OTWAY WATER BOOK 42

Response to Jacobs' Draft Report

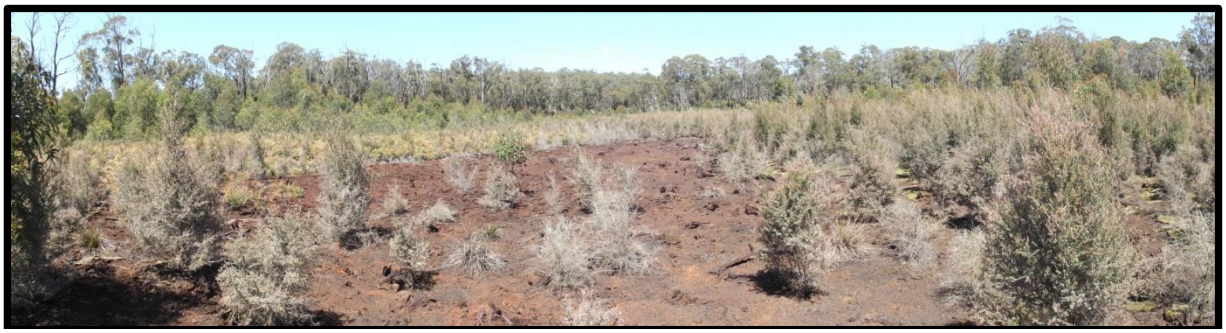
2016-2017 Technical Works Program

Barwon Water

Yeodene Swamp Study

Final draft

9 November 2017



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December 2017
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"*The new monitoring program will increase understanding of the Barwon Downs groundwater system in its normal state.*"
(SKM 2015)
"***No evidence was found that declining groundwater levels caused by groundwater extraction at Barwon Downs had a negative impact on vegetation health in the catchment.***"
(Jacobs 2016)
"***...water table drawdown occurs during pumping, but no long-term environmental impacts have been linked to borefield operation.***"
(Barwon Water, February 2012:Water Supply Demand Strategy 2012-2062, Draft.)

"***It is becoming apparent that to protect groundwater resources as a sustainable source of drinking water requires the protection of natural ecosystems that support it***."
(Simons & Notenboom 2009)

Why Jacobs chose to rename the Big Swamp the Yeodene Swamp is some what astonishing as locally this area has been know as the Big Swamp for some considerable time. More recently the Big Swamp Wetland was dubbed by the 1997-98 fire fighting crews as Jurassic Park - so dubbed because of the dense swampland vegetation and dangerous saturated peats. The top end of the Big Swamp Wetlands that caught fire had such saturated peat so close to the surface that bulldozers could not traverse it. Downstream was not on fire. It was far too jungle like and saturated to cause any threat of the fire burning into these lower reaches of the wetlands.

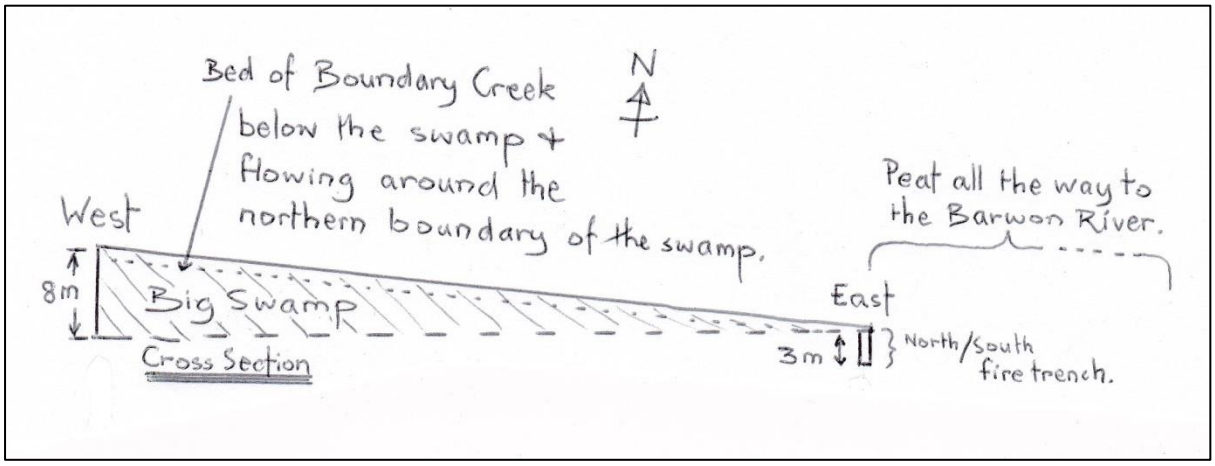


Fig. 1. Cross section of the Big Swamp showing the elevation from one end of the swamp to the other.

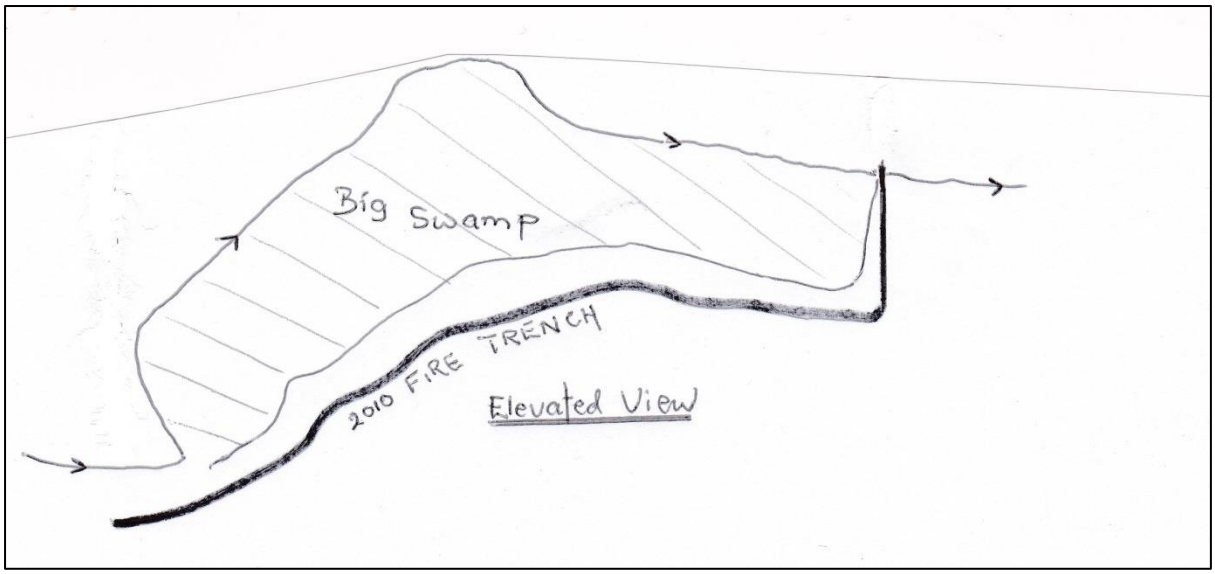


Fig. 2. Elevated View of the Big Swamp showing the Boundary Creek flow path & the fire trenches.

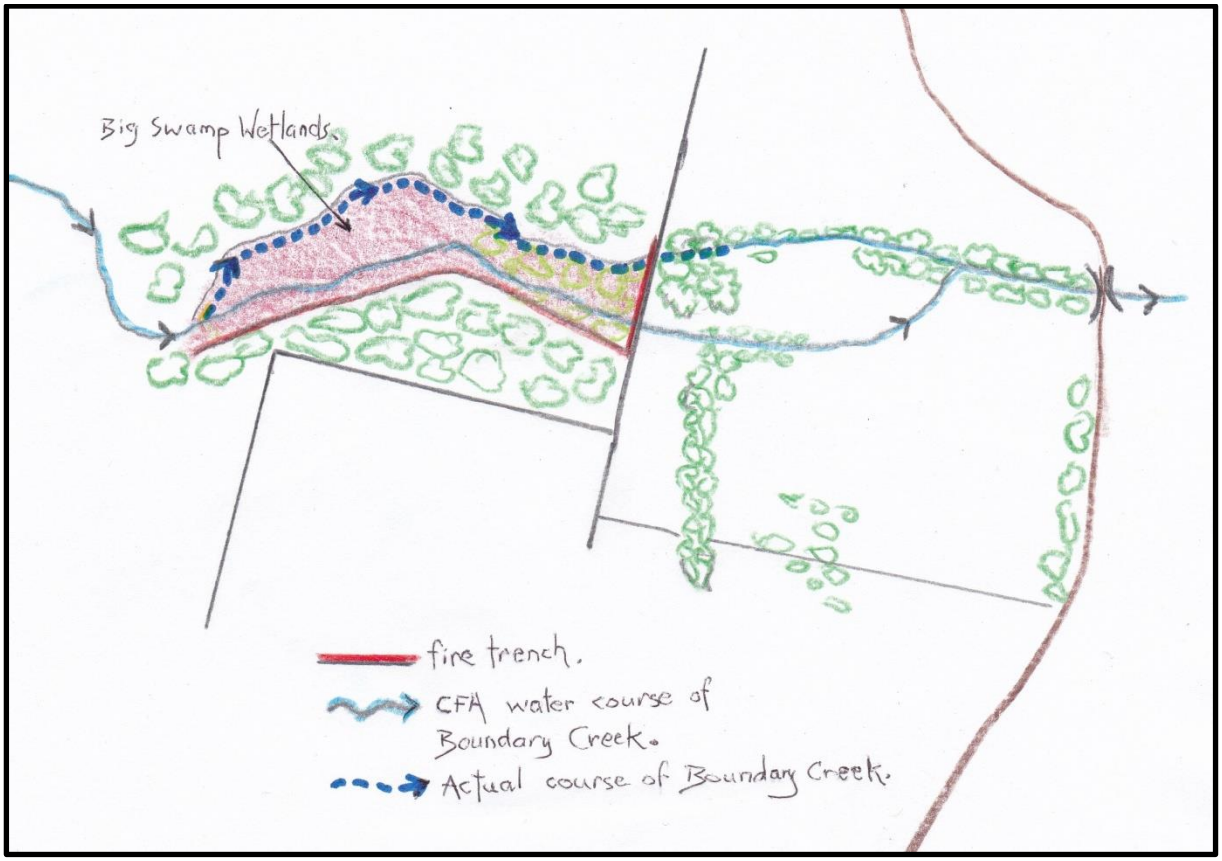


Figure 3. Details taken from the DSE & CFA fire report of the 2010 Big Swamp Wetland fire.

An addition made to this CFA map is the actual course of Boundary Creek that flows around the northern perimeter of the Big Swamp Wetlands. As with so many computer generated maps the true course of many small streams such as Boundary Creek are approximations. However, by not conducting on ground work such maps can cause serious miscalculations to be made. Not knowing that Boundary Creek flows around the Big Swamp Wetlands is such a case.

Comment on the Jacobs report.

PAGE i.

It is noted that 5 people have been involved in this report's development. As with all of the SKM & Jacobs reports it has been claimed that a high level of scientific rigor and technical expertise has been reached. Having 5 people involved in this report should have ensured that this is the case.

PAGE 1.

1. From my understanding Artificial Supplementary Flows were not released until this became part of the 2004 Groundwater Extraction Licence conditions. Consequently the statement "***... a supplementary***

flow of 2 ML/day has been released by Barwon Water into the upper reaches of Boundary Creek since 2002..." would appear to be incorrect.

