.
- Pits indicate that inflow is surprisingly slow, but this may not be a true indicator as private drains already dug at the top and bottom of the catchment have been very successful.
- The pH range is between 4.8 - 6.2
- The salinity range of between 3.9 - 11 mS/cm.
- The depth to ground water in the valley floor is in a range of between 0.2 – 1.6 metres.
- The sub catchment 27 in itself constitutes the Burakin Zone.

The main connecting drain lines in this system have been selected for stage 1 and 2 of the Yarra Yarra Regional Drainage program.

PRIORITIES FOR DEEP DRAINAGE IN THE YARRA YARRA CATCHMENT



KALANNIE ZONE



The Kalannie Zone comprises of a total area of 137,800 hectares of which, 9,892 hectares of farming land is affected by salinity.

Most of the salinity is located in the Xantippe sub catchment 34 and a privately funded scheme was established with the help of the Kalannie Goodlands LCDC in 1988 to address this. There is to be some modification done to this drainage line under the Yarra Yarra Regional Drainage Program Stage1.

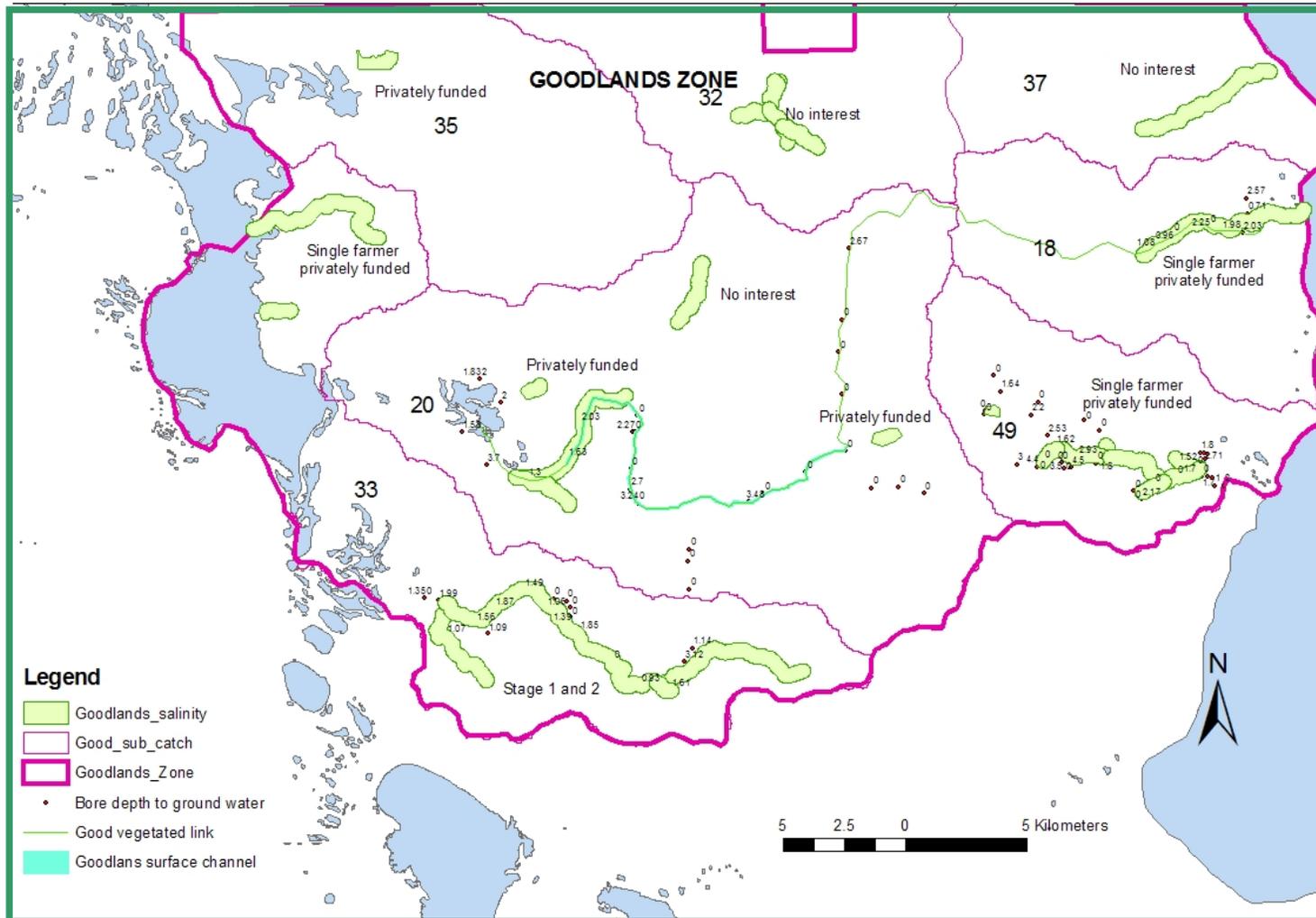
Most of the deep drainage activities in this zone have been carried out privately. Some of the early work was not all that successful as contractors did not dig deeper than 1.8 metres. However the most successful private drain was established in sub catchment 23 in 1999 and has been steadily flowing into Lake DeCoursey since it was first constructed. The results are quite spectacular. A strange phenomenon is that the ground water ph is neutral compared to the more highly acidic water in the Burakin Zone to the South. One of the main shortfalls with early drainage work is that very little monitoring has been recorded.

In more recent years, deeper drains have been dug privately in sub catchment 26 which have been very successful. Other than the Xantippe sub catchment, the salt affected land is more minimal with private drains being the norm. There is no opportunity for further arterial drains to be introduced.

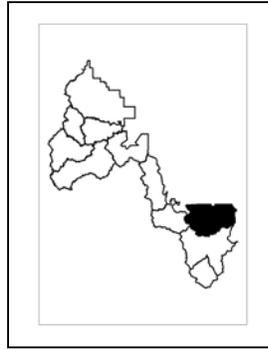
During the late 1980's and through the 1990's a prolific tree planting program was introduced by the Kalannie Goodlands LCDC. This was mainly targeting areas of perched water tables and met with varying success.

Some modification work has been selected in catchment 34 for inclusion in the Yarra Yarra Regional Drainage program stage 1

PRIORITIES FOR DEEP DRAINAGE IN THE YARRA YARRA CATCHMENT



GOODLANDS ZONE



The Goodlands Zone comprises of 112,695 hectares in total, of which 5,693 hectares of the farming lands are affected by salinity.

Most of the salinity appears in the earlier cleared land of sub catchments 33 and 49. Drainage work in sub catchment 49 has been privately funded as only one farmer is involved. Sub catchment 33 will be part of Stage 1 of the Yarra Yarra Regional Drainage program.

In 1995 the Goodlands LCDC was formed and a vegetated 100 metre wide corridor was formed that traversed sub catchments 18 and 20 joining up two major lake systems Lake Moore to the east with Lake Goorly to the West. This corridor incorporates an arterial surface water control system using minor levee banks to convey excess flood water out of the two sub catchments to the appropriate lake systems. It is to be noted that very little salinity is evident in these valley floors as is indicated by the negative readings of the observation bores in the map on the previous page.

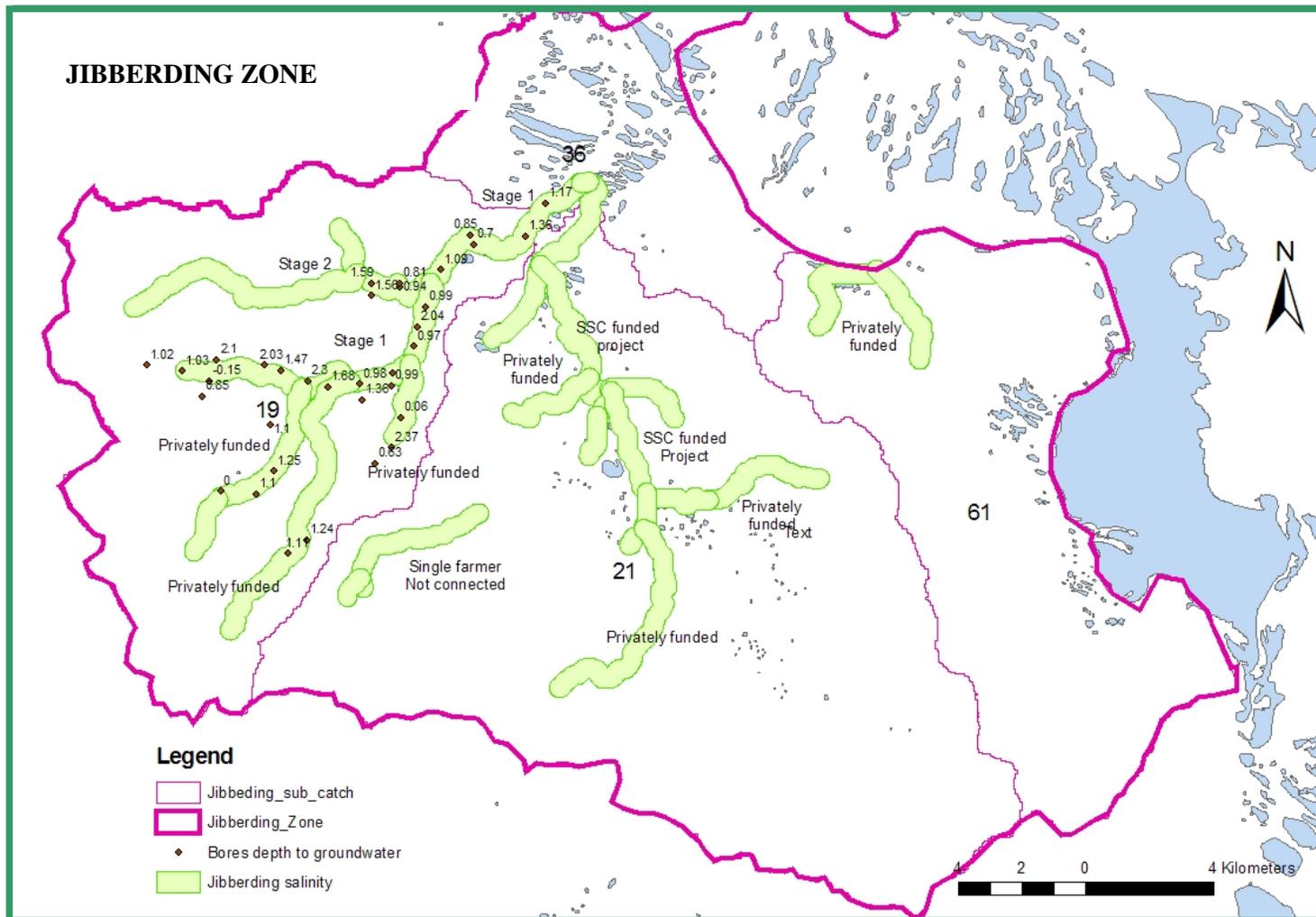
The YYCMG have applied for funding to upgrade the levee bank system with a shallow delivery drain to give more definition to the drainage line in the flatter areas and allow the surface water to move out of the catchments more rapidly. In a high flood some of the levee banks can overtop. The YYCMG believe that this is most important to maintain the relatively low water tables in the valley floor of sub catchment 20.

Technical Comments for Goodlands 33

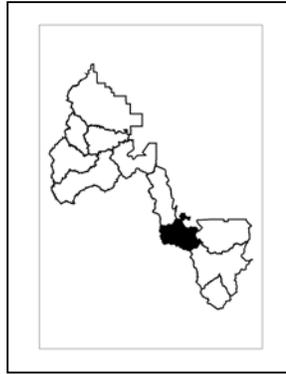
- Water tables are high and the inflow rate into soil observation pits is fast.
- Depth of top soil is 72 cm
- Medium to hard digging
- PH in a range from 3.7 to 7.2
- Depth to Ground water 0.9 to 2.0 metres

Sub catchment 33 has been selected for stage 1 and 2 of the Yarra Yarra Regional Drainage program.

Sub Catchment 20 has been selected for Stage 1 of the Regional Drainage program for the development of a surface water channel.



JIBBERDING ZONE



The Jibberding Zone comprises of a total of 64,986 hectares, of this 7,352 hectares of farm lands are affected by salinity. Nearly all the saline land is contained in sub catchments 19 and 21.

In 2002 some farmers in sub catchment 21 entered into a joint project with the State Salinity Council to establish some deep drains to relieve a land locked system that was exacerbating the salinity problem. This was really the fore runner to the Yarra Yarra Regional Drainage program. This project was plagued by numerous problems but was invaluable as a background to our new initiative.