2. The acidic pH levels in Boundary Creek were showing a significant increase as far back as 1990 and the following statement does not tell the full story.
   "***Since 1999, significant declines in pH water have occurred in Reach 3 of Boundary Creek...***"
3. The impacts from the toxins coming out of the Big Swamp are listed as acidic pH water, increased salinity and increased concentrations of sulfate and dissolved metals. Unfortunately all of the dissolved metals are not named and Appendix C which should contain the Laboratory Reports regarding these metals has not been included in the Jacobs'document.
4. **It would appear that winter high flows greater than 15 ML/day in 2017 did not dilute the acidic inputs or the concentration of dissolved metals**. Interesting. It would appear that the concentrations are extremely high for this to be the case.

PAGE 2.

"***The drying of the swamp and subsequent acidic water being released has been further exacerbated due to the 2 ML/day supplementary flow not reaching the swamp because the flows have not been passed at McDonalds Dam over the summer months.***"

Since 2007 I have never observed a cessation of flows coming out of McDonalds Dam. Throughout many visits during the Millennium Drought the releases were always observed. However, the flows in Boundary Creek never made it past the Big Swamp Wetlands disappearing from the creek bed half way along the northern boundary of the swamp. The actual volume of the releases would have been hard to regulate without a water flow gauge, but what was being released never made it past the Big Swamp Wetlands.

Until 2017 it is a travesty of justice that the only assessment of the Big Swamp wetlands attempted, has been made by the LAWROC Landcare Group.

"*Before the study that is documented in this report there has been limited assessment of the swamp to understand...*" Southern Rural Water made the written assurance that the Big Swamp would be studied in 2008. This was never done.

The Executive Summary makes no mention that the Actual Acid Sulfate Soil being generated in the Big Swamp could also be polluting the aquifers below.

PAGE 3.

As will be pointed out later in this book, very little is still known about the Big Swamp Wetlands. It seems inconceivable that a remediation of the swamp can be undertaken with so much still to be determined. Page 3 also highlights this inadequacy through words such as "it is considered," "likely" and "predict." Similar wording is scattered throughout this report.

PAGE 4.

1. In the section dealing with major groundwater extractions the 1982-83 drought extraction has not been included. This extraction is reported to have supplied Geelong with 50% of its water and that Geelong would have been in a terrible situation without this source being available.
2. This page states that the saturated peat sediments in the Big Swamp are "...***hydrologically separated from the underlying regional aquifer (LTA) by the aquitard***."
3. But, also states "***The aquitard thins to the west and is absent upstream of the swamp, however the exact location where aquitard is absent is not known.***" Considering the lack of data collected a definitive statement cannot be made claiming that the Big Swamp is not directly connected to the LTA. The middle and western sections of the swamp are still a mystery.
4. Figure 0-1-1 wrongly depicts the flow of Boundary Creek flowing into the Big Swamp. The flowpath in Boundary Creek follows the contour of the lowest point hugging the northern boundary of the swamp(see Figure 3, page 5, above). Neither does the water pool as depicted in the diagram. This inaccuracy has been an ongoing debate that could easily be resolved if the authors actually walked the creek path. It would be quickly seen that the bed of the creek is below any chance of the flow dissipating into the swamp at the western end except in exceptionally wet periods. Since 2007 I have yet to see this event to take place.

It is interesting to note that Jacobs believes the LTA water table is 10-15 m below ground level upstream of the Big Swamp. This matches with Boundary Creek being a losing stream in the Damplands upstream of the Big Swamp. A connection to the LTA in the Big Swamp would also account for the creek being a losing stream up to half way along the rim of the Big Swamp. The flow completely disappeared from here during the Millennium Drought.

The disappearing point of this flow moved a considerable distance upstream into the Damplands after the drought and floods of 2010. This is as yet an unexplained event. However, whatever the explanation the Artificial Supplementary Flows during the drier months, do not pass the Big Swamp Wetlands.

PAGE 5 and Page 36.

The Key Findings under the Vegetation section states this about the lower reaches of the Big Swamp Wetlands...

- ***This part of Yeodene Swamp was not a permanent swamp historically (i.e. greater than 50 years ago) as the tree ferns and trees would not have established unless there was periodic drying. This could be the result of the construction of agricultural drains in the area.***
- ***The trees and tree ferns are likely to have died as a result of root death caused by permanent inundation.***
- ***Inundated areas is un-vegetated as a result of the acidic water which is toxic to most plant species.***

Before examining and discussing these statements an assumption that I have continually made since first becoming involved with the Big Swamp, is the location of its boundaries. Up until most recently I have always regarded the Big Swamp as one unit as outlined in Aerial Photograph 2, page **12**. (the Big Swamp boundary being the dotted blue line.). However, after a discussion with a group of friends versed in native vegetation, I believe that the Big Swamp can be broken down into several areas with distinctly different vegetation and hydraulic conditions prevailing. (The distinction can be better seen in the Jacobs aerial photograph found on Page 21 of their report).

Aerial Photograph 3 breaks the Big Swamp down into 7 parts.

- The ***black*** outline being the melaleuca squarosa wetland area.
- The ***green*** outlining the vegetation supported from flows along the Boundary Creek course.
- The ***blue*** area indicating an area of unknown conditions.
- The ***yellow*** with a higher profile and vegetated with eucalypts.
- The ***red*** being the area where the 3m observation bores YS01, YSO2 and YSO3 are located.
- The ***white*** area has what appears to be three distinct sub areas.
- The white dot is an area of inundated melaleuca squarosa.

What the ***brown*** patches indicate is the differences in height that can be found within the Big Swamp area. Any elevated areas allow a different drier type of vegetation to exist. See Aerial Photograph 4, page **13**, that highlights four of these areas.

When discussing a swamp or wetland one is immediately thinks of an expanse of permanent inundated land. This is especially so when one discusses the Big Swamp. However, the lower section of what has been regarded as part of the swamp pinches out into a narrower section and has undulations, mounds or high points. These higher points would allow eucalyptus trees to establish, especially swamp gums. Perhaps the whole swamp area would be better defined as the Big Swamp ***Wetlands***.

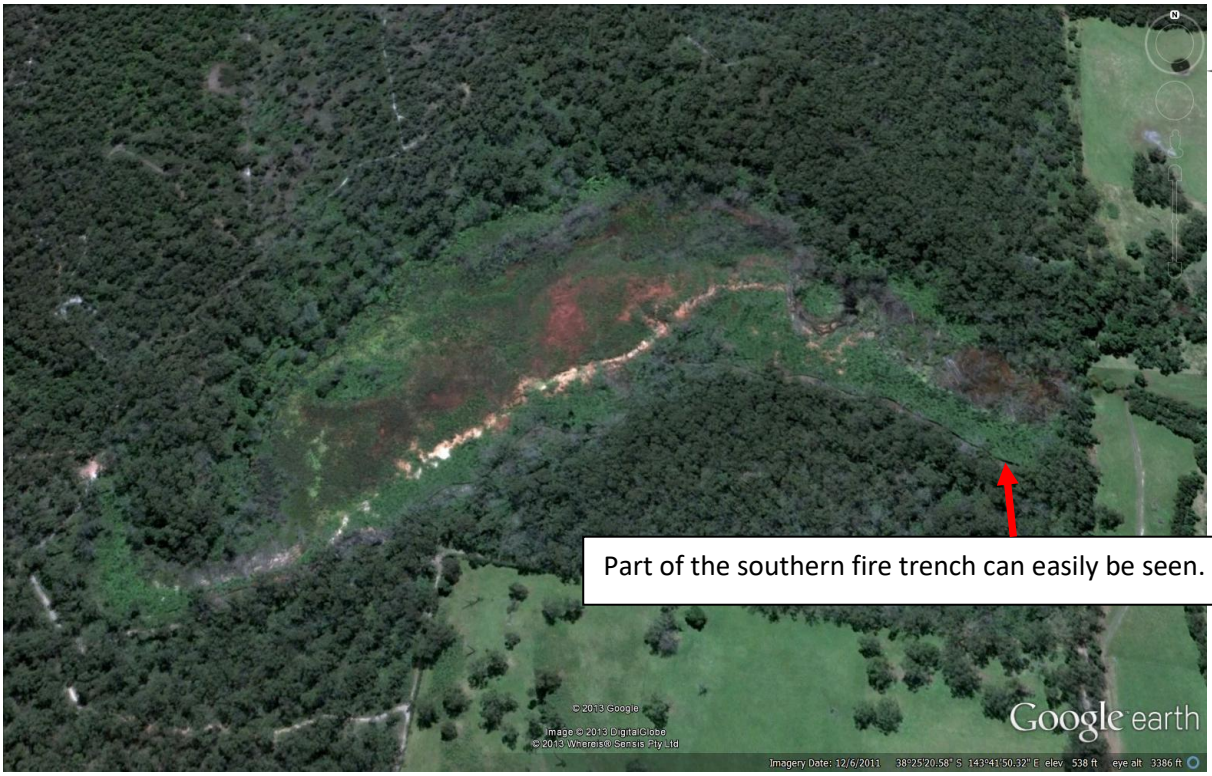
If accepting that the original boundary of the Big Swamp in fact comprises an area of different elevations, flats and dips, then a better understanding can be made as to how the Jacobs' statements above can be so wrong.

1. The higher mounds areas would have never been permanent swamp but in high rainfall periods may have been temporally inundated. The swamp gums trees would have easily survived under these conditions.
2. The lower lying sections in amongst the eucalyptus trees supported tree ferns that can survive in permanently inundated conditions. Tree ferns can establish in such conditions; are capable of producing aerial roots and are water loving plants.
3. Before the 2010 fire that devastated this area the trees and tree ferns were still alive (see photographs on pages **10** and **11**), not suffering from "*root death"* as suggested by Jacobs.

The lower reach of the Big Swamp in 2009 showing the ferns and trees alive and in reasonable condition.

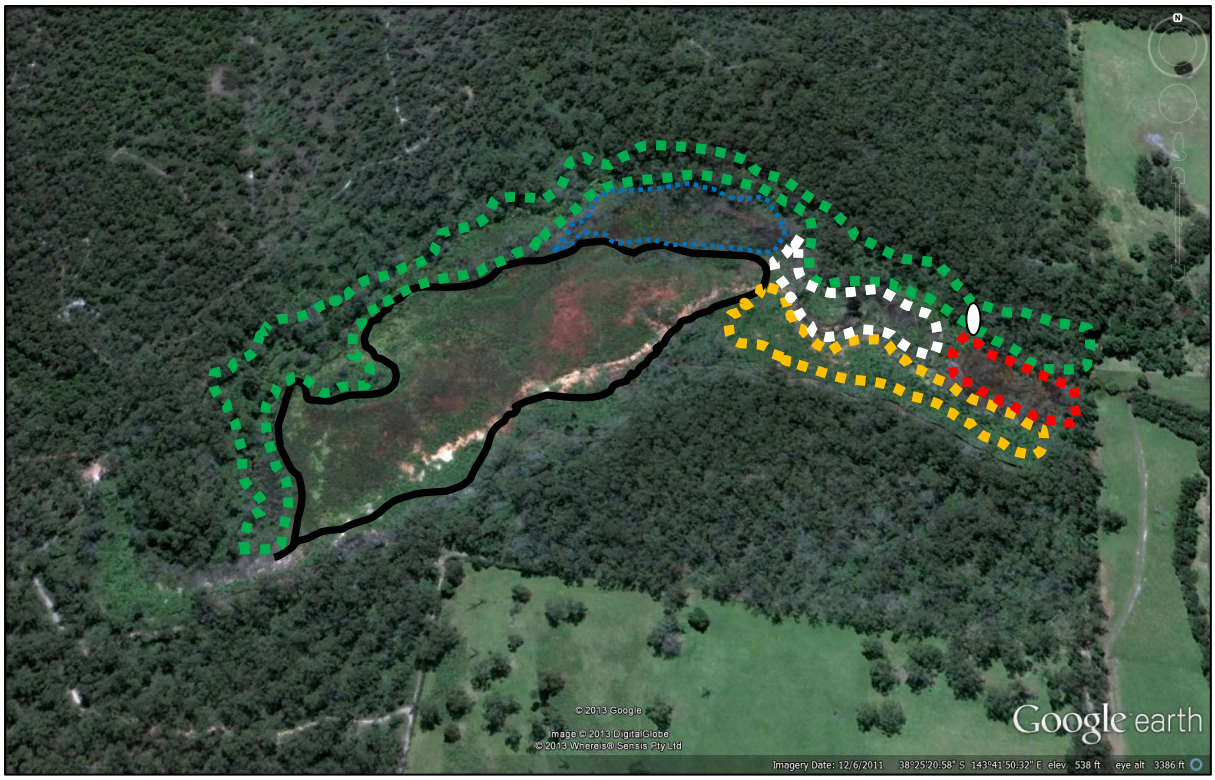
This photograph was taken on the same day looking down into the same area. Consequently the quote regarding the trees and ferns dying from root death due to inundation, is wrong. If anything the vegetation was suffering from the generation of acid and heavy metals leaching down form Actual Acid Sulfate Soil impact further up the wetlands.

Just upstream of this area a low inundated melaleuca squarosa wetland was struggling with 2.5 pH levels. This acid water was being generated upstream and being transported through the peaty soil into the lower sections of the wetlands.

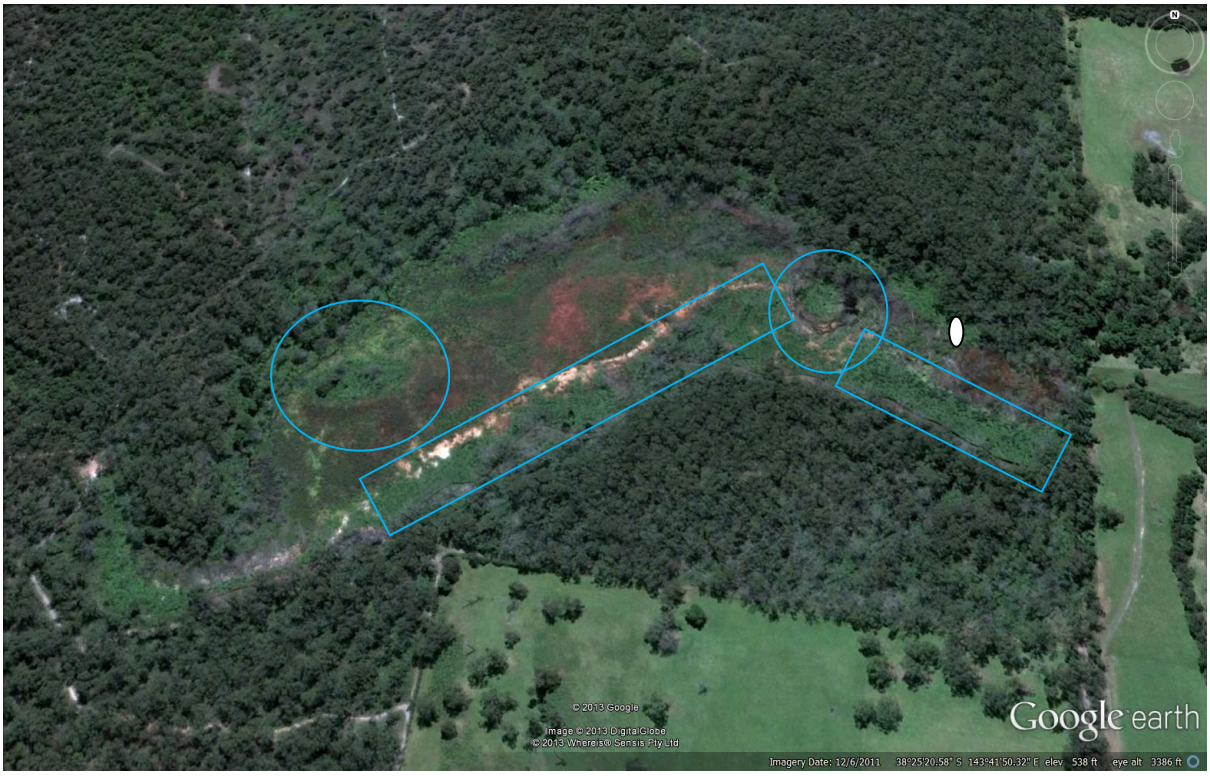


Aerial Photograph 1.

Aerial Photograph 2.



Aerial Photograph 3.



Aerial Photograph 4.

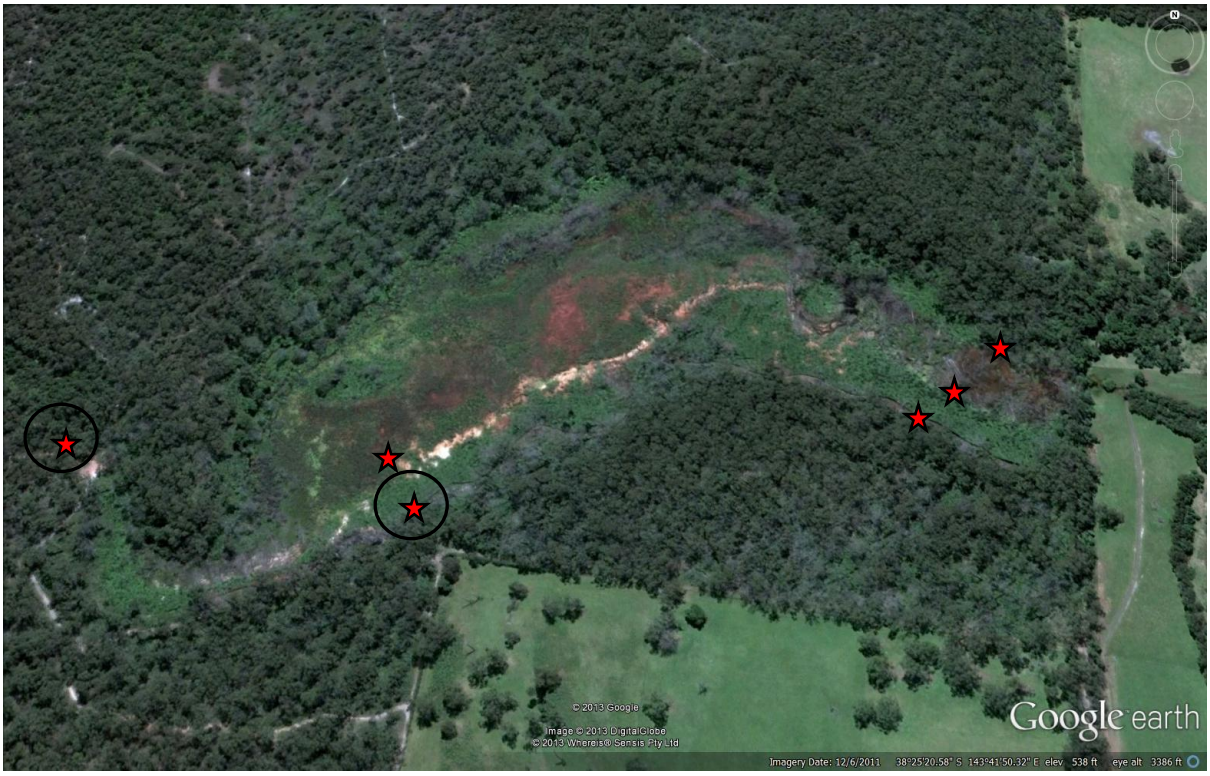
4. Tree ferns thrive in inundated conditions and would not suffer root death from inundation.
5. Also, the inundated areas were covered with water loving vegetation, pre the 2010 fire.
6. Yes, the plants in the lower reach of the area were suffering from acidic water. But, they would have been suffering just as badly from the excessive amount of dissolved toxic metals also being generated in the Actually Acidic Sulfate Soils. For example the extremely high levels of dissolved Aluminium would have been as toxic as the acid. (In Jacobs final draft report Appendix C that was to contain the results of the Dissolved Metal, was not included. Through special request this appendix was finally released and is commented upon later)
7. With a minimum amount of effort the assumptions and guesswork made of the conditions of the wetlands 50 years ago, could have been avoided simply by asking the 70 year old who now owns and was brought up on the property adjoining the Big Swamp Wetlands.

PAGE 6.

This page summarises 6 management options for the Big Swamp. However, a successful management program relies on knowing what one is attempting to

manage. In this particular situation there are so many things that still require investigation it is doubtful that appropriate management can be achieved. This is most definitely not a scientifically sound way to proceed.
There are so many unanswered questions.

1. What impact did the 160m AHD potentiometric level of the LTA have on the Big Swamp wetlands pre groundwater extraction?
2. What impact would it have if returned to a level above the Big Swamp?
3. Is the Big Swamp actually a series of disjointed wetlands displaying different characteristics that require different management decisions to be made?
4. Where exactly does the aquitard peter out in relation to the Big Swamp Wetland area?
5. Why haven't transects across the Big Swamp Wetland in both a north south and east west direction been done?
6. How deep is the peat throughout the Big Swamp Wetlands?
7. At what depth is the peat oxidising throughout the wetlands?
8. How can putting a NSL clay barrier at the eastern end of the wetlands saturate the wetlands all the way back to the western edge when there is an 8m elevation difference?
9. What is the rationale to this option, even taking into account capillary action?
10. What is the analysis suggesting that an increase of 1 ML/d in the Artificial Supplementary Flows will be enough water to flood the swamp?
11. What is taking place in the riparian areas in the verges of the Big Swamp Wetlands of Boundary Creek? (Green dotted area on Aerial Photo 3, page **12**.
12. Where do the Artificial Supplementary Flows disappear to?
13. Why do these flows disappear?
14. At no stage has there been any attempt to understand groundwater biota and what part it plays.
15. Aerial Photograph 5(see page **15**) shows the approximate locations of 3m deep piezometric observation bores (red stars) that were sunk in an effort to learn more about the Big Swamp Wetlands. The two with the black circle appear to be located outside the boundary of the Big Swamp Wetlands. The one on the extreme left is definitely beyond the boundary, but wherever the others have been placed they will provide an extremely limited data set when the entire swamp wetlands are taken into consideration. (the exact locations of the observation bores were asked for months ago but have not been given)



Aerial Photograph 5.