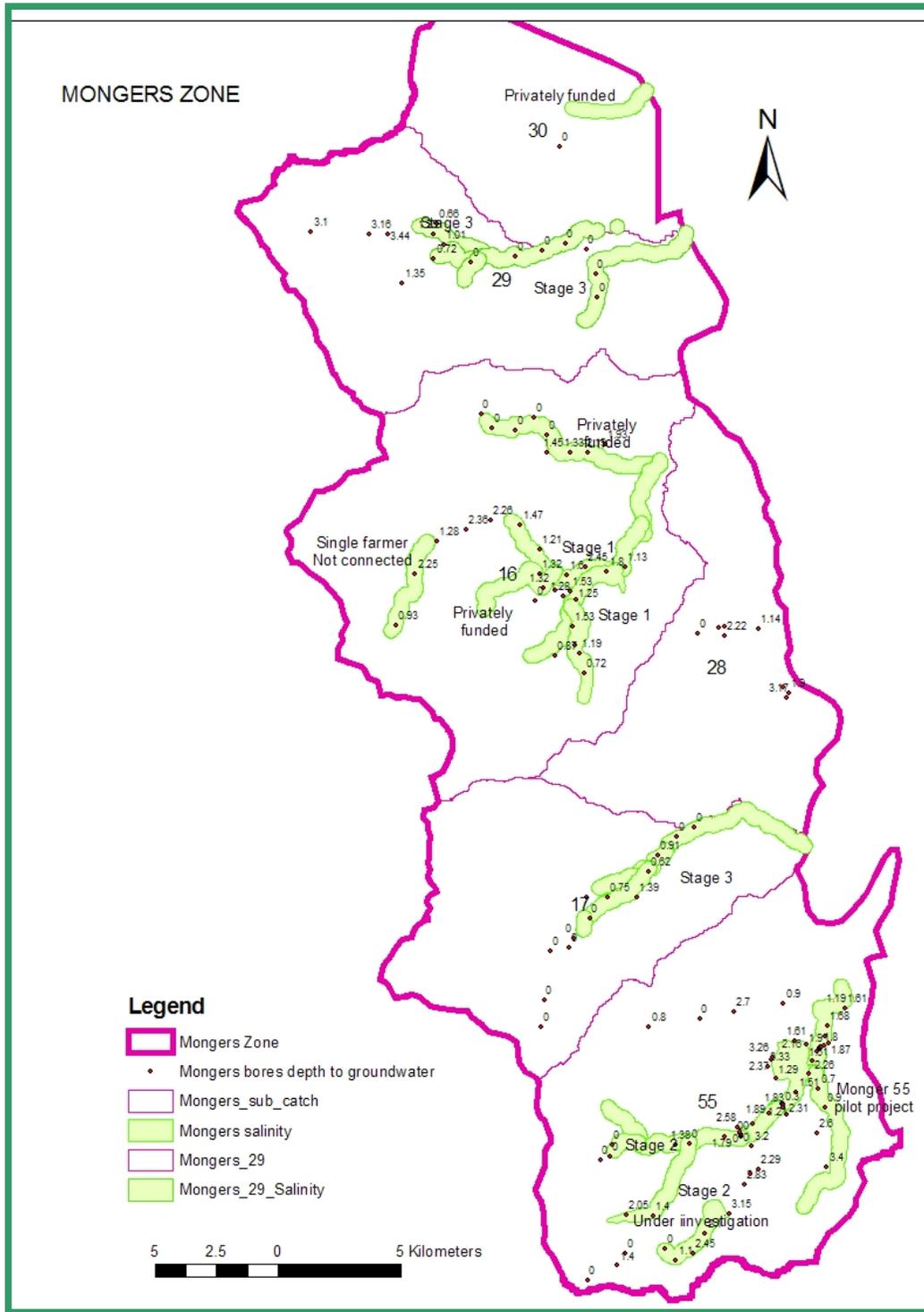
We learnt that communications with all the stakeholders and management is imperative and that too many stake holders of a bureaucratic background make communications and decision making more difficult. We also learnt that monitoring is very important and that surveys need to be extremely accurate considering the flat terrain we are working with. The project made us aware of the need for a comprehensive drilling program and the need to dig observation pits for soil testing and inflow calculations.

In the higher reaches of sub catchment 19 (which is part of Stage 1 of the Yarra Yarra Regional Drainage program), the water table is extremely shallow with one reading of 0.15 metres (from the surface) within 400 metres of a homestead. Vital infrastructure at this kind of risk is considered a top priority when assessing the need for drainage.

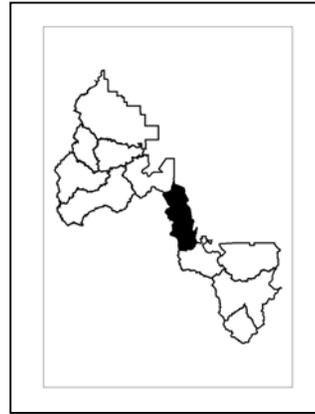
Technical Comments

- The pH ranges from 3.3 to 7.4
- The depth to ground water in the valley floor ranges from 0.9 to 2 metres
- The digging is estimated to vary from medium to hard
- The depth of top soil averages around 54 cm

Sub catchment 19 has been selected for Stage 1 of the Yarra Yarra Regional Drainage program. All the farmers along this valley have signed an MOU agreeing to accept an easement over the land directly adjacent to the drain.



MONGERS ZONE



The most significant feature of the Mongers Zone is its long narrow configuration as compared to other Zones. The distance from the western shores of Lake Monger to the range of hills that constitutes the western boundary of the Yarra Yarra Catchment Basin is only 17 km.

The pilot project of Mongers 55 is in the South end of this Zone. This project has been concluded with very satisfactory results with yields of ground water quite high, up to 11 litres per second at its peak. The pH is in the low to mid 3's which is probably a bit lower than anticipated.

The second stage of Mongers 55 has been put on hold as farmers wish to have more time to decide on whether or not to proceed further up into the landscape. In the meantime Yarra Yarra staff will carry out further investigations into the water table location.

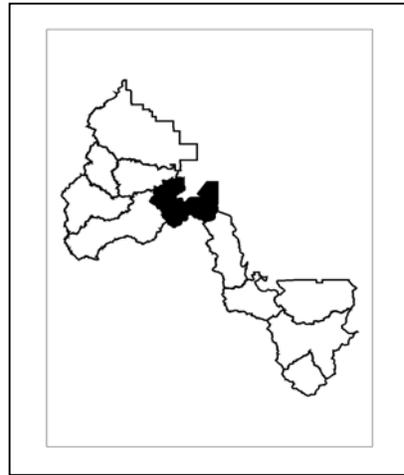
Because there is such a short distance from the source to the discharge area in the Zone and also the long configuration, sub catchment 16 was included in Stage 1 of the Yarra Yarra Regional Drainage program to get a better coverage of the Mongers Zone for our research program and also a better spread over the whole Catchment Basin Management area.

Technical Comments

- Water inflow is medium
- PH in a range from 6.3 to 6.9
- Digging is soft
- Depth to Ground water in a range from 1.2 to 1.9
- Salinity mS/cm in a range from 16.5 to 44.8

Sub catchments 17 and 29 are included in Stage 3 of the program.

PERENJORI ZONE



The Perenjori Zone has an overall area of 83,696 hectares. Of this 8,052 hectares are farming lands affected by salinity.

There has been a fair bit of interest expressed in establishing a deep drain in sub catchment 13 and our investigations show that it would be a high priority according to its physical attributes. However no agreement can be entered into until legal aspects of the settling of a deceased estate in the lower reaches of the catchment are resolved. For this reason, this drainage line has been relegated to stage 3 of the Yarra Yarra Regional Drainage program.

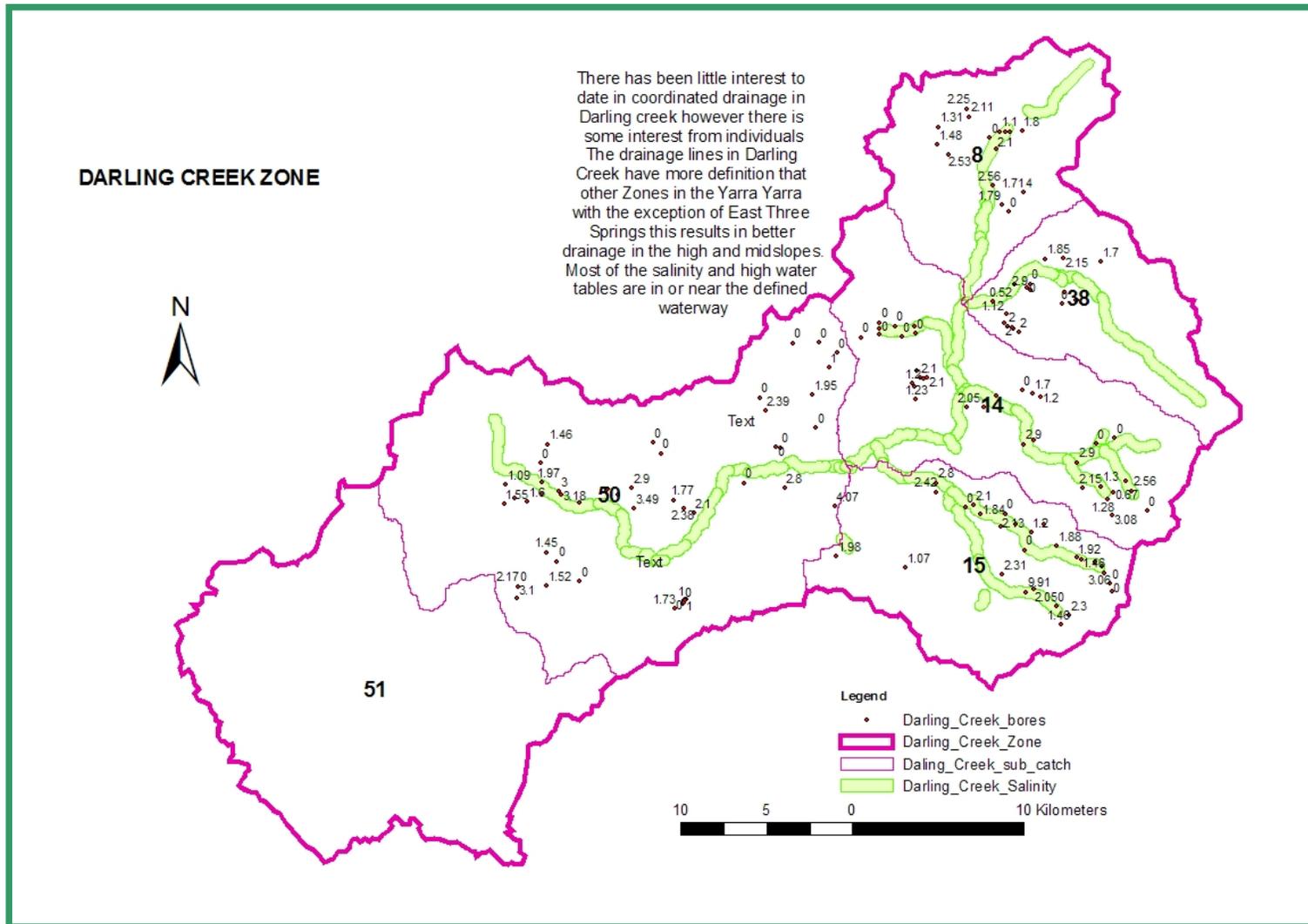
There has been no interest in deep drainage by farmers in sub catchments 7, 10 or 31. There appears to be little degradation in these catchments and this is not conducive to a regional drainage scheme.

Sub catchment 12 has shown early signs of salt encroachment. This problem has been tackled by private investment.

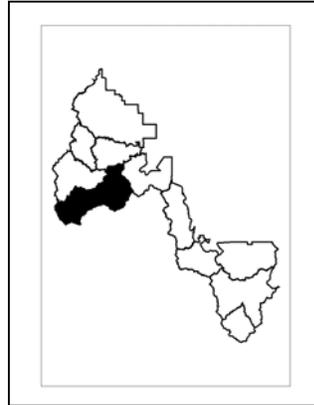
Sub catchment 9 has some severe problems which have affected drainage in the Perenjori Town site. This problem is being address by the Rural Towns Program.

To the North of the town in sub catchment 9 a major drainage line has been the subject of an NLP project run jointly with the local farmers. This project highlighted the idea of draining into a local lake that could then be used for recreational purposes.

There has been some interest shown in sub catchment 46 as a drainage proposal. First impressions are that it is not suitable but further investigations need to be carried out to see if it could be eligible for Stage 3 of the Yarra Yarra Regional Drainage program.



DARLING CREEK ZONE



The Darling Creek Zone has the Yarra Yarra Lake as its focal point and is 128,983 hectares in total area of this 10,724 hectares of farming land is affected by salinity.

There has been little interest to date in coordinated drainage in Darling creek. However there is some interest from individuals.

The drainage lines in Darling Creek have more definition than other Zones in the Yarra Yarra with the exception of East Three Springs. This results in better drainage in the high and mid slopes. Most of the salinity and high water tables are in or near the defined waterway.