16. This photograph highlights just how limited the investigation areas are compared to the total area of the wetland.
17. No attempt has been made to determine the impact of the transmissity of flows through, under, into or across the wetlands caused by the hydrophobic state of the burnt and dried peats.
18. What impact is ET having with the changed conditions prevailing in the wetlands?
19. To what degree has the opportunistic vegetation changed conditions and functions within the impacted area?
20. When the borefield is operating air is sucked down into the void being made as the water is extracted. Even without this fan of air flow, peat can spontaneous combust at around the 40% moisture level. How these two facts have been considered when attempting to inundate the swamp wetlands has not been discussed.

PAGE 7.

The automated flow control on McDonalds Dam is an excellent recommendation, as is the continuation of monitoring in the area.

It has not been made clear why the dates between November and June have been chosen for the ensuring of 3 ML/day releases out of McDonalds Dam. There are occasions when the flows disappear half way along the Big Swamp outside these dates and passing flows need to be maintained during these periods.

PAGEs 8-16.

The mistakes and inaccuracies made in these pages have been commented on in earlier Otway Water Books as they are the very same ones made in previous Jacobs documents. The one exception being found on page 15(see Appendix 2, page 42). In earlier reports this diagram, Figure 1-4, included dates for each of the stages and indicated that local stakeholder consultation had taken place from 2012 when this new monitoring program was being scoped out. However, there was no local input when this 2012 document was written up. Neither was there any local involvement when the 2012 document was modified in 2013. Considering the detail and scope of the 2012 document, it is feasible to assume that planning began long before the report was finalised in 2012. The Barwon Water Groundwater Community Reference Group first met in October 2013, long after the new monitoring program directions and scoping had been completed. The objective of the Reference Group was to ensure that the new monitoring program was carried out according to the 2013 report. Even when it was pointed out that this diagram was extremely misleading, the diagram continued to appear in documents and reports. It was not until the 9 November Yeodene Swamp Study report arrived that a change was noted. Unfortunately, without dates of when the process began, this new diagram still gives the impression that stakeholder and local community consultation has been part and parcel of the project from day one.

As an aside, Nellie Shalley one of the landholders critically affected by any review of and development of a new monitoring program was excluded from the Community Reference Group. Then, at one stage at least a year into the "consultation," she was asked onto the Group but was once again denied attendance before attending one meeting. Community consultation at its best? However, at the time the administration of Barwon Water was extremely difficult to work with. Thankfully things appear to have undergone a dramatic change since new administration has been appointed.

PAGE 18.

As has happened in a few of the Jacobs reports this page once again shows a lack of understanding of what has taken place in the Boundary Creek region in relation to fires. The 2006 peat fire was in the extreme western edge of the Damplands some 800m above the Big Swamp Wetlands; not in the Big Swamp Wetlands as stated. No fire trenches were dug in 2006. They were dug in 2010 around the Big Swamp Wetlands. At the 2006 peat fire site a mineral earth policy was adopted by the CFA. Approximately 20 acres were clear felled; the timber was meant to be burnt and the area kept vegetation free as a fire

control so that there was no chance of the peat fire escaping into the near by bush. The CFA was very aware after the top end of the Big Swamp Wetlands catching fire in 1997-98, that special handling of a peat fire in this region was required.

Also, under the Catchment History section it fails to mention that other than the mineral earth policy of 2006 very little if anything in the way of land use change had taken place in the Boundary Creek Catchment since 1979. In fact land clearing and channelization had stopped many years before. The McDonalds had been attempting to drain the area just above the Damplands unsuccessfully for decades, if not generations. This area could not be drained pre groundwater extraction taking place at the Barwon Downs Borefield.

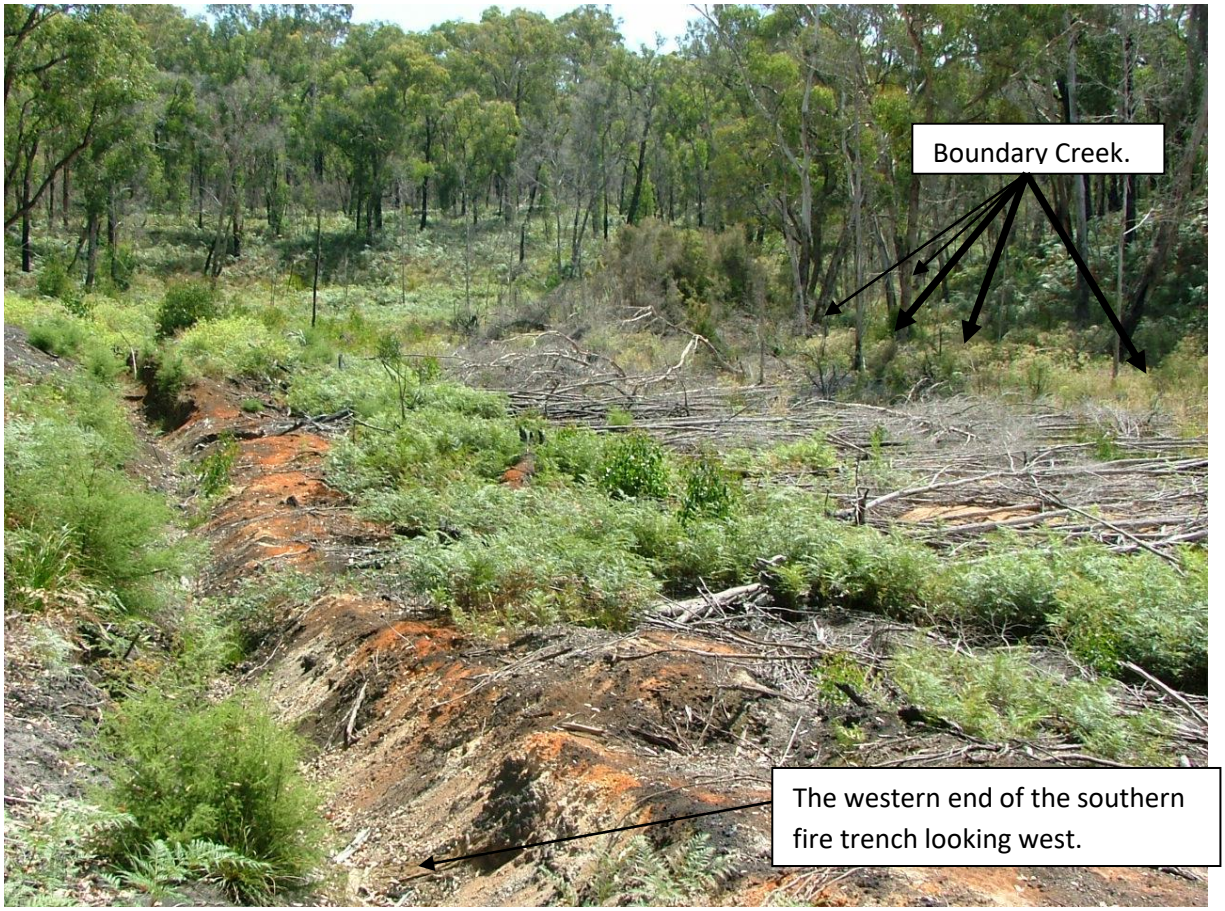
In this section of the Jacobs' report it fails to mention the major groundwater extraction that took place during the 1982-83 drought, whereby the groundwater was so extensive it is reported that it provided Geelong with 50% of its water.

PAGE 20.

During the 2010 re-ignition of the Big Swamp a fire trench was dug on the southern and eastern boundary of the swamp in an effort to prevent the burning peat spreading beyond the swamp boundary. The southern trench was approximately 2m deep and the eastern trench was approximately 3m deep. Jacobs stated that "***The construction of these fire trenches is likely to have intersected some runoff to the swamp from the southern uphill slopes. Further, the trenches are likely to have intersected the water table, resulting in the drainage of groundwater and the lowering of the water table.***" From personal experience these trenches did not appear to intersect the water table and any intersecting of runoff from the southern direction would have been minimal. Observations by Cr. Higgins of the Colac Otway Shire confirmed my observations (see Appendix One, page **40**.) The fire was contained in March 2010. The trenches were dug at this time and by the end of September the trenches still had no water in them.

"***Cr Higgins raised the issue that the trench, which had been cut along the edge of the peat fire area at Yeodene, was not filling with water as he believed was intended to avoid future fires.***"

In fact I have never seen the southern trench with any water in it except after a rainfall event when some pools gather.



Even after months of Artificial Supplementary Flows being released from the Otway Colac Pipeline the eastern trench did not fill until the floods late in 2010. It would appear that the water table was not intersected and at the time was below the 3m mark. It also seems most doubtful that the fire prevention trenches contributed to the draining of the Big Swamp area as suggested by Jacobs.

When constructed the eastern trench was dug until the peat reached appeared damp enough to not burn. The southern trench was dug until the peat soil stopped. The majority of the southern trench was dug just to the south of the peat layers.

The southern fire trench looking east.

Looking west.

These photographs shows the north south fire trench looking south. The log is lying in the Boundary Creek bed facing in a west to easterly direction. I am photographed standing in the Boundary Creek bed partially backfilled with excavated peat.

PAGE 19.

This page does make reference to the 1982-83 groundwater extraction. Strictly speaking it was not the first extraction as smaller extractions were made pre this. These small extractions were the initial test phases. The 1982-83 extraction most definitely was not done as an "...***initial test phase***..." At the time there was a desperate need to provide drought relief for Geelong. There is also considerable dispute over the amount extracted during this 1982-83 drought period. Stated extractions range from the 2000 ML mark to over 8000 ML, depending on which source one refers to. Interestingly to note, under an FOI application Barwon Water stated that after diligent research the extraction rates pre 1988 could not be located. Bearing in mind that a stress test pump to see how the aquifer would react was conducted between 1987 and 1990. This stress test was to determine the amount of water that could be extracted sustainably. The data during this stress test pump was critical as it was to be used to form the basis for future sustainable extractions. Being so important, how it could not be found is quite extraordinary. In the mean time Southern Rural Water with the Water Minister's sanction of the time, granted a licence to extract 12600 ML/year. The stress test pump results stated that 1500 ML/year would be a sustainable extraction rate. Another extraordinary event.

Figure 2-1 of the Ecological Vegetation Class mapping for 1750 and 2005, found on page 20, also seem quite extraordinary considering:

- The 1750 map is based on a massive amount of assumption and speculation. This map predates Captain James Cook's exploration of the east coast of Australia and the arrival of the First Fleet by 38 years.
- There is no reference to the mapping of the very same area that Carr and Muir completed for Barwon Water as part of the 1994 vegetation study. Their mapping was detailed and extremely extensive. Unlike the Ecological Vegetation Class mapping, it was not based on conjecture or assumptions, but was based on actual on ground visits and verification.

PAGE 20.

It is interesting to note that a Warrnambool Standard newspaper cutting was used as a source of information regarding the Big Swamp Wetlands' fires when a detailed and official account of the fires can be easily obtained from the CFA. The CFA report is comprehensive, detailed with first hand observation.

The Glover reference on this page should read 2014 not 2004.

Interesting the Reference section on page 62 are very limited as there is no mention of the Big Swamp Wetlands studies carried out by the LAWROC Landcare Group; other press cuttings of the time or locally verifiable data.

If genuinely seeking local knowledge one would think that the Otway Water Books would have been referred to as well. These books would have assisted in avoiding some of the very basic mistakes made by Jacobs.