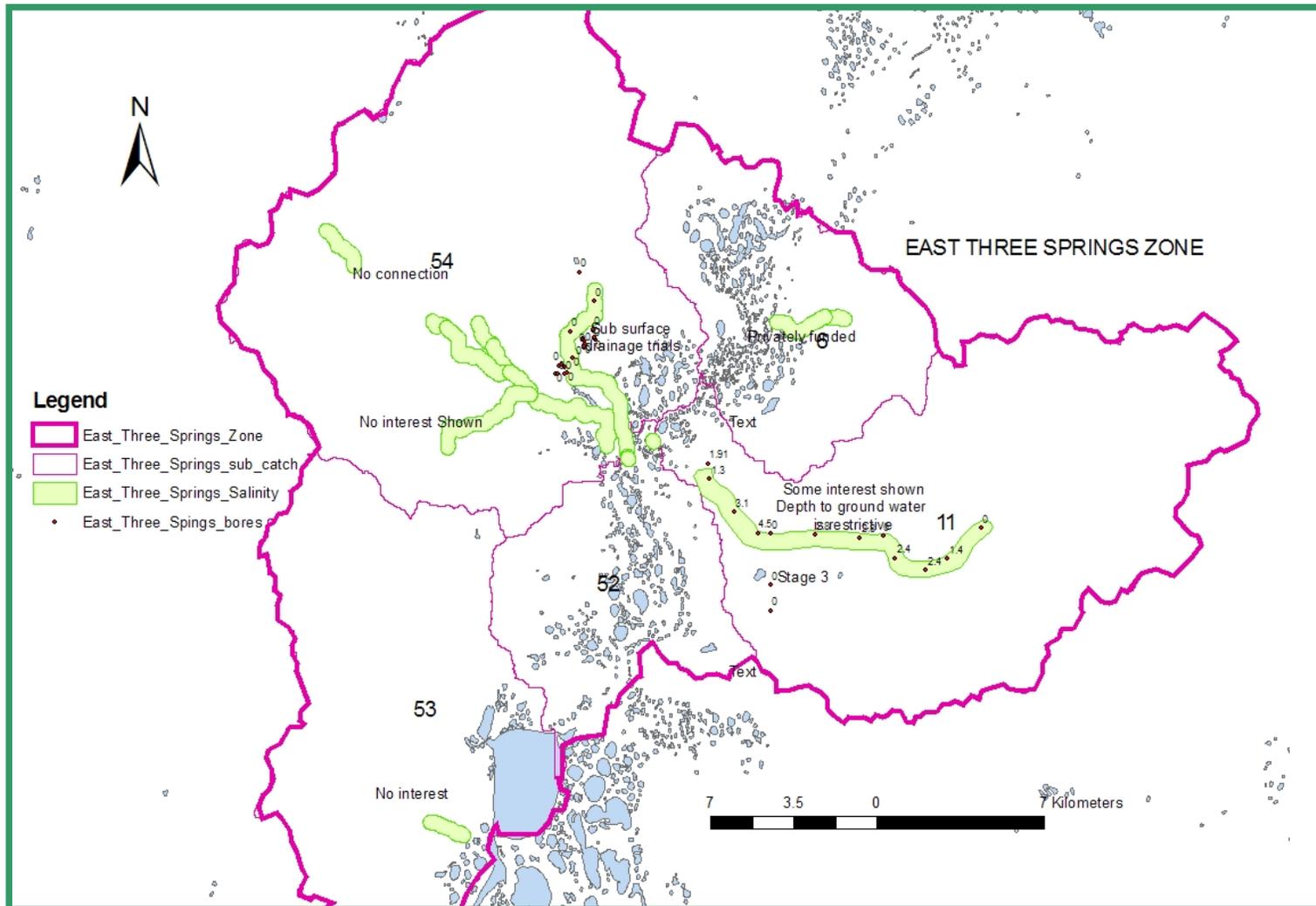
Our main contact with this Zone has been through the LCDC and the chair of that committee who attends the Yarra Yarra meetings regularly and reports on the situation.

The Darling Creek Zone comprises of six sub catchments; 8, 38, 14, 15, 50 and 51. All of the sub catchments drain into a main arterial water way that in turn passes through a multitude of playa lakes and then on to the main receiving area, the Yarra Yarra Lake. This system provides the main source of inflow to the Yarra Yarra Lake, the Darling Creek Zone thus forming its own significant catchment that is in no way connected to the main Yarra Yarra Lake chain.

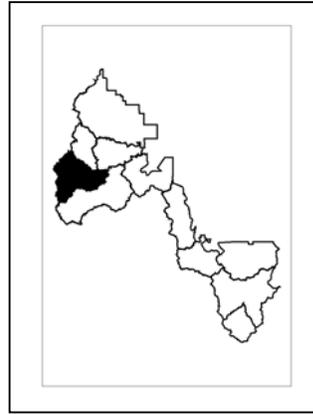
We will closely monitor the situation in the Darling Creek Zone. We feel that the catchment creates its own unique environment that could need special investigation. However, in the short term the salinity problem does not seem to be a major source of concern. If deep drainage did become an option then disposal would have to be investigated in depth.

There is no work scheduled for the Darling Creek Zone in the Yarra Yarra Regional Drainage program.

PRIORITIES FOR DEEP DRAINAGE IN THE YARRA YARRA CATCHMENT



EAST THREE SPRINGS ZONE



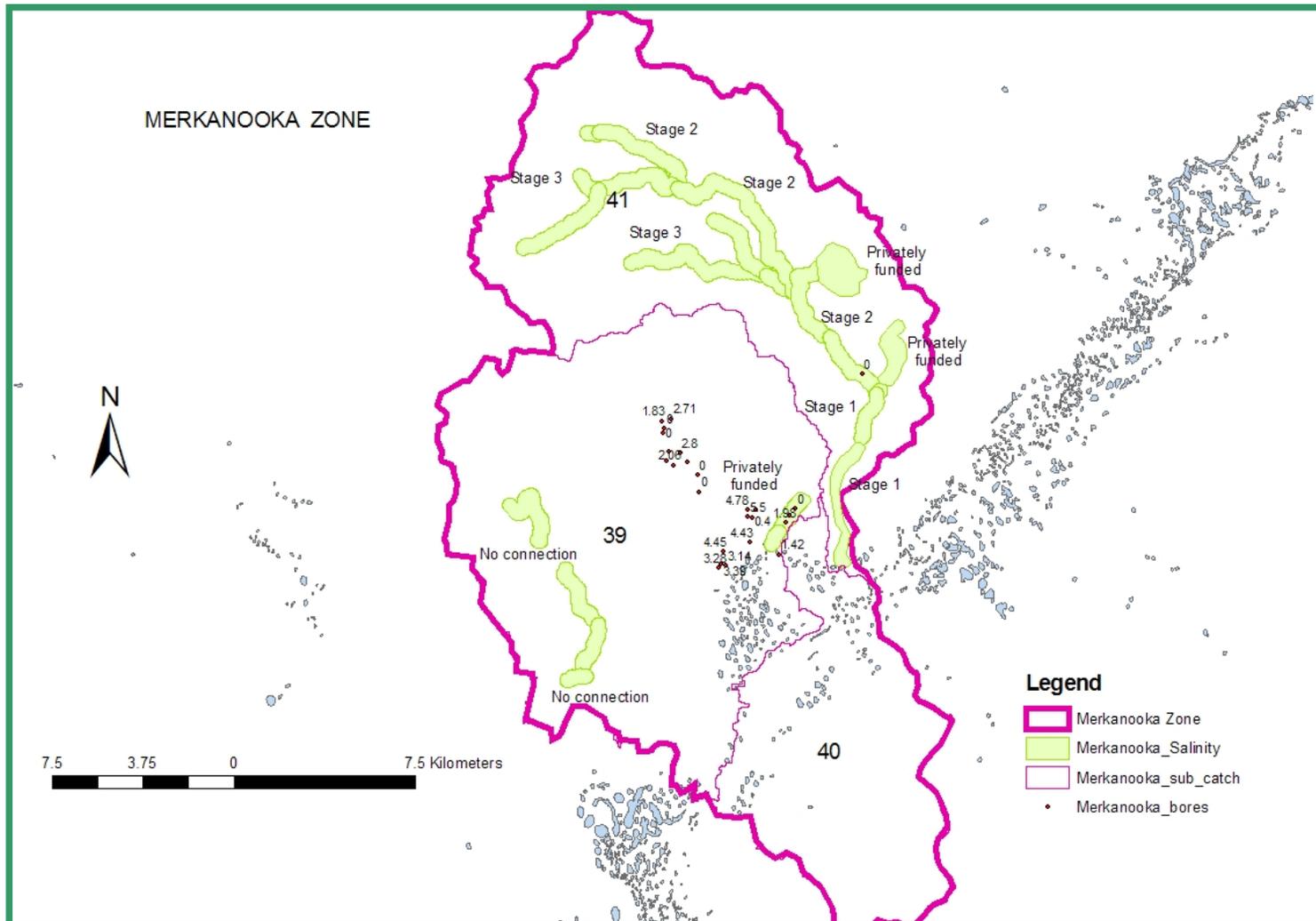
The East Three Springs Zone is 91,229 hectares in area with 3,867 hectares of farm land affected by salinity.

The East Three Springs Zone drains into a series of playa lakes and compared with other Zones in the lake chain the terrain is of higher relief resulting in less build up of ground water in the farming land over time.

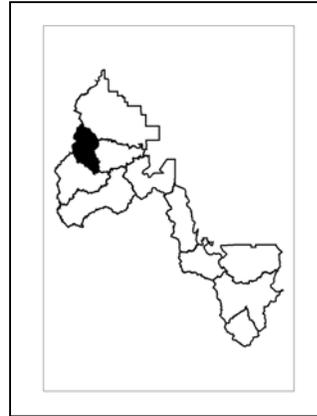
The most noticeable feature of the Three Springs Zone is that generally farmers are able to crop right up to the lake's edge without yield reduction. We have conducted regular Zone meetings in East Three Springs, but there has not been a great deal of interest shown in deep drainage. Some investigations have been carried out in sub catchment 11 but the indications are that the ground water readings are not shallow enough to warrant excavation. We will revisit this site to see if it can be a potential for Stage 3 of the Regional Drainage program.

Some sub surface drainage trials have been conducted in Sub Catchment 54 using subterranean slotted polyethylene pipe. The release of ground water from this site is most spectacular but investigations into the practicalities of using this form of drainage in the wheat belt show that it is not a viable option.

PRIORITIES FOR DEEP DRAINAGE IN THE YARRA YARRA CATCHMENT



MERKANOOKA ZONE



The Merkanooka Zone has a total area of 50,177 hectares with 4,798 hectares affected by salinity. The Yarra Yarra Lake chain passes through the catchment in the form of a series of playa lakes which can become connected in a major flood.

A dominating factor in Merkanooka and all the Zones in the Morawa Shire is that the ground water is either alkaline or neutral. This is a major advantage when discharging into the lake system as in sustained high rainfall events the system can flow from Morawa westward to the Yarra Yarra Lake.

In sub catchment 39 the dominating feature is the Bellaranga Hills, this is a mini mountain range with peaks rising to 392 m AHD compared to the lakes edge 10 km away which is 252 m AHD. Because of the high relief there is a minimal problem with rising ground water in sub catchment 39 but more of a surface water problem.

Sub catchment 40 is a small catchment to the South of the lake chain, there is no scope for regional deep drainage in this area.