PAGE 27.

It is often mentioned in Jacobs' reports that the Artificial Supplementary Flows were commenced in 2002 but the licence conditions stating that these releases must be done were introduced two years later as part of the 2004 extraction licence.

"***In response to this Barwon Water releases a supplementary flow of 2 ML/day into the upstream reach of Boundary Creek (when triggered by licence conditions) since 2002 (Jacobs 2017b, Jacobs 2016a, SKM 2011, and SKM 2001).***" Is this another case of, if something is stated often enough it becomes accepted as a fact?

PAGE 29.

I was quite amazed when looking at the number of no flow days at the Yeodene Stream flow Gauging Station No. 233228A and compared them with figures I had researched from the vic.water.data warehouse, and Barwon Water's financial year reports sent to Southern Rural Water. I also decided to check the figures for some of the years against the Victorian Government water data warehouse. I was amazed to find that the figures were all over the place, with the exception of 2012 and 2013. However, my figures were based on financial years and could account for some of the discrepancy.

The following chart (Chart 1) shows approximate numbers calculated from the Jacobs graph on Page 29; the data.water.vic.gov.au figures and the ones I had calculated. The data.water data had periods of no record for Station 233228A. This gauge is the same gauge that the Jacobs data is compiled from, so the figures should match. With these limitations in mind it is obvious that there are quite a few significant differences that need to be explained.

Year	Page 29 Jacobs	data.water	OtwayWater Bks
1990	38	16	15
1999	61	45	32
2000	170	Not done	133
2001	122	107	112

2007	183	Not done	169
2012	158	Not done	158
2013	159	Not done	159
2015	183	128	107

Chart 1. Approximate figures for days dry at the Yeodene Stream flow Gauging Station.

Regarding the pH levels recorded in Boundary Creek and graphed out on page 29 of the Jacobs' report, it is more than likely that there would have been many more days of really low pH if the data was collected weekly or daily, rather than monthly. Extreme acid events could have taken place between monthly readings being taken.

PAGE 30.

Over the period 1984- 2017 Jacobs states that with no groundwater extraction Boundary Creek would have kept flowing.

"***This shows that there was groundwater flow into the creek until the mid-1980s (indicated by positive values) and since then the flow has reversed and surface water flows to the groundwater (indicated by negative values). With no pumping, the groundwater would have continued to discharge to the river, as demonstrated by the orange line.***"

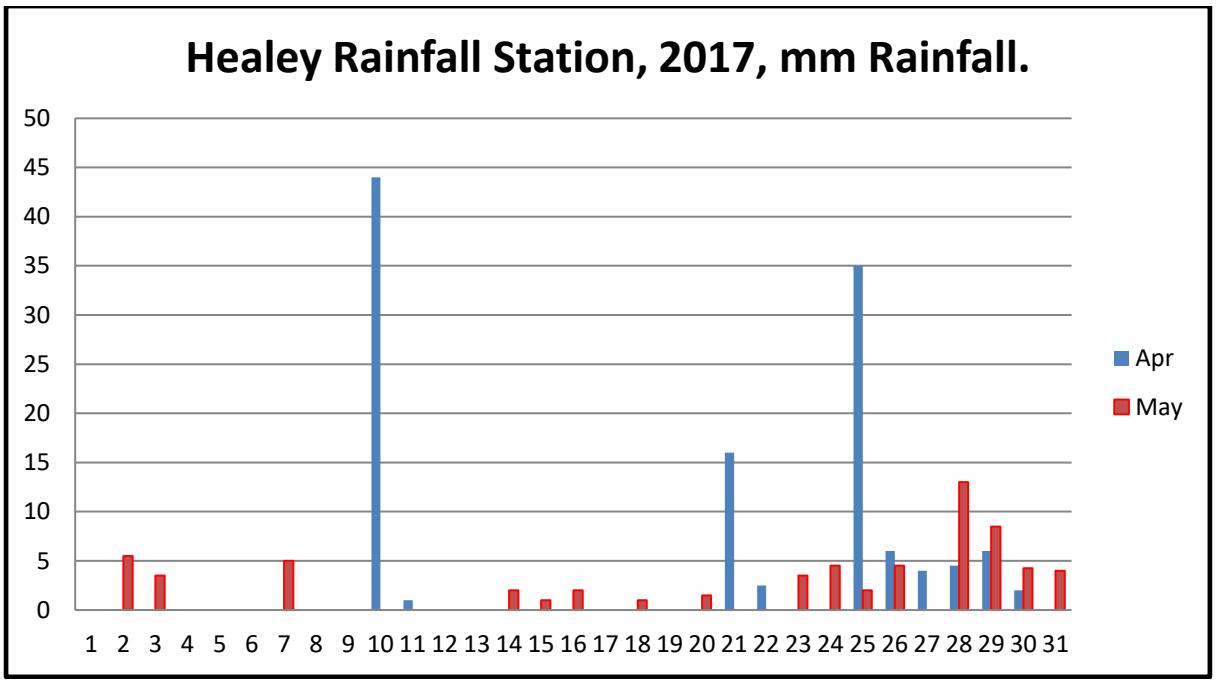
PAGE 31.

In the Chapter overview of the Field Program Jacobs had this to say.

"***This chapter provides an overview of the field works undertaken as part of this study. It summarises the methods used during monitoring and sampling so that the results can be assessed with rigor and within the context of the program.***" Unfortunately Appendix C containing the analysis of soil and water samples was not provided. Appendix C was provided some months after the report was placed on the Barwon Water web site. This appendix was granted after being specifically requested.

There are other items that cannot be assessed with rigor as the data and metadata is not provided in the text or Appendixes, e.g. the stop flow monitoring.

The first monitoring was conducted on the 4th and 5th of May 2017 which "...***represented the first period of flow in Boundary Creek following the 2016-2017 summer***." Drawing conclusions from such a very short period of monitoring has limited value.



In April 2017 there was a total of 212 mm of rain with the bulk of it falling late in the month. Then on the 2nd and 3rd of May there were falls of 5.5 mm and 3.5 mm. How the Stream Flow Gauging Station No. 233228A started to record flows on the 4th and 5th needs to be explained. Perhaps the April flows were not getting past McDonalds Dam until some adjustments were made at the outlet. Whatever the reasons this data and accompanying explanation, needs to be clarified.

Appendix A as referred to in this chapter has not been included in the Jacobs report.

PAGE 34.

The vegetation survey transect between YS01 and YS03 is not shown in Figure 2-6 as described. It is possibly Figure 4-1 or 4-2.

The flora species identified have not been listed.

Using an “adaptation” of the method adopted in previous vegetation surveys has doubtful merit as the previous method has some serious shortcomings as described in Otway Water Book 31.

An explanation of why only the extreme easterly section of the Big Swamp Wetlands was surveyed needs to be given.

PAGE 35.

Under the ***Hydrology*** section of this page dot point 3 cannot be taken as a definitive statement when considering dot point 5.

Dot point 3 "***Saturated peat sediments in Yeodene Swamp are hydraulically separated from the underlying regional aquifer (LTA) by the aquitard.***"

Dot point 5 "***The aquitard thins to the west and is absent upstream of the swamp, however the exact location where the aquitard is absent is not known. Shallow bores indicate that the western end of the swamp the alluvial deposits overlie the regional aquifer.***"

As stated here the exact location of where the aquitard finishes in the Big Swamp Wetlands is not known. With the extremely limited number of observation bores in the swamp this is not surprising. YS05 is the only bore in this area and its location is doubtful whether it is giving a true indication of the soil structure in the top end of the swamp. What is actually happening in the middle sections of the swamp is anyone's guess (see page 37 of Jacobs' report).

"...***it remains unclear as to the exact boundary between outcropping aquifer deposits in the west and aquitard deposits in the east.***"(Quote from page 36 of the Jacobs' rport)

The ***Acid Sulfate Soils*** section states that "***The highest concentrations of net and potential acidity were found in the central and lower lying areas of Yeodene Swamp.***" Where these central and lower lying areas are not shown on any of the maps in the report. See page **13** of this book, for the areas designated by Jacobs as monitoring sites. These are definitely not in the central part of the swamp. Where the lowest section is difficult to define if the topography of the swamp has not been examined.

In the ***Surface Water Flow*** section not all possibilities why the reach of Boundary Creek immediately below McDonalds Dam is a gaining section of Boundary Creek. "***Surface water flows increase between McDonalds Dam and the top of the Damplands...***"

It is possible that the spot flow measurements could be incorrect, or there could be seepage underneath and or around McDonalds Dam, especially considering that the Dam has been constructed on an area where the Lower Tertiary Aquifers come to the surface.

However, lower down the page this statement is made... "***Immediately downstream of McDonalds Dam to the Damplands the spot flow measurements indicate the creek could be gaining.***" Throwing some doubt on

the definitive statement made earlier stating that this section of Boundary Creek ***is*** a gaining section.

As for Reach 3 being variable, gaining/losing, depends on the amounts and timing of the groundwater extraction periods.

The ***Groundwater Quality and Groundwater – Surface Water Interaction*** sections raise some interesting points. Where is the water from Artificial Supplementary Flows going to when it completely disappears during most months of the year? Does this water take the acidity and dissolved heavy metals with it? Is it polluting the LTA?

PAGE 36.

This page reiterates that "...***it remains unclear as to the exact boundary between outcropping aquifer deposits in the west and aquitard deposits in the east.***" To fully understand how to remediate this area of the Boundary Creek Catchment, knowing where the aquitard finishes and the LTA starts in relation to the Big Swamp Wetlands is critical. Not having assayed the greater majority of the wetland ensures any decision is based on pure assumption and guesswork. The schematic type cross sections of the eastern end of the Big Swamp Wetlands (see Jacobs' Figure 4-2, above) needs to be duplicated throughout the wetlands. Why a cross section between YS04 and YS05 has not been done, is a puzzle, as is why there is no mention of Actual Acid Sulfate Soils in these schematic cross sections.

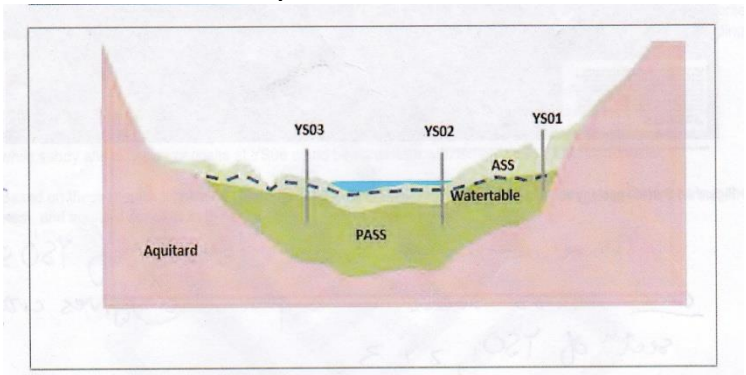


Figure 4-2 Schematic cross sections of eastern end of Yeodene Swamp

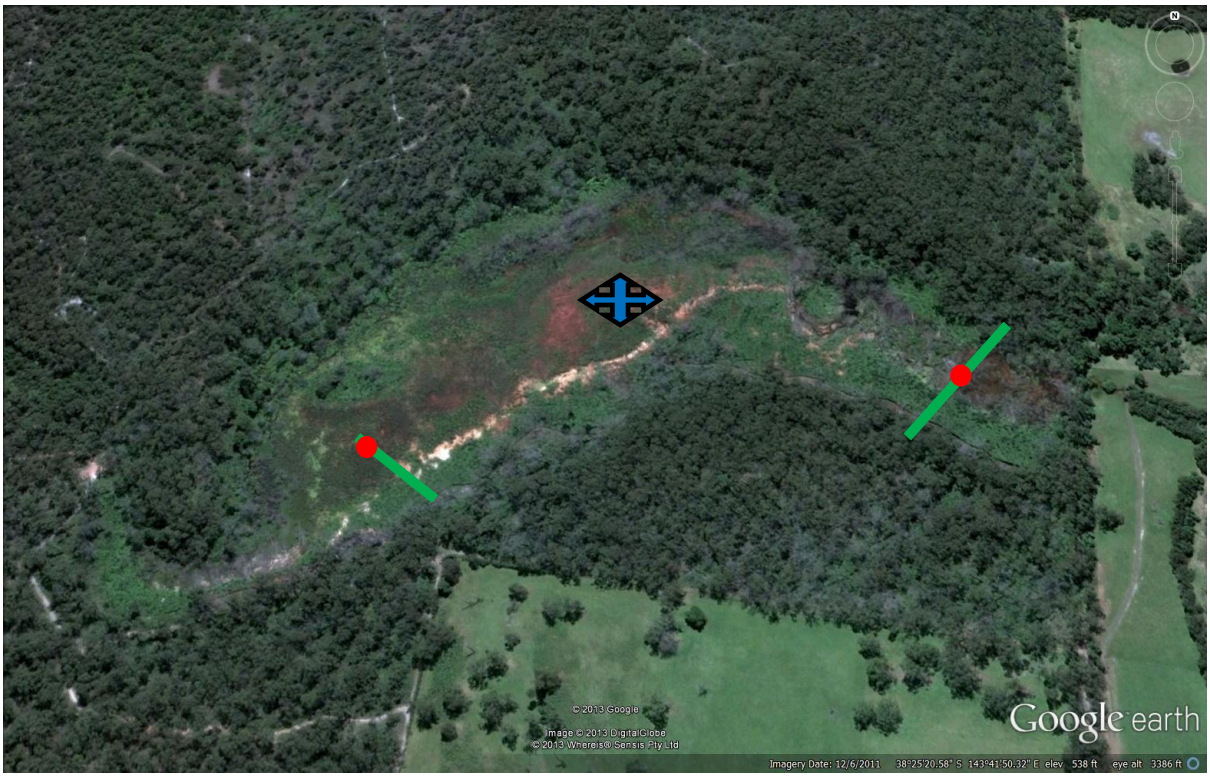
PAGEs 39-41.

The references made to Appendix D and E are incorrect. It seems quite incredible that mistakes such as this can be made when this report has been passed by five people on two separate occasions.

The reference to the centre of the swamp on page 40 is very misleading (see red dots below, page 27). The blue cross would be closer to the centre of the swamp.

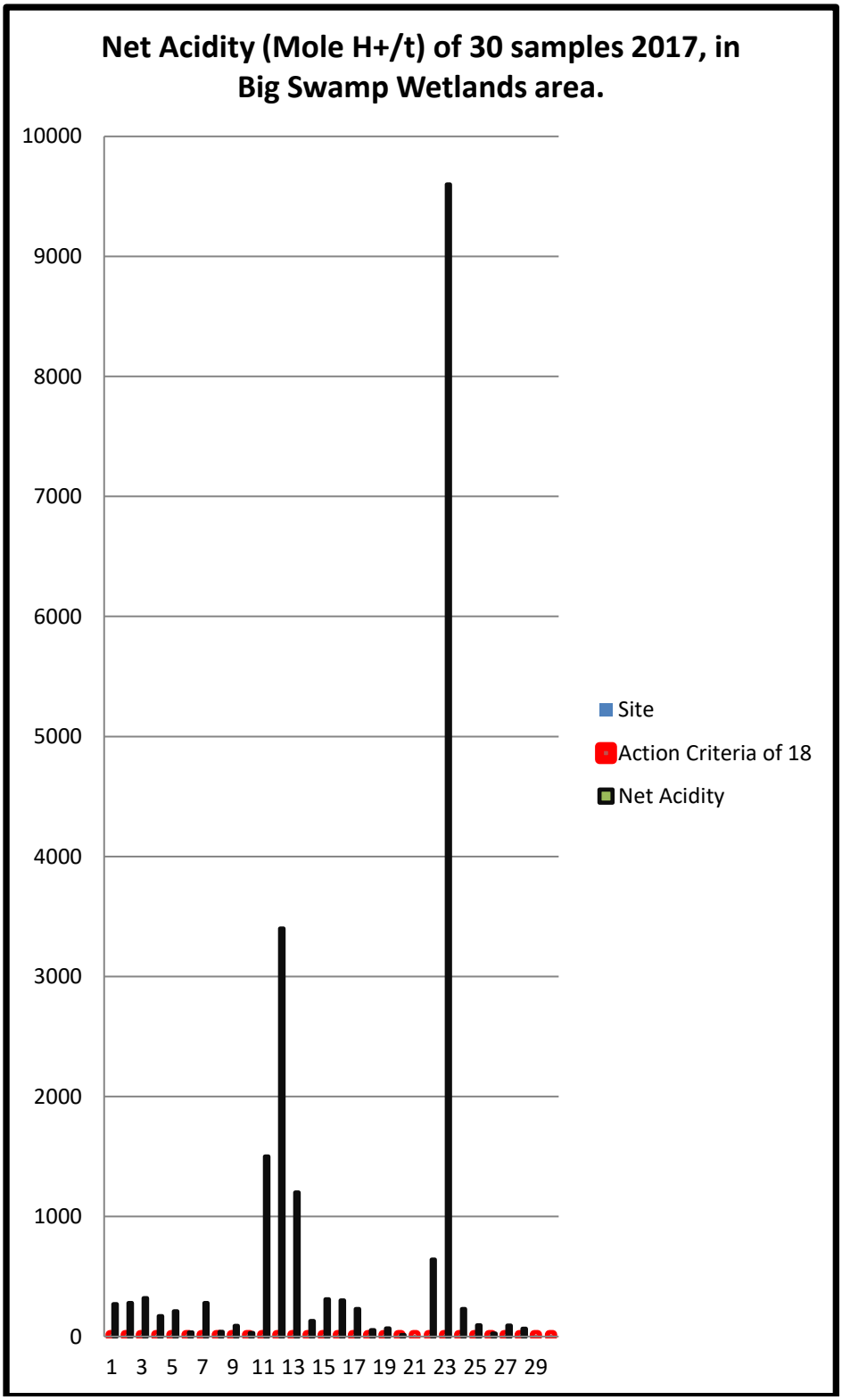
Jacobs also wrongly assumes that the red dot areas are both the most susceptible sites to inundation. In 9 years I have never seen the wetlands to

the west inundated. The area marked with the blue cross has never been inundated through this same period.



Jacobs accepts there is a very serious problem in the Big Swamp Wetlands.

1. The samples taken were void of Acid Neutralising Capacity.
2. The vast majority of samples were well in excess of the Victorian Government's Action Criteria levels of 18 moles of acid. 26 out of the 30 samples were over the 18 moles criteria (see page**28**).



Figures taken from Jacobs report, Page 66.

3. If the acidity in the top one metre of the Big Swamp Wetlands could be mobilised, Jacobs estimated that there are 134 million moles of acid.
4. The annual amount leaving the wetlands each year is estimated to be 55,000 moles.

5. If the current conditions in the wetlands remain the same, this situation could persist for ***several hundred years***.
6. In some areas the peat has been subject to oxidation below the one metre mark.

Considering the top one metre has been subjected to burning and has already leached out a considerable amount of acid water and dissolved heavy metals, the several hundred year prediction may be very conservative.

Little mention of the dissolved metals can be found in the text and with Appendix C not included any immediate comment had to wait (see the discussion below on **PAGEs 42-44**).

PAGE 41.

With the 2ML/day Artificial Supplementary Flows being released on a regular basis and considering there have been reasonable rains each winter since the last extensive groundwater extraction in 2010, it is difficult to understand why the Artificial Supplementary Flows still disappear into the Big Swamp Wetlands area. Surely the "***shallow groundwater***" would have been recharged by 2017.

The reference to Appendix B on this page appears to be incorrect.

PAGE 42.

Not being able to gain access to the Spot flow monitoring data and calibration, no comment can be made.

PAGEs 42-44.

The bottom of page 42 through to page 44 deal with the quality of the water samples taken. However, the reference to Appendix B in the text is incorrect. This appendix does not include analysis of the surface water as stated. "***The results of field and laboratory analysis of surface water from Boundary Creek has been summarised in Appendix B...***"

Samples site locations for YGS, SUS, CS1, LBC, SDS, YG and Lower BC have not been shown on any of the Jacobs' maps. It is therefore difficult to make comment on these sites and or results.

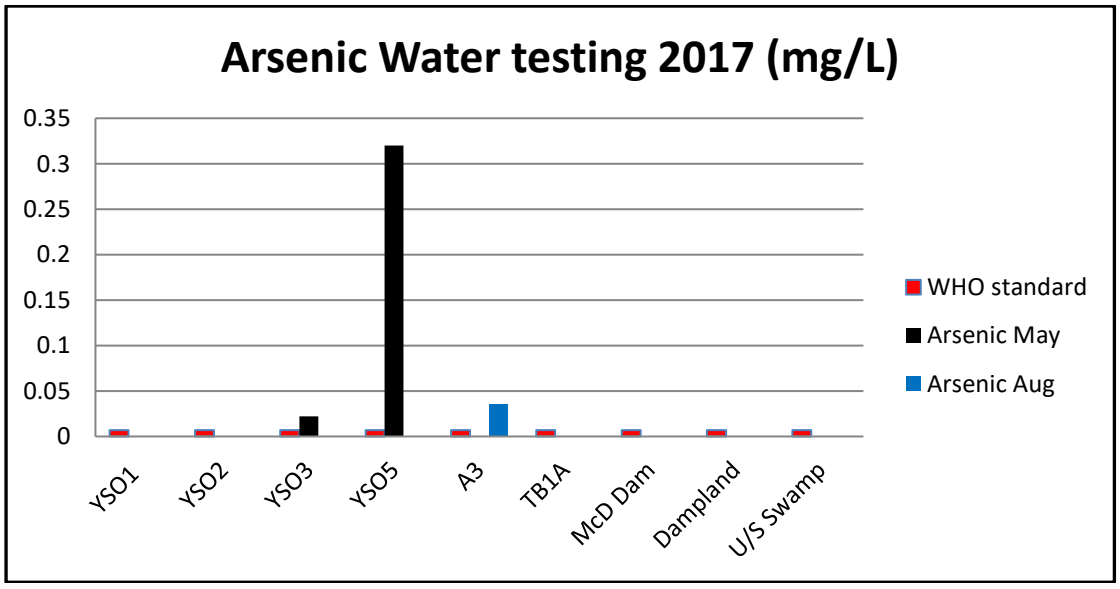
There is no reference to, or analysis of water samples from site YSO4.

No explanation has been given why some of the samples in May where not taken again in August, and why extra samples were taken from new sites in August.