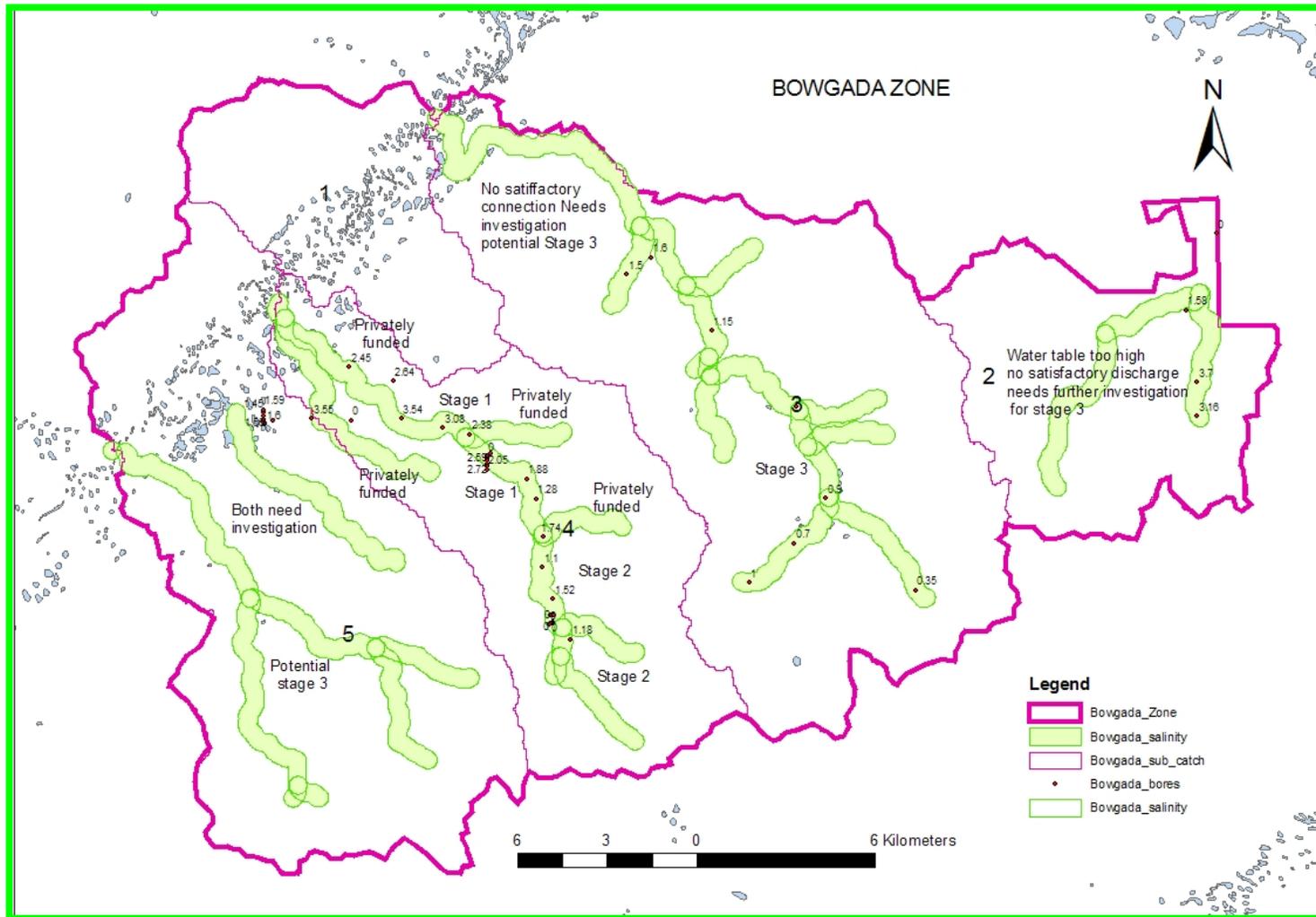
Sub catchment 41 is known as the Merkanooka sub catchment and although there are only 18,785 hectares in the catchment there are 3,881 hectares of salt affected farm lands. All the farmers within this drainage network have agreed to participate in the Yarra Yarra Regional Drainage program. These farmers have already made a commendable effort to control salinity with expansive plantations of trees and shrubs. They have turned to deep drainage to solve the problem as the plantings have only had minimal effect.

The depth to ground water along the valley floor in the Merkanooka sub catchment ranges between 0.8 – 2.12 metres, pH ranges from 6.5 – 7.6, 12.5 km of drainage has been established as part of stage 1 of the Yarra Yarra regional drainage program. The bottom 6.7 km of this is a shallow enhanced creek line which has been de-silted as part of this contract.

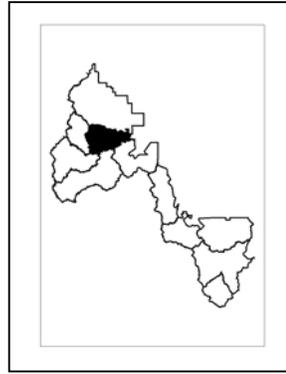
An easement in favour of the Yarra Yarra Catchment Regional Council is being surveyed for stage 1. We hope to have this registered before the end of the year. 120,000 melaleuca seedlings will be planted within the easement area along this creek line this winter. This venture will be funded by Yarra Yarra Enterprises.

33 kilometres of deep drains have been planned for stages 2 and 3 of the Yarra Yarra Regional Drainage Program here.

PRIORITIES FOR DEEP DRAINAGE IN THE YARRA YARRA CATCHMENT



BOWGADA ZONE



The total area in the Bowgada Zone is 65,510 hectares of which 10,207 hectares of farm land is affected by salinity.

This problem had been recognised for many years and the formation of the Koolanooka Bowgada catchment group in the late 1980's resulted in some excellent work with surface drainage and a vast revegetation program. Similar to the Merkanooka farmers it was found that these methods were not enough to make a significant difference to the water tables.

In 2004 the Bowgada group commissioned a drainage consultant to develop a drainage plan for sub catchment 4 and a Notice of Intent to Drain (NOI) was accepted by the Commissioner in May 2005. However a series of adverse seasons curtailed the advancement of this project.

As Bowgada sub catchment 4 meets all of the criteria for the Yarra Yarra Regional Drainage program and the NOI was due to expire shortly, it was decided to use Bowgada as a starting point for Stage 1 of the drainage program. Another advantage was that a lot of preliminary work on surface drainage had already been done in earlier years making a saving of around \$40,000.

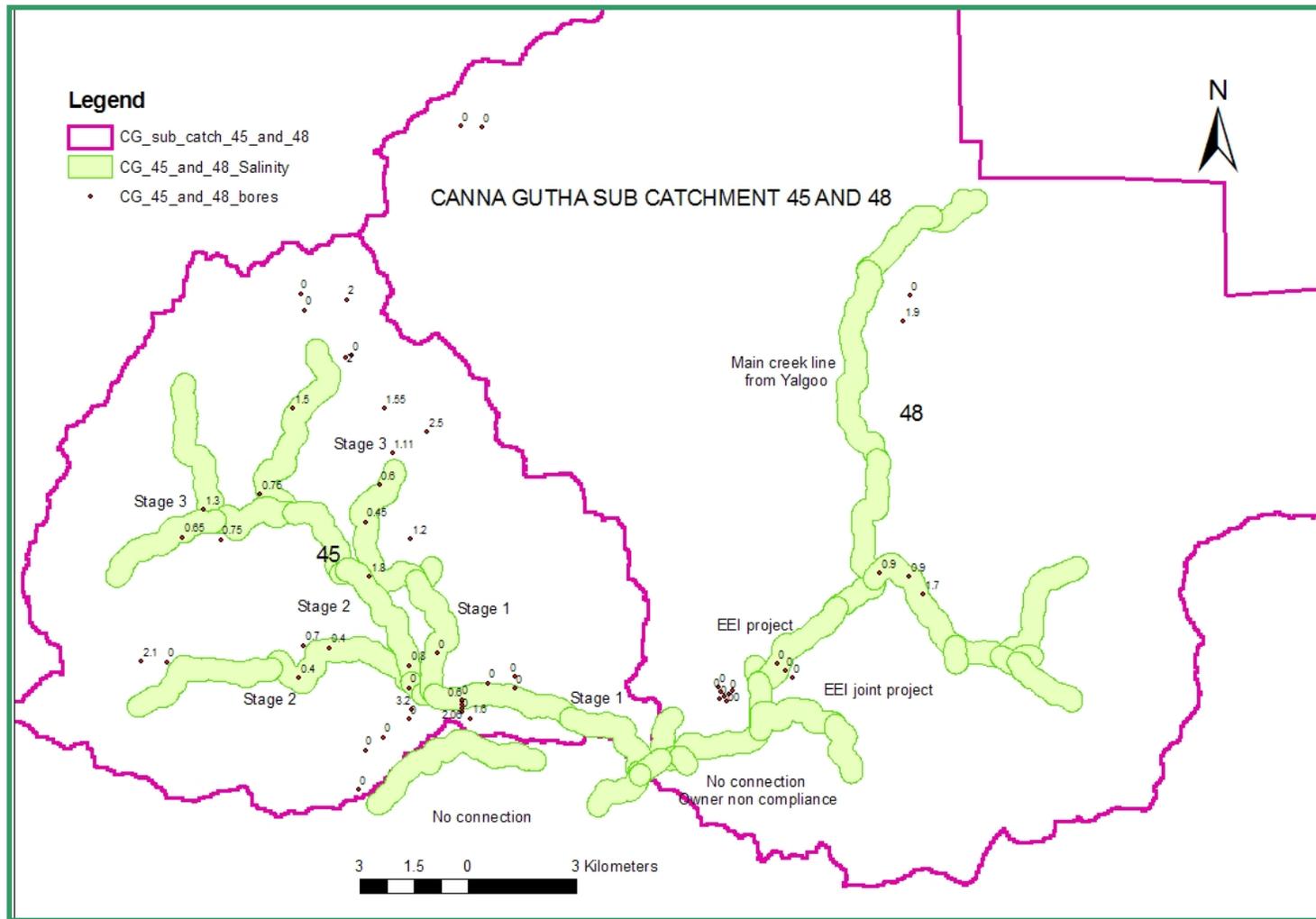
Stage 1 has been completed but unlike the other drainage projects done to date by the Yarra Yarra Regional Drainage program we consider the ground water yield has been a little disappointing and has not mirrored our preliminary investigations. However reasonable flows have been recorded in the upstream 2.5 km of excavation.

This project was to proceed a further two kilometres South for stage 1 but after the MOU had been signed a family conflict developed as to whether the drain should be dug or not. We did not wish to hold this family to the signed document so have moved this section of the drainage works to stage 2 of the program.

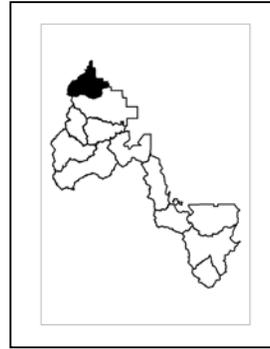
If the drainage is not allowed to proceed, then the four farmers upstream who wish to participate in the project will be jeopardized. Unfortunately most of the shallow ground water is in the higher reaches of this sub catchment, which would contribute greatly to the overall yield of the drain. We are confident that this issue will be resolved in time for stage 2. 10 km of fencing has also been completed in the Bowgada 4 project.

Sub catchment 5 shows potential for inclusion in stage 3. Sub catchments 2 and 3 need further investigation but connection to a discharge point is a problem.

PRIORITIES FOR DEEP DRAINAGE IN THE YARRA YARRA CATCHMENT



CANNA GUTHA ZONE
Sub catchments 45 and 48



Sub catchment 45 of the Canna Gutha Zone has a total area of 69,008 hectares with 6,955 hectares of farm land affected by salinity. This is a very significant amount as most of the salt concentrations are in catchment 45. From a priority point of view this catchment needs urgent attention.

Both these catchments have a high recharge potential with sub catchment 48 being fed from surface water feeding in from drainage networks as far back as Yalgoo in the range lands. Sub catchment 45 is fed by the enormous watershed of sheet granite located in and around the Canna reserve, which covers around 2,700 hectares.

Stage 1 of this drainage network is nearing completion; the yield of ground water is about 5 litres per second at this early stage.

All the farmers in stage 1 of the program have signed an MOU agreeing to paying an annual service fee as well as allowing an easement of the drain and adjacent land in favour of the Yarra Yarra Catchment Regional Council.

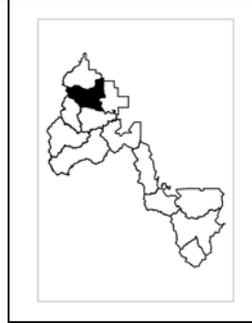
Soil pits show that:

- The digging was medium to soft with the inflow medium to fast
- The water table is 1.7 metres from the surface
- pH 7.4
- Salinity 37 mS/cm
- Top soil depth 85 cm

Stage 2 will account for a further 13 km of drain and stage 3 a further 17km in sub catchment 45.

Sub catchment 48 harbours the EEI project which has 8km of deep drain; this is serviced by evaporation ponds as permission to drain was not forthcoming from the downstream neighbour. The natural waterway leads down to Morawa and finally into the Yarra Yarra Lake chain.

CANNA/ GUTHA ZONE
Sub Catchments 42, 43 and 47



The total area of these combined catchments is 74,655 hectares with 9,367 hectares affected by salinity. This figure can be misleading, as the main waterway traversing sub catchment 42 is included in this. This waterway carries the combination of the discharge from sub catchment 45 and 48 which converge at the headwaters at the top of catchment 42 and finally discharge into the Yarra Yarra Lake chain east of Morawa.

This waterway has some definition and only farmlands in close proximity are affected. It is considered that some investigation needs to take place as to whether a deep drain flanking either side of the waterway is a reasonable option.

To the west of the main water way in Sub Catchment 42 there is a drainage line coming in from the Pintharooka area that needs further investigation and could become part of the Yarra Yarra Regional Drainage program Stage 3. Individual farmers have shown some interest in developing this line.

Another drainage line to the east of the main waterway in sub catchment 42 needs investigation but no interest has been registered in this.

There is some salinity in sub catchment 47, this needs further investigation but there is no acceptable connection to a discharge area at this stage.

SUMMARY

Burakin

- Is one sub catchment on its own
- Depth to ground water and the huge salinity problem are dominating factors.

Kalannie

- Sub catchment 34 has a major problem with salinity. Most of that is being addressed by a previous project. Some upgrading will be done during stage 1.
- Sub catchments 23, 24, 26 and 56 have mostly been addressed by private funding.

Goodlands

- Sub catchment 33 services three farms and will be addressed by stages 1 and 2. A deep drain to the north of sub catchment 33 has been privately funded.
- Sub catchment 20 needs increased definition in 20 km of shallow surface channel.
- Deep drainage in sub catchments 20, 18, 35 and 49 is privately funded. There has been no interest shown in deep drainage to address salinity in sub catchments 37 and 32

Jibberding

- There is an extensive salt problem in sub catchment 21; this has been addressed by a State Salinity Council project and a large amount of private funding.
- There is a major problem in sub catchment 19, roughly half of this will be addressed by Stage 1 and 2 of the Yarra Yarra Regional Drainage Scheme, the remainder will be privately funded.
- There is very little problem in sub catchment 61
- Sub catchment 36 is receiving wet lands

Mongers

- Sub catchment 55 has major problems in its lower reaches and also in its higher reaches with a gap in the mid slopes. The lower reaches have been addressed by the Mongers 55 pilot scheme. The higher reaches have been put on hold.
- There are some salinity problems in sub catchment 17 but they are not as extensive as in the other catchments so this will be addressed in stage 3. This is also the case for sub catchment 29.
- There is little or no problem in sub catchment 28

Perenjori

- Sub catchment 12 has quite a significant problem that has been addressed by private funding.
- Sub catchments 10, 7 and 31 have no significant problems.
- Sub catchment 13 has a significant salinity problem but the way is not clear for all land holders to participate in the drainage program at this stage.
- Sub catchment 19 has been addressed by other funding programs.
- While there has been little interest in deep drainage for sub catchment 46, it is worthy of investigation for stage 3 works.

Darling Creek

- Darling Creek Zone is made up sub catchments 51, 50, 14, 15 and 8. This Zone is a stand alone catchment of higher relief than Zones adjacent to the Yarra Yarra Lake Chain and little interest has been shown in deep drainage. This catchment discharges directly into the Yarra Yarra Lake.

East Three Springs

- There are no outward signs of major salinity in sub catchments 6, 52 and 53. Here again the landscape is of higher relief and has better natural drainage.
- 54 is the sub catchment mostly affected by salinity within this zone. Buried slotted pipe has been tailed an alternative method of drainage here.

Merkanooka

- Sub catchment 41 is badly affect by salinity and this will be addressed by a total of 45 km of deep drainage spread over stages 1, 2 and 3 of the Yarra Yarra Regional Drainage program.
- Sub catchment 39 has some salinity problems, these are being addressed by private funding.
- Sub catchment 40 has no major problems.

Bowgada

- A high proportion of the salinity in the Bowgada Zone is within sub catchment 4. Most interest was taken in this sub catchment when assessments were done with 6 participating farmers. Deep drainage is allocated for stages 1 and 2.
- There has not been much enquiry coming from sub catchment 5 concerning coordinated drainage but it is worth investigating as a potential project for Stage 3.
- Sub catchment 3 has a lot of salt affected land but the salinity is a long way from a significant discharge point. The only possible discharge site is of indigenous significance. Otherwise Sub catchment 3 shows a lot of potential for drainage.
- Sub catchment 2 is also a long way from any satisfactory discharge point.

Canna Gutha Zone

- Sub catchment 45 is mainly influenced by drainage water originating in the range lands. There is a lot of salt damage especially in the lower reaches. A large proportion of this is being addressed by the EEI program on Rod Maddens' property.
- Sub Catchment 48 is fed from the vast Granite outcrops to the North in the Canna region. This is being addressed with a combination of private funding but mainly by Stages 1, 2 and 3 of the Yarra Yarra Regional Drainage program.
- Sub Catchment 42 is mainly a delivery conduit for the large watersheds to the North and North East of the Zone. The drainage line here is more clearly defined and most salt affected land is in close proximity to the waterway with the exception of one privately funded spur to the West and another waterway coming in from the North West from the Merkanooka area. This needs further investigation.
- There are other areas of salinity in sub catchments 43 and 47 but there is no significant connection to any satisfactory discharge point.

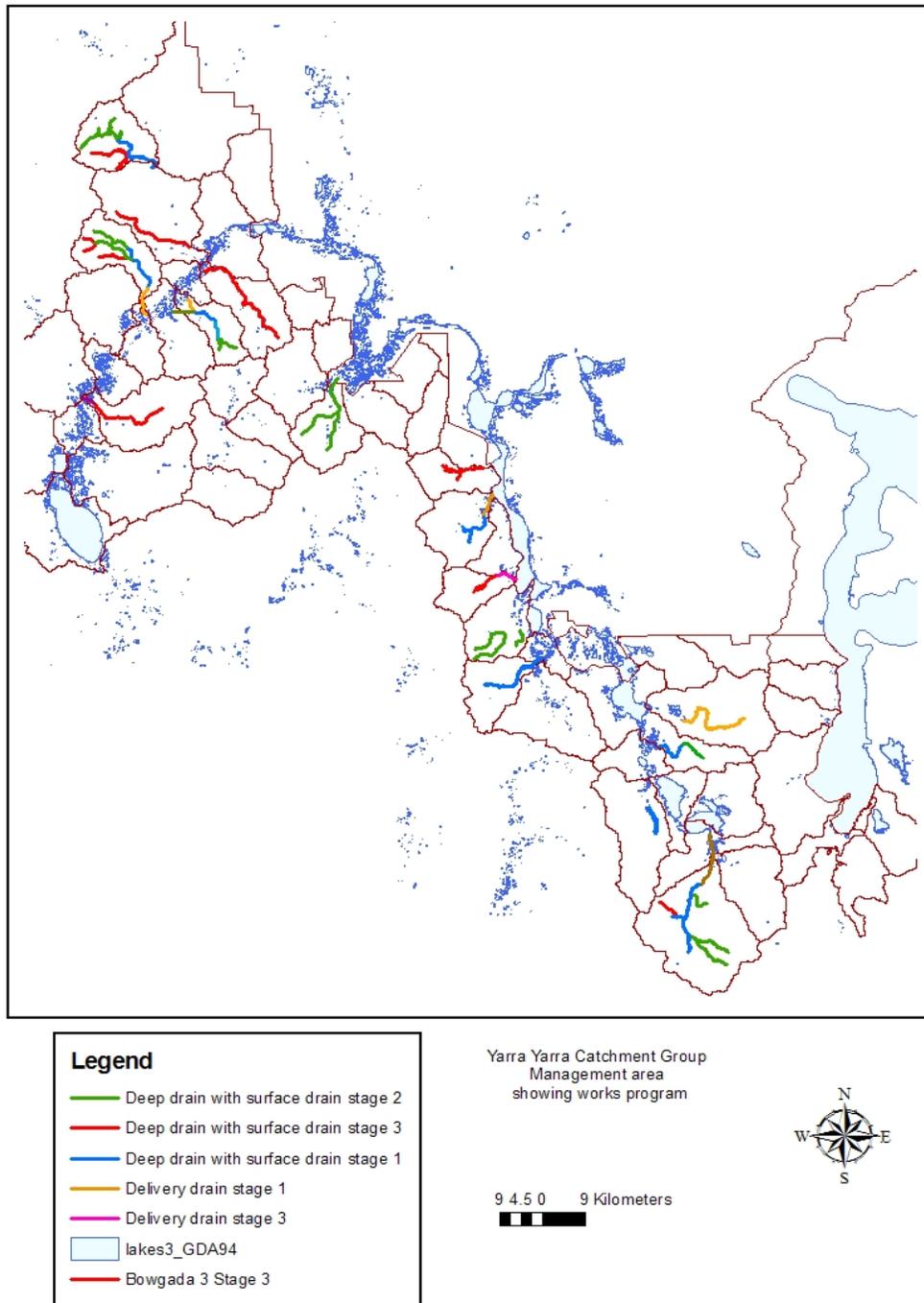
Part Three – Yarra Yarra Regional Drainage Program: Work Schedule

Yarra Yarra Three Stage Drainage Program

Aside from the fact that there are insufficient funds available to construct all of the drains in one go, the project needs to be split into three years. We feel that around 100 km per year is a realistic target to aim for considering the amount of time needed for construction and monitoring of the drains.

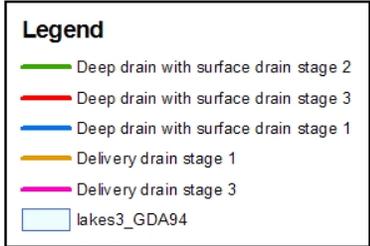
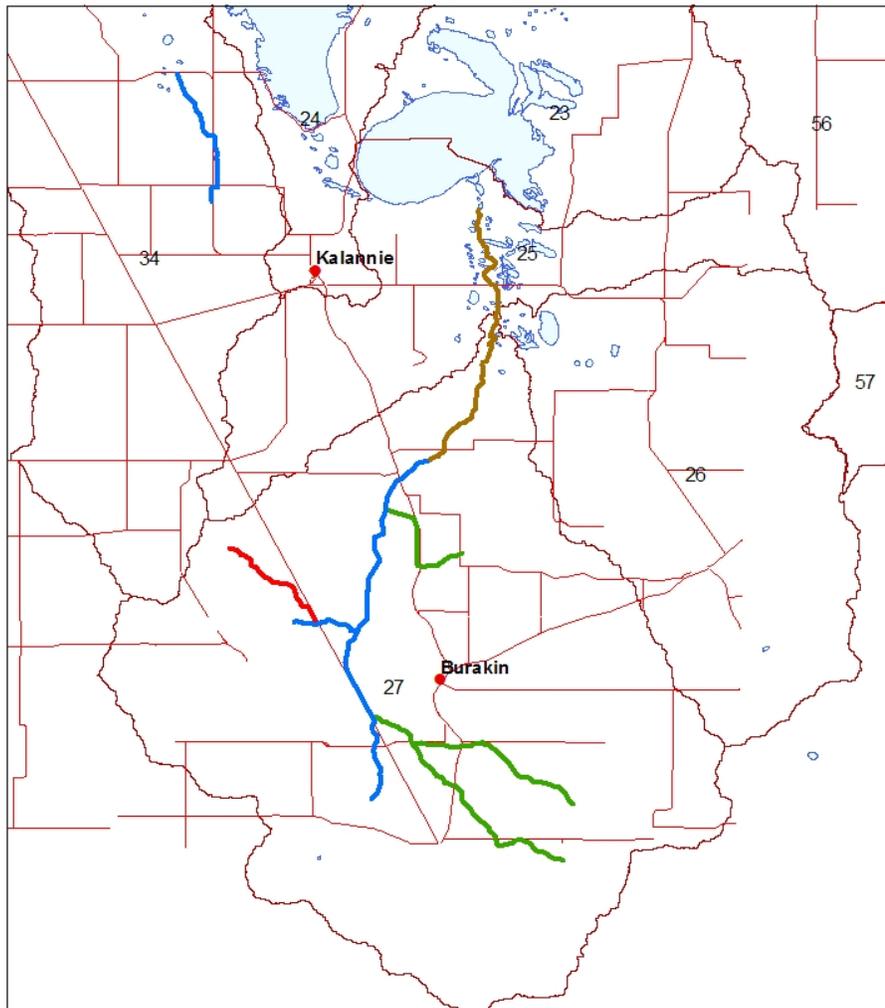
The following maps and comments provide a summary of the work schedule for the Yarra Yarra Regional Drainage program.