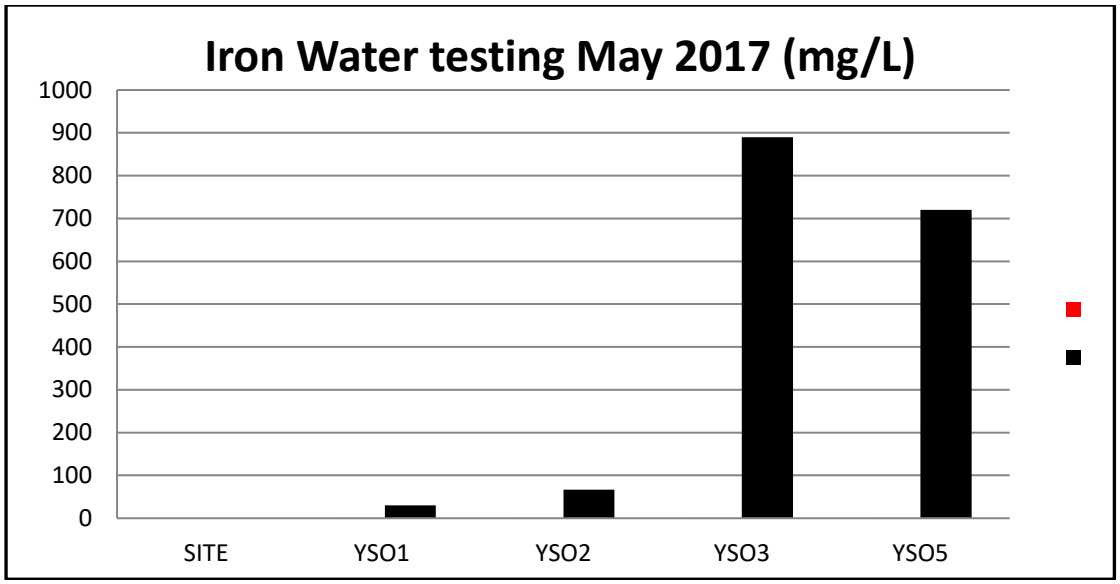
No comment has been made explaining at what level in the water columns, the water samples were taken.

The key findings of the analysis, as summarised by Jacobs, concentrated on the pH, EC and sulfate levels in the water sampled, making scant reference to the "***...various dissolved metals...,***" with the exception of Aluminium. The only naming of the various dissolved metals is to be found in this statement.
"***It is also noted that the concentration of many dissolved metals, including Aluminium, Cadmium, Nickel and Zinc were below of near the analytical detection limit upstream of Yeodene Swamp. These increased <u>several orders</u> of magnitude downstream of the swamp, and were <u>above</u> ANZECC guideline for the protection of 80% of freshwater species (ANZECC, 2000). Similar trends were observed in August for Aluminium, Nickel and Zinc.***" There is no mention of Arsenic, Lead or Manganese.

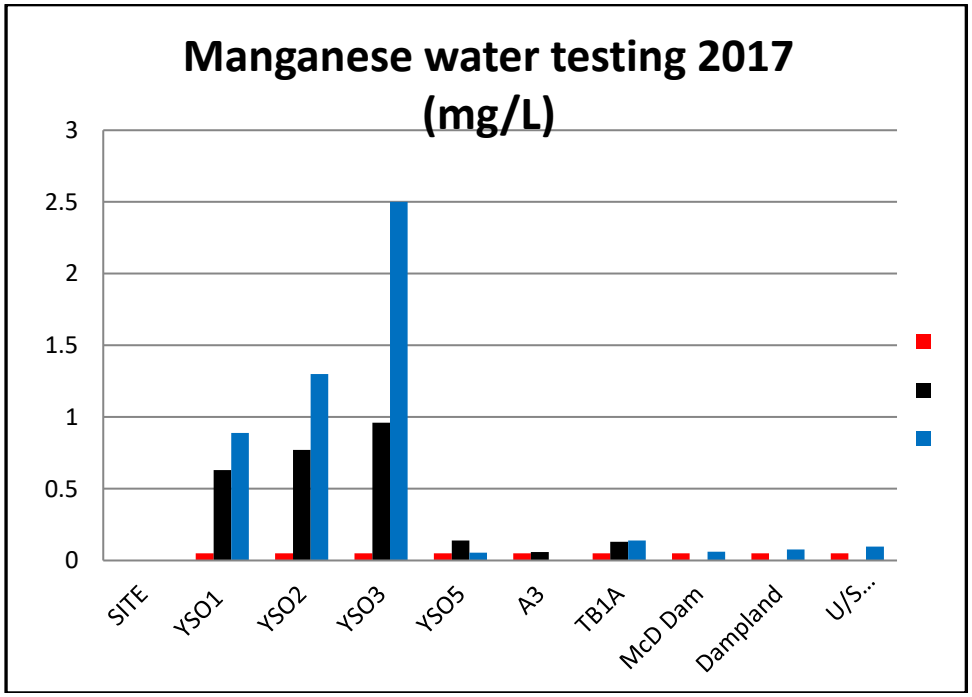
"***The results of field and laboratory analysis of surface water from Boundary Creek has been summarised in Appendix B and detailed in full in Appendix C.***"
Appendix C was finally made available some months after the final draft of this Yeodene Swamp report was posted on the Barwon Water web site "*Have your say*." The following charts have been produced using the data provided in Appendix C.



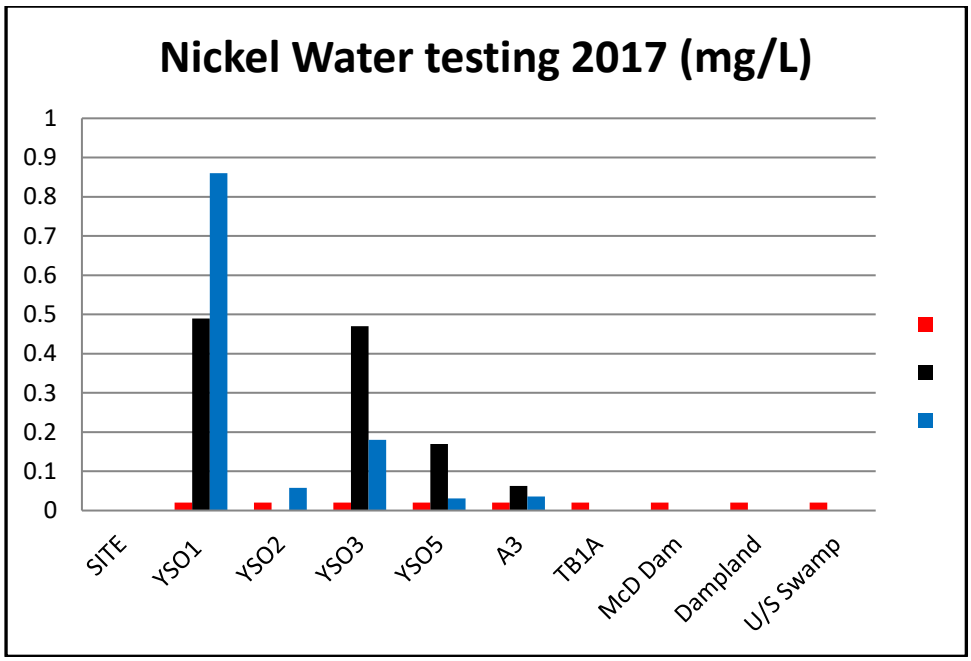
The **Black** bars are the May readings in all of the graphs.
The **Blue** bars are the August readings in all Graphs.
The **Red** bars are the WHO drinking water standard.



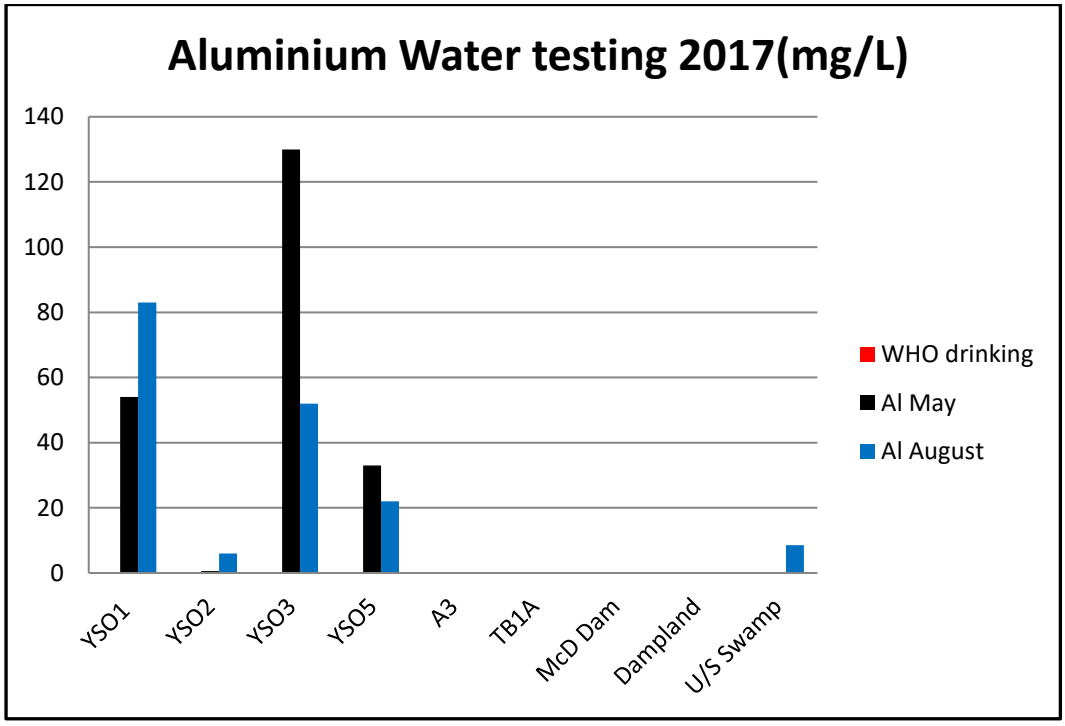
The WHO drinking water standard of 0.3 does not show up on this graph.



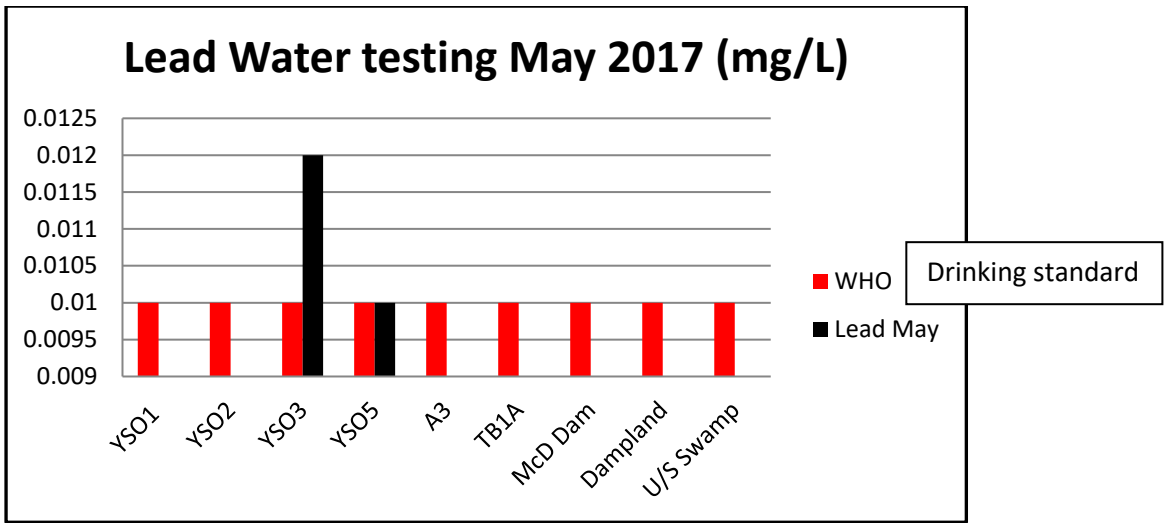
The Manganese water samples taken in 2008 by the LAWROC Landcare Group were significantly lower than these samples of 2017.