PRIORITIES FOR DEEP DRAINAGE IN THE YARRA YARRA CATCHMENT



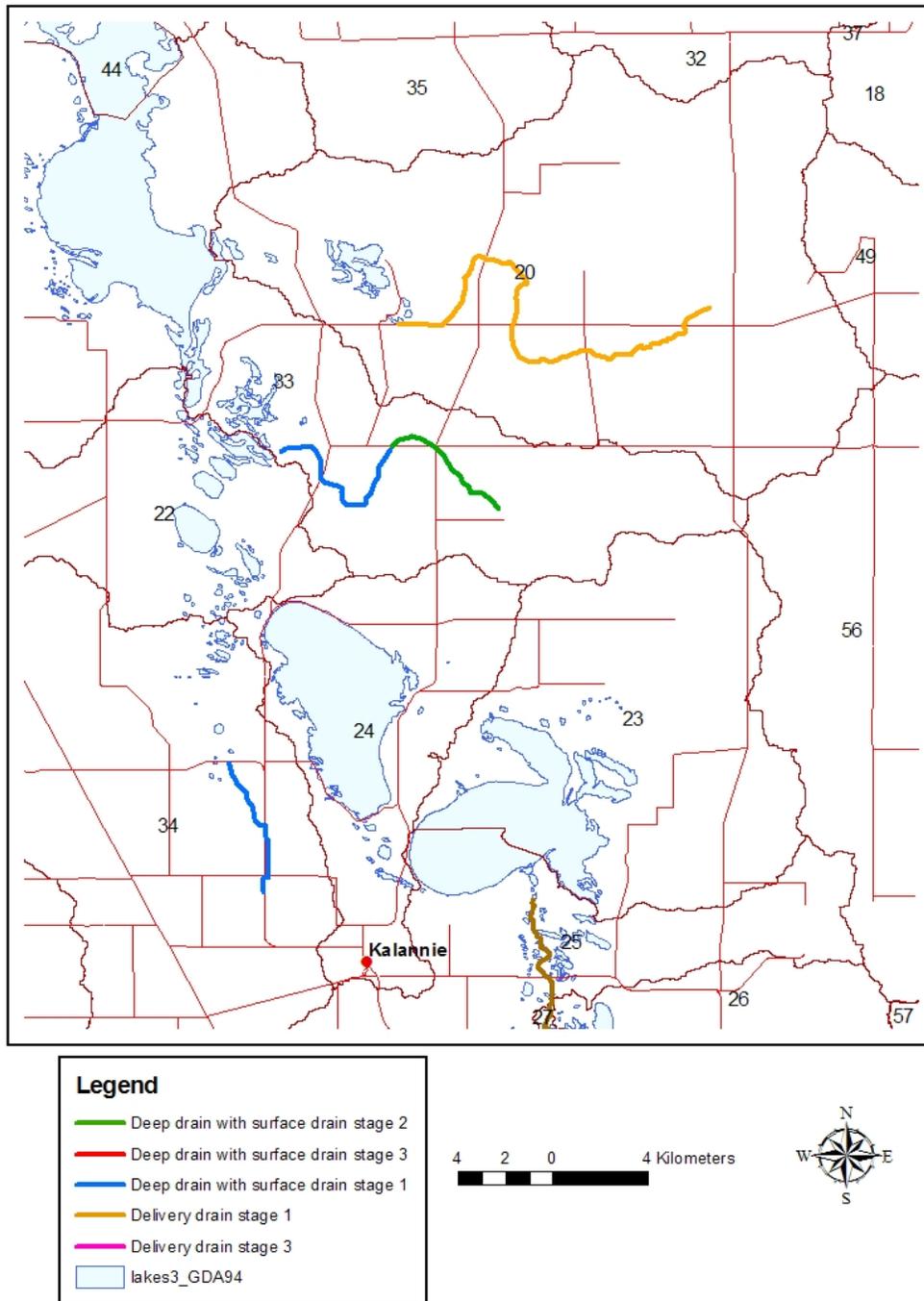
The map above shows the location of all the drains in the Yarra Yarra three stage drainage program.

Burakin and Kalannie Drainage Schedules



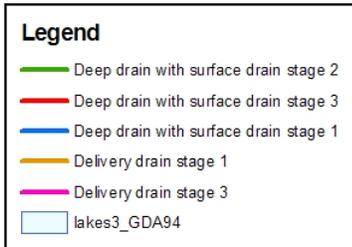
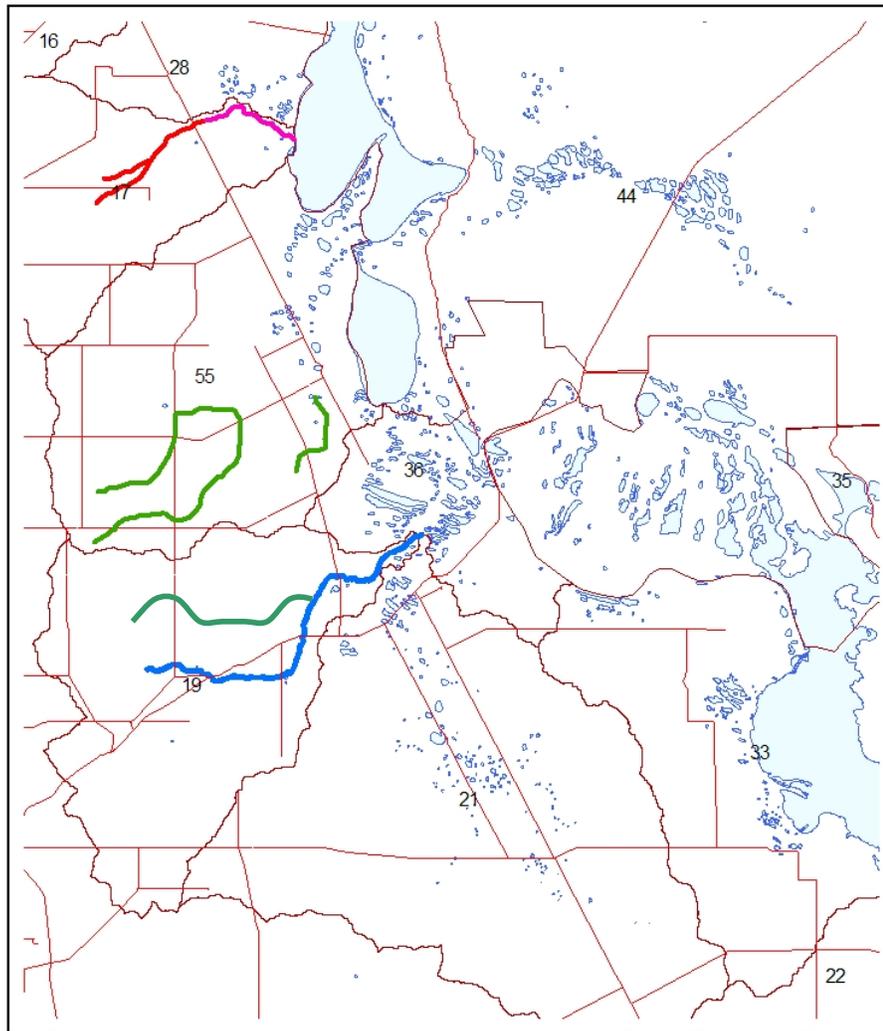
The blue line on the diagram above indicates stage 1 of the project. This will result in the establishment of the main arterial drain in catchment 27. Stage 2 is depicted by the green line and will be established in the second year to address the salinity problems higher in the landscape. Stage 2 cannot be accessed until stage 1 is completed. By developing the network in two stages, the main flush of stage 1 will be given time to abate before starting stage 2, thus relieving the pressure on the drain at the delivery point. The delivery drain depicted in brown has already been established. Stage 3 depicted in red is of lesser consequence at this stage in the project. The drain shown in catchment 34 is a spur which delivers into an existing drain and involves 3 farmers.

Goodlands Drainage Schedule



Stage 1 of catchment 33 may have to be relegated to stage 2 if there are insufficient funds in the stage 1 allocation. The area of salinity affected land and the number of farmers involved does not match other higher priorities designated as stage 1 projects. The surface drain (or delivery drain) in catchment 20 is of lower priority as the available funds are required to enhance the existing surface drain which is in need of increased definition. An easement will not be required on this drain, so other cost sharing arrangements will need to be negotiated.

Jibberding 19, Mongers 55 and Mongers 17



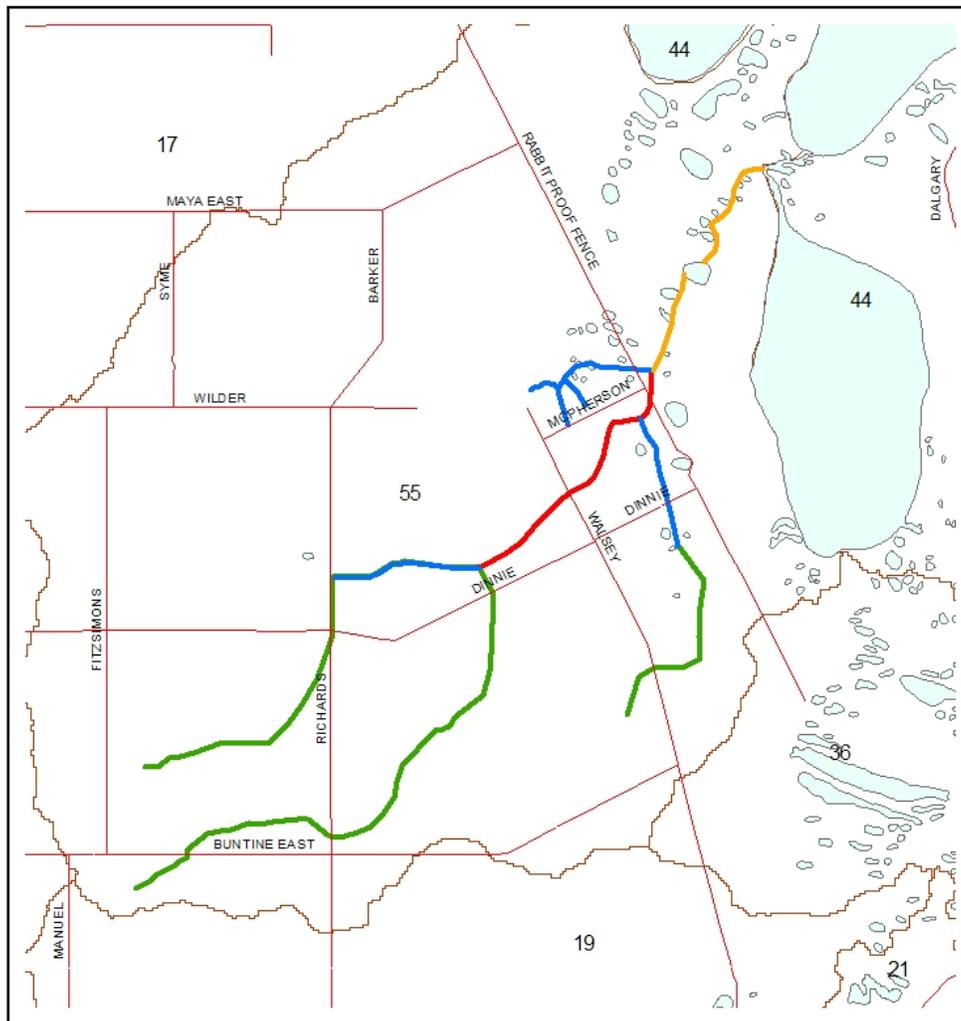
Catchment 19 is of high priority because of the potential to rehabilitate a large area of salt affected land, plus 2 homesteads are at severe risk. Stage 2 involves three farmers and is in an area of extensive salt damage.

Stage 2 of Mongers 55 is to address salt affected land higher in the catchment and will be an extension of Mongers stage 1. Because the main drain of stage 2 will need to traverse some productive land to access the saline areas it has slipped down the priority list and is of lower priority than many stage 2 contenders in other catchments.

PRIORITIES FOR DEEP DRAINAGE IN THE YARRA YARRA CATCHMENT

Mongers 17 is a relatively small catchment and it does not contain as much salt affected land as some of the other catchments. The drain proposed here will benefit fewer farmers than alternative projects and has subsequently been relegated to stage 3 of the project.

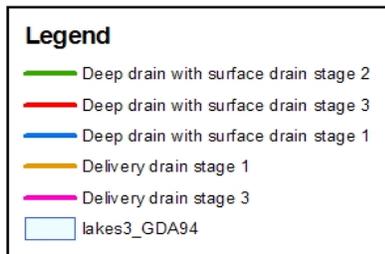
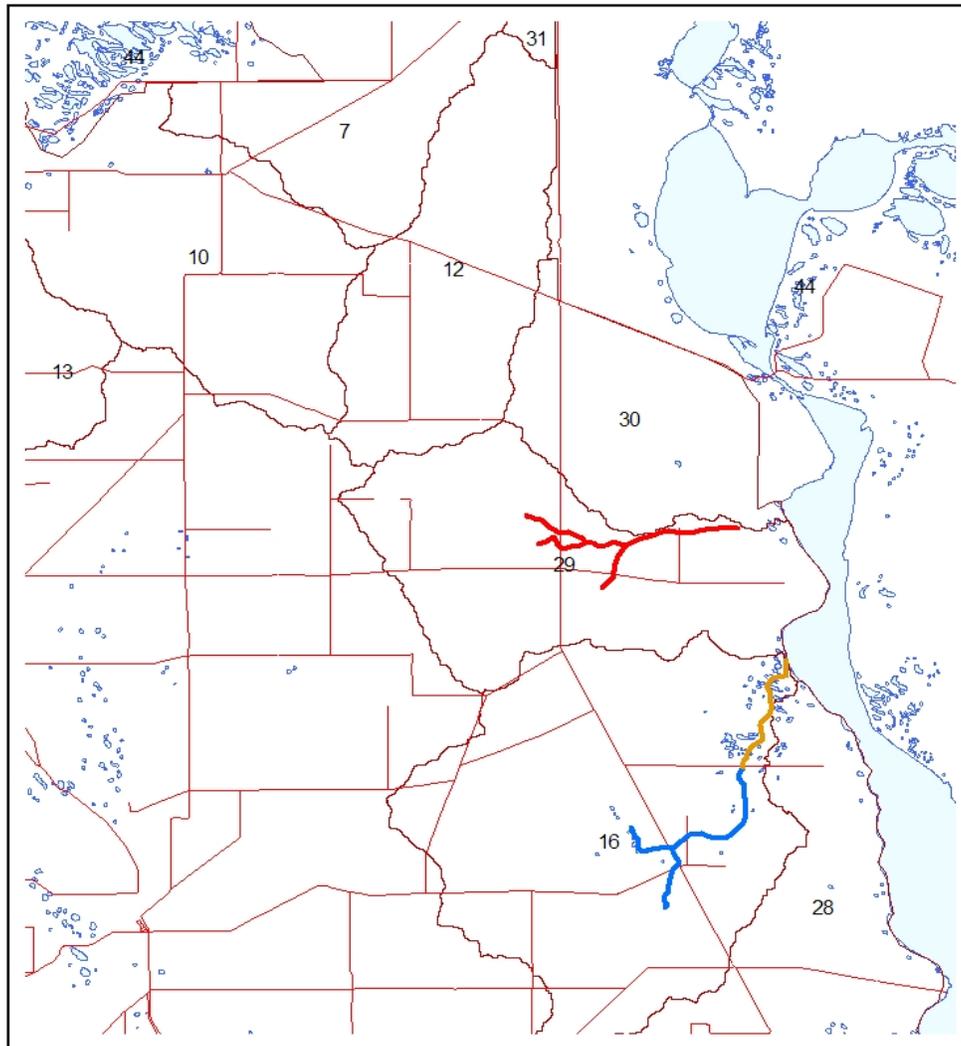
Mongers 55 showing the various stages of this pilot project



Mongers 55 showing Stage 1 completed and stage 2 pending



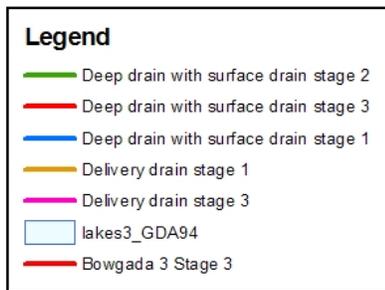
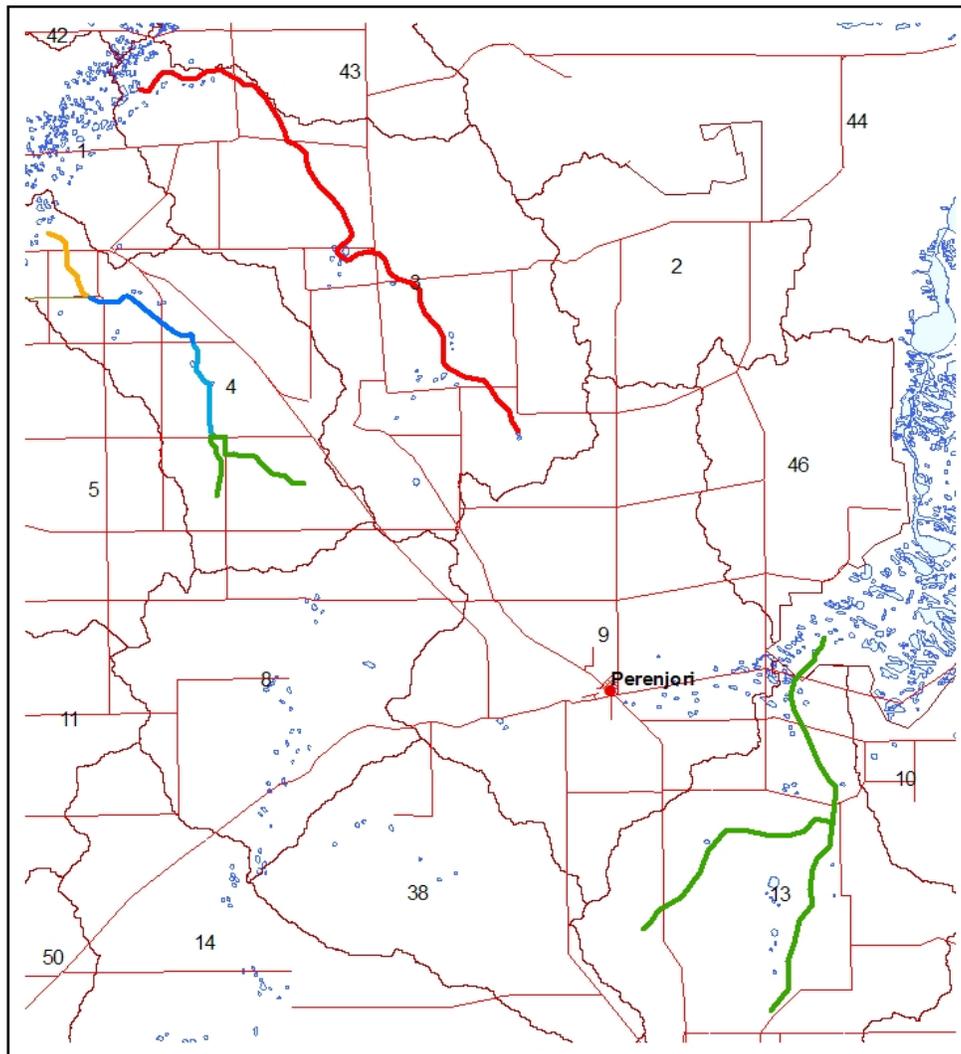
Mongers 29 and Mongers 16



Mongers 16 is a stage 1 project and services five farmers. This project has the potential to protect a number of large areas of remnant bush totalling 364 ha. The most significant site is 100 ha of predominately York Gum forest. This remnant is showing signs of great stress due to the rising water table. It is a classic site suitable for rehabilitation.

Mongers 29 has been relegated to stage 3 as only two farmers will be beneficiaries of this project and it does not address as much salt affected land as other catchments higher up the priority list.

Perenjori and Bowgada Drainage Schedules

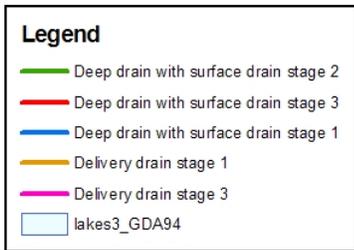
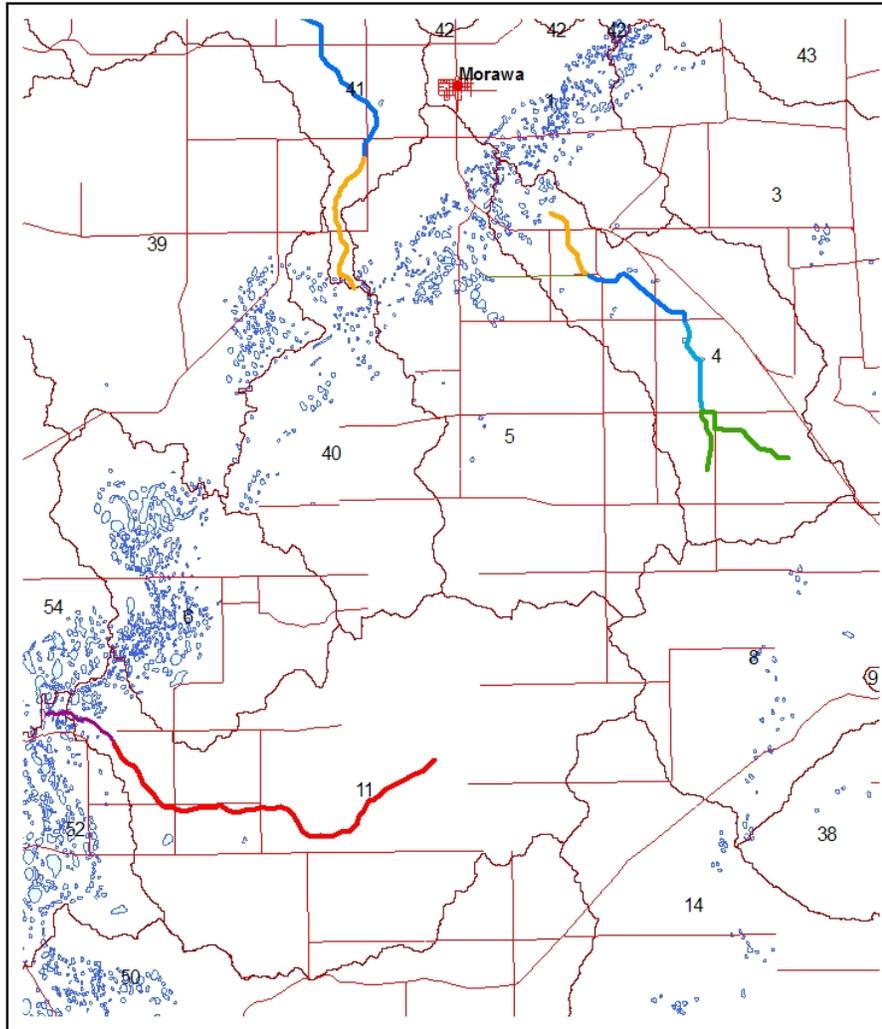


Catchment 13 in the Perenjori Zone is of high priority but we cannot proceed any further with this until a legal dispute regarding ownership of a property within the drainage line is resolved. Stage 1 of Catchment 4 in the Bowgada Zone has been completed with the exception of 2km of drain, which has been relegated to stage 2 while a family dispute is resolved. Stage 2 will address extensive salinity problems in the higher landscape and involves six farmers. Catchment 3 in the Bowgada Zone is a

PRIORITIES FOR DEEP DRAINAGE IN THE YARRA YARRA CATCHMENT

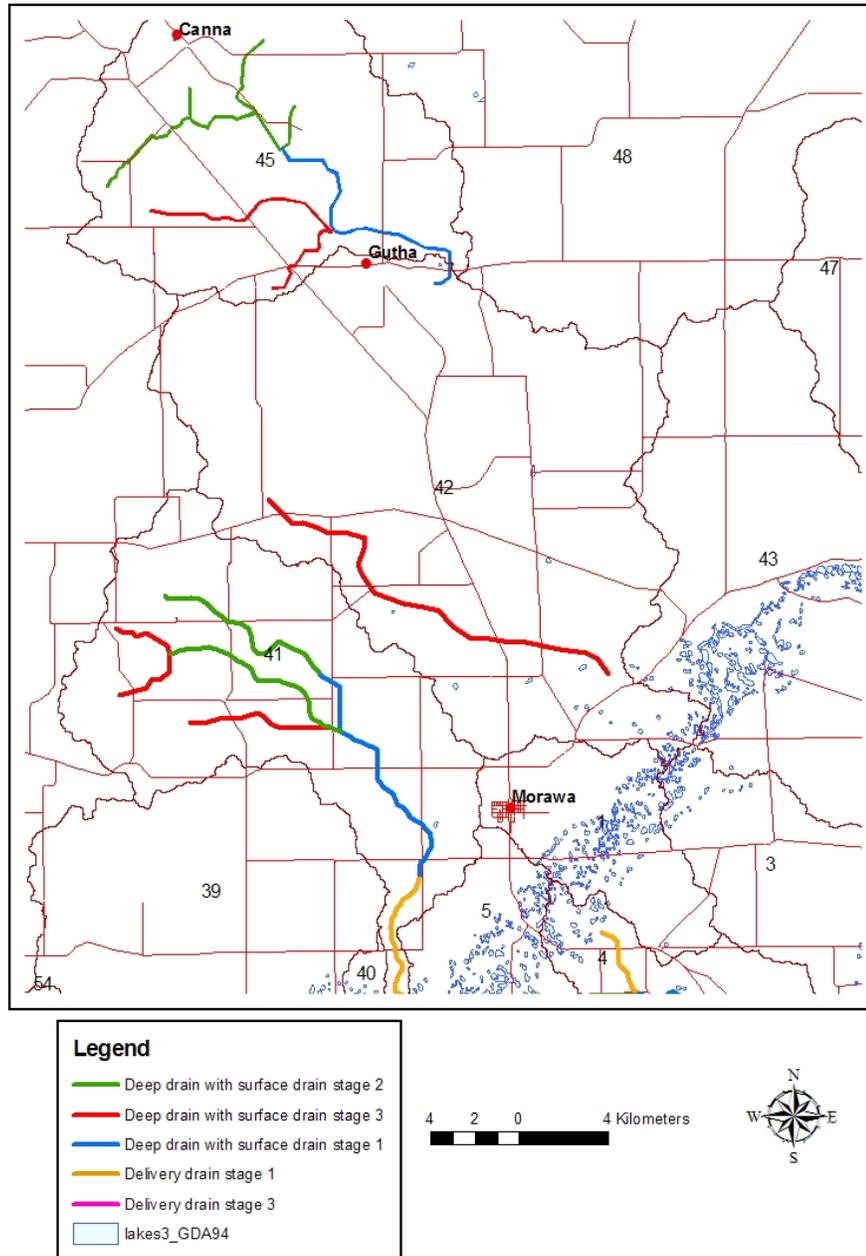
worthy catchment but has a long lead distance to a satisfactory discharge point and has subsequently been downgraded to stage 3.

East Three Springs Drainage Schedule



There has been little interest shown in integrated drainage in the East Three Springs Zone with the exception of Catchment 11. We have drilled along this drainage line and the results show that the water table would respond to deep drainage but not to the extent of other catchments of higher priority, it is subsequently a stage 3 project.

Canna Gutha 45, Canna Gutha 42 and Merkanooka 41



The Merkanooka drainage network in Catchment 41 is extensive with around 45 km of drainage line in total. Stage 1 had to be terminated at the Mingenew/Morawa road as funds allocated to Stage 1 in this catchment ran out. This drainage network was split into stages 1, 2 and 3 because there are insufficient funds available to carry out all of the work in one year. Stage 2 is more significant as regards the amount of recoverable land for the distance of drain excavated.

PRIORITIES FOR DEEP DRAINAGE IN THE YARRA YARRA CATCHMENT

More recently two farmers have shown interest in developing a drainage line in Catchment 42 (Pintharooka) in the Canna Gutha drain, this requires further investigation.

Catchment 45 is extensive and similar to 41 and is likewise divided into three stages. The first stage of 45 has been completed; however it was terminated 2 km short of the targeted distance due to funding constraints.

YARRA YARRA WORKS PROGRAM, TOTAL 405.98 km

| | Stage 1 | | Stage 2 | | Stage 3 | |
|-----------------------|--------------|----------------|---------------|----------------|---------------|----------------|
| | Main drain | Delivery drain | Main drain | Delivery drain | Main drain | Delivery drain |
| BURAKIN | 15.00 | | 38.00 | | 5.55 | |
| XANTIPPE | 5.50 | | | | | |
| GOODLANDS 20 | | 21.35 | | | | |
| GOODLANDS 33 | | | 16.14 | | | |
| JIBBERDING 19 | 16.54 | | 10.00 | | | |
| MONGERS 55 | | | 23.00 | | | |
| MONGERS 17 | | | | | 8.47 | 4.86 |
| MONGERS 16 | 11.30 | 5.70 | | | | |
| MONGERS 29 | | | | | 13.76 | |
| PERENJORI 13 | | | | | 28.00 | |
| EAST THREE SPRINGS 50 | | | | | 18.00 | 3.5 |
| BOWGADA 3 | | | | | 23.65 | |
| BOWGADA 4 | 7.41 | 4.78 | 9.90 | | | |
| MERKANOOKA | 3.5 | 6.70 | 26.93 | | 13.18 | |
| PINTHAROOKA | | | | | 19.35 | |
| CANNA / GUTHA | 11.34 | | 15.86 | | 18.71 | |
| | | | | | | |
| Total | 70.59 | 38.53 | 139.83 | | 148.67 | 8.36 |

Mongers 55 1st stage (completed)

| | |
|-----------------|------|
| Main Drain | 5.19 |
| Farmers Spurs | 6.29 |
| Farmer delivery | 2.61 |
| Delivery 2 | 1.83 |
| Delivery 1 | 2.29 |

Part Four – Tables of Attributes

Zone Attributes Table.

| | Canna Gutha | Merkanooka | Bowgada | East Three Springs | Perenjori | Mongers | Kalannie | Darling Creek | Jibberding | Goodlands | Burakin |
|-------------------------------|--------------------|-------------------|----------------|---------------------------|------------------|----------------|-----------------|----------------------|-------------------|------------------|----------------|
| Zone Name | | | | | | | | | | | |
| Total Zone Area | 143 663 | 50 177 | 65 510 | 91 229 | 83 696 | 78 602 | 137 800 | 128 983 | 64 986 | 112 695 | 45 000 |
| | | | | | | | | | | | |
| Threatened Town Sites | | | Morawa | | Perenjori | | | | | | |
| Threatened Private Homesteads | 0 | 4 | 1 | 0 | 0 | 2 | 2 | 0 | 6 | 0 | 4 |
| Threatened Public Road (km) | 60.25 | 17 | 41.61 | 13.21 | 34.77 | 18.69 | 38.95 | 24.46 | 19.63 | 10.23 | 22.84 |
| Threatened Arable Land (ha) | 16 322 | 4 798 | 10 207 | 3 867 | 8 052 | 6 550 | 9 892 | 10 724 | 7 352 | 5 693 | 6 247 |
| Threatened Vegetation (ha) | 1 852 | 243 | 1100 | 638 | 375 | 779 | 198 | 1454 | 510 | 217 | 172 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

PRIORITIES FOR DEEP DRAINAGE IN THE YARRA YARRA CATCHMENT

Sub-catchment Attributes Table

Shaded attributes are those considered critical - at least for the current selection process

| Sub-Catchment Number | 45 | 41 | 4 | 3 | 11 | 13 | 29 | 16 | 17 | 55 | 19 | 33 | 27 |
|------------------------------------|-----------------|------------|-----------------|-----------|--------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------|
| Sub-Catchment Name | Canna Gutha | Merkanooka | Bowgada-4 | Bowgada-3 | East Three Springs | Perenjori | Mongers-29 | Mongers-16 | Mongers-17 | Mongers-55 | Jibberding | Goodlands | Burakin |
| Total Catchment Area | 19 079 | 18 785 | 12 230 | 21 200 | 25 410 | 17 788 | 12 431 | 19 647 | 11 478 | 17 754 | 15 831 | 14 796 | 44 911 |
| Average Gradient | 0.2 | 0.19 | 0.23 | 0.17 | 0.08 | 0.13 | 0.25 | 0.24 | 0.28 | 0.2 | 0.21 | 0.1 | 0.1 |
| Workable Gradient for all Sections | Yes | Yes | Yes | id | | Yes | | | No | Yes | Yes | Yes | Yes |
| Discharge Area | Small Salt lake | Playa | Small Salt lake | Claypans | Small Salt lake | Small Salt lake | Large Salt lake | Existing Drain |
| MOU (Memo of Understanding) | Yes | Yes | Yes | No | No | No | No | No | No | Yes | Yes | No | Yes |
| NOI (Notice of Intent) | Yes | Yes | Yes | No | No | No | No | submitted | No | Yes | submitted | in progress | submitted |
| Clearing Permit | Yes | Yes | Yes | No | No | No | No | submitted | No | Yes | submitted | No | submitted |
| Aboriginal Heritage Clearance | Yes | Yes | Yes | No | No | No | No | Yes | No | Yes | Yes | No | No |
| Agreeable to Easement | Yes | Yes | Yes | No | No | No | No | No | No | No | Yes | No | Yes |
| Agreeable to 100m Buffer | Yes | Yes | Yes | No | No | No | No | No | No | Yes | Yes | Yes | Yes |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

PRIORITIES FOR DEEP DRAINAGE IN THE YARRA YARRA CATCHMENT

| Sub-Catchment Number | 45 | 41 | 4 | 3 | 11 | 13 | 29 | 16 | 17 | 55 | 19 | 33 | 27 |
|------------------------------|-------------|------------|-----------|-----------|--------------------|-----------|------------|------------|------------|------------|------------|-----------|---------|
| Sub-Catchment Name | Canna Gutha | Merkanooka | Bowgada-4 | Bowgada-3 | East Three Springs | Perenjori | Mongers-29 | Mongers-16 | Mongers-17 | Mongers-55 | Jibberding | Goodlands | Burakin |
| Subsurface Attributes | | | | | | | | | | | | | |
| (i) Pits | | | | | | | | | | | | | |
| Water | | | | | | | | | | | | | |
| pH | 7.4 | id | id | 7.4 | id | 6.7 | 7.9 | nd | 6.5 | 3.8 | 4.8 | 6.7 | 4.9 |
| Inflow | Med-Fast | id | id | Med-Fast | id | Med-Fast | Slow-Med | Med | Slow | Fast | Slow-Med | Fast | Slow |
| Depth to Groundwater (m) | 1.7 | id | id | 1.6 | id | 1.5 | 2.1 | 1.3 | 2.1 | 1.2 | 1.9 | 1.3 | 1.8 |
| Salinity (mS/cm) | 37 | id | id | 32 | id | 61 | 24 | nd | 38 | 57 | 49 | 54 | 36 |
| Soil | | | | | | | | | | | | | |
| Depth of Topsoil (cm) | 85 | id | id | 116 | id | 72 | 125 | nd | 115 | 81 | 54 | 72 | 37 |
| Firmness | Med-Soft | id | id | Med | id | Soft | Med | Soft | Soft | Soft | Med-Hard | Med-Hard | Soft |
| (ii) Bores | | | | | | | | | | | | | |
| Depth to Groundwater (m) | nd | 0.8-2.12 | 0.8-2.9 | 0.4-1.6 | 1.3-4.5 | 0.6-2.3 | 0.5-1.3 | 1.2-1.9 | 0.6-1.4 | 0.2-1.5 | 0.6-2.5 | 0.9-2.0 | 0.2-1.6 |
| pH | nd | nd | 6.5-7.6 | 6.1-7.5 | 5.4-7.4 | 6.0-6.8 | 5.8-8.2 | 6.3-6.9 | 6.2-6.6 | 3.1-7.2 | 3.3-7.4 | 3.7-7.2 | 4.8-6.2 |
| Salinity (mS/cm) | nd | nd | 18-59 | 7-59 | 9-53 | 57-82 | 11-49 | 16-45 | 24-55 | 34-77 | 5-98 | 18-110 | 4-11 |
| (iii) Drains | | | | | | | | | | | | | |
| pH | 7.5 | 7.9 | 7.9 | | | | | | | 2.8-7.7 | | | |
| Salinity (mS/cm) | 34 | 54 | 51 | | | | | | | 12-74 | | | |

Part Five – Drainage Prioritisation Policy

The purpose of this policy is to ensure that decisions on expenditure of public money on drainage projects is appropriate, that processes are transparent and that the reasons for decisions are adequately documented.

Council in setting drainage priorities will consider the following criteria. The CEO will provide to Council an assessment of proposed projects that addresses the following criteria. Council will balance these factors to determine drainage priorities. Each project will be assessed as high, medium or low priority.

Extent of Salinity

Initial investigation of the potential for projects will be determined on the basis of sub-catchment level assessment.

Disposal

Council must be satisfied that there is an appropriate disposal point taking account of the likely volume of water, capacity of the disposal point, historical information in relation to major weather events and the chemical nature of the water to be drained (salinity, acidity).

Surface water

Council must be satisfied that drainage projects do not adversely affect surface water flows or freshwater streams.

Public Infrastructure

Drainage projects that help protect threatened public infrastructure such as roads, railways, public buildings and townsites will be given priority.

Native vegetation

Drainage projects that help protect or recover threatened remnant vegetation or public reserves will be given priority. Pristine vegetated areas will be given a higher priority than regrowth. Any need to clear native vegetation for drainage lines will be weighed against other potential benefits.

Protection of private infrastructure

Projects that help protect threatened private infrastructure such as homesteads, farm buildings, water points or dams will be well received.

Multiple landowners

Projects that provide benefits to a larger number of landowners will be given a higher priority. This will include the capacity of the drainage project to service additional privately funded drains. Projects that benefit a single property will only be considered where public infrastructure or native vegetation is threatened.

Demonstration value

Projects that provide demonstration value due to different landscape attributes may be given priority even if not highly scored against other criteria.

Agricultural land

Projects with the highest potential to recover degraded land or protect land from further salt encroachment will be favoured.

Landowner support

Projects will only proceed if all affected landowners agree to the project, agree to the proposed easement and agree to contribute to the maintenance of the drain.

Engineering issues

Projects will be assessed on the basis of the potential success of the project. This assessment will include depth of ground water, gradients, soil types, inflow to test pits and difficulty of digging.

Value for Money

Council will consider the value for money of proposed projects after other factors have been considered. Value for money will be used to separate projects that are rated as the same level of priority (high, medium or low).

Construction

Drains within a particular funding year or project will not necessarily be constructed in order of priority. Factors that will influence the construction schedule will include:

- Minimising mobilisation costs between projects
- Extent of approvals delays – projects with all approvals in place may be constructed more quickly than projects for which approvals are delayed.
- Engineering factors – some projects will be easier to construct than others during periods of inclement weather.
- Availability of contractors or stakeholders.

Recording

Reports from the CEO will be included in Council Agendas and decisions published in Council Minutes.