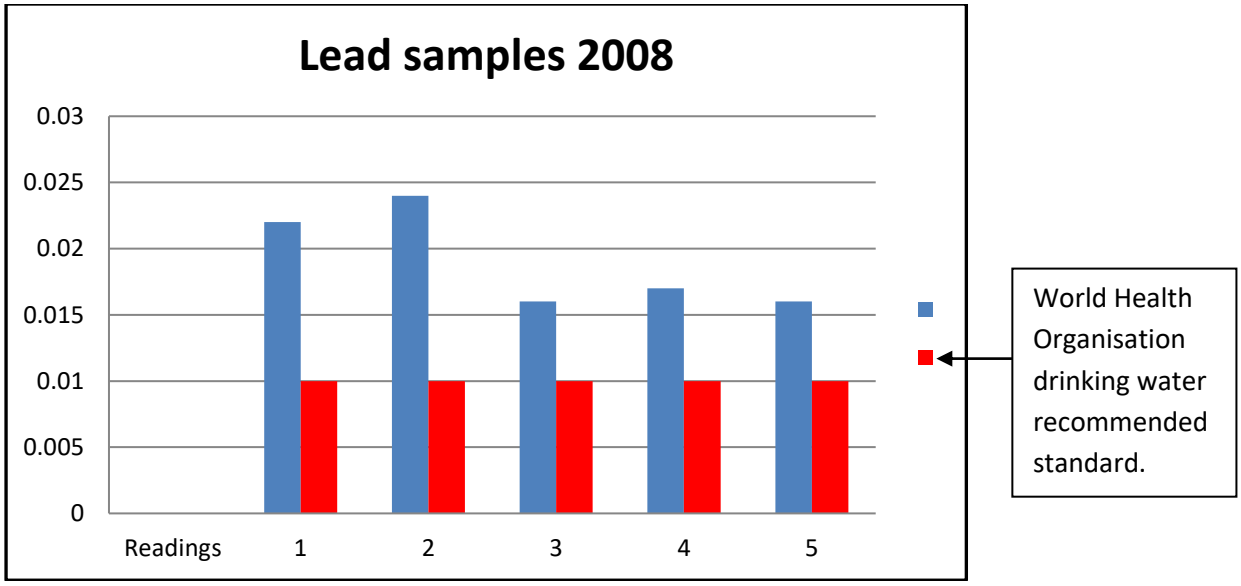
The 95 % Nickel level of protection for freshwater species is 0.01 mg/L.



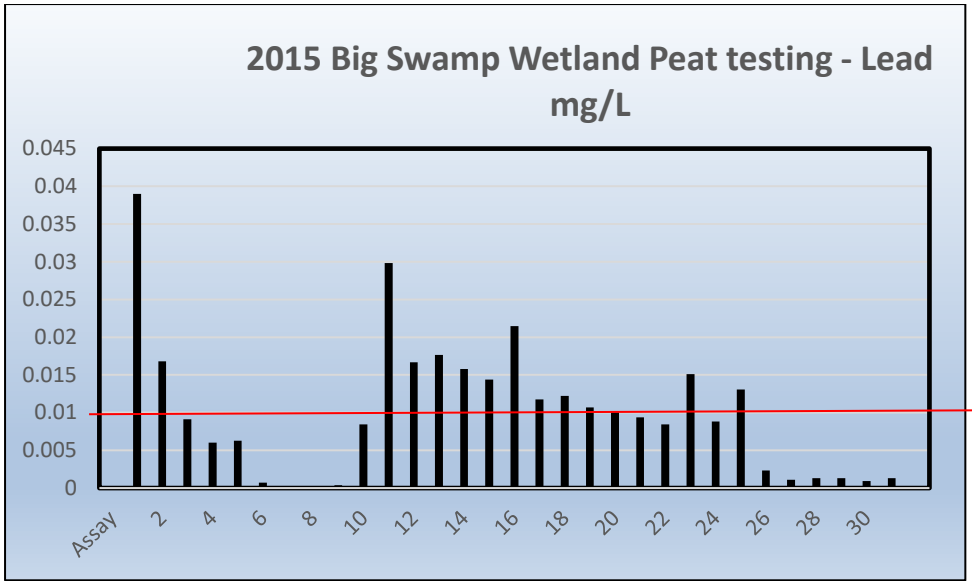
The 95% Aluminium level of protection for freshwater specie at pH greater than 6.5 is 0.055 mg/L.

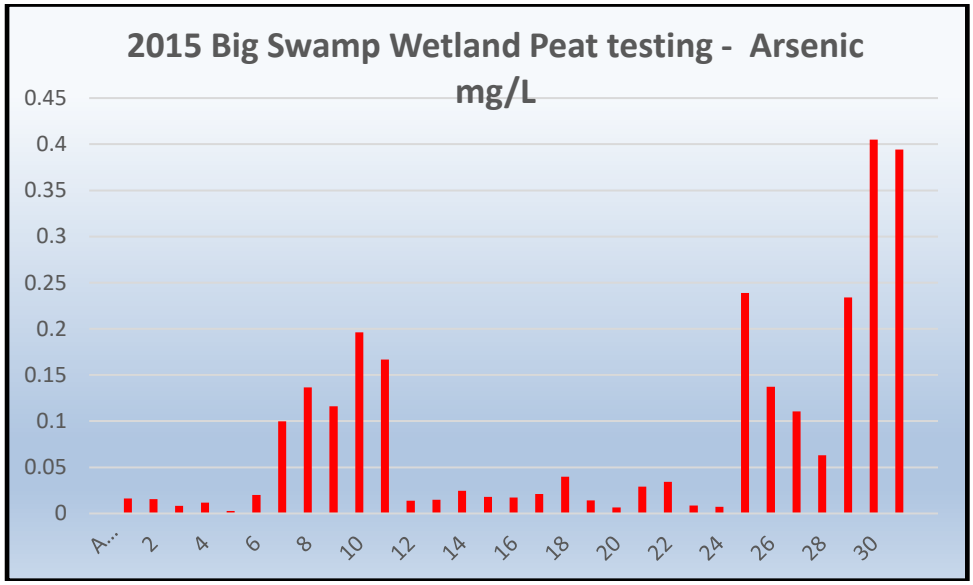


Water samples taken from the Big Swamp area by LAWROC in 2008 indicated a very different Lead picture to the samples collected in 2017. The 2010 fire through the wetlands may had some impact on these results. A lot more needs to be learnt about the chemical structures at play in the Big Swamp Wetlands.



In 2015 as part of his PhD studies Phil Hirst collected 31 samples from 6 assay sites across a north south transect in the middle section of the Big Swamp Wetland. The following two graphs indicate the levels of lead and arsenic found at these sites. I have converted his peat/soil results of mg/kg to mg/L.





The **EPA** is proposing to set the drinking water standard to 0.005 mg/L.

PAGEs 49-55.

These pages have not been studied in any detail as they are strategies that have been ruled out as appropriate to improve the quality and volume of water flowing in Reach 3 of Boundary Creek. However, a few things stood out on page 54.

- The Artificial Supplementary Flows have gained a new name, now being called “release water” or “flow release.”
- The Artificial Supplementary Flows or “release water” has a very limiting buffering capacity on the acid and metal concentrations. The Artificial

Supplementary Flows are presently set at 2 M/day and are planned to be stepped up to 3 M/day even though 15 ML/day has been predicted to have little impact diluting the acid and dissolved metals.

- The "release water" is part of the plan to remediate the swamp by inundating the Big Swamp Wetlands. This remediation is an attempt to return the Big Swamp to some form close to what it was like pre pumping. At the present time opportunistic drier tolerant vegetation has moved into sections of the Big Swamp Wetlands. If the Big Swamp Wetlands could be re-saturated then original species would have some chance to return. However, Jacobs portrays this as a negative development by stating "***The release of such volumes of water would also significantly change the current environmental setting of Boundary Creek and Yeodene Swamp and negatively impact the existing flora and fauna.***"
  "***Further, such flow releases would also almost certainly result in flooding in the catchment.***" Why this would be anything other than the way it was pre groundwater extraction has not been explained.
  Could it be that...
  1. there are still areas of the Big Swamp Wetlands still not revegetated, reducing the amount of evaporative transpiration, therefore contributing to flooding,
  2. the peat has become hydrophobic in many sections not easily allowing the peat to become rewetted, increasing runoff.
  3. the fire regimes have altered the chemical characterisation of the peat and soil, and or
  4. the impact from subsidence, burning and oxidation of the peats has had a dramatic influence.

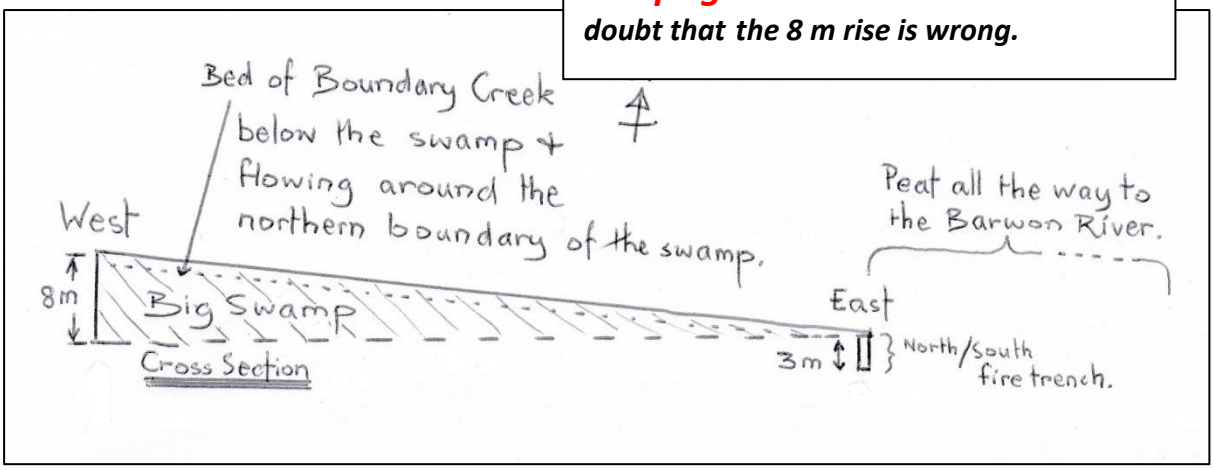
PAGEs 56-59.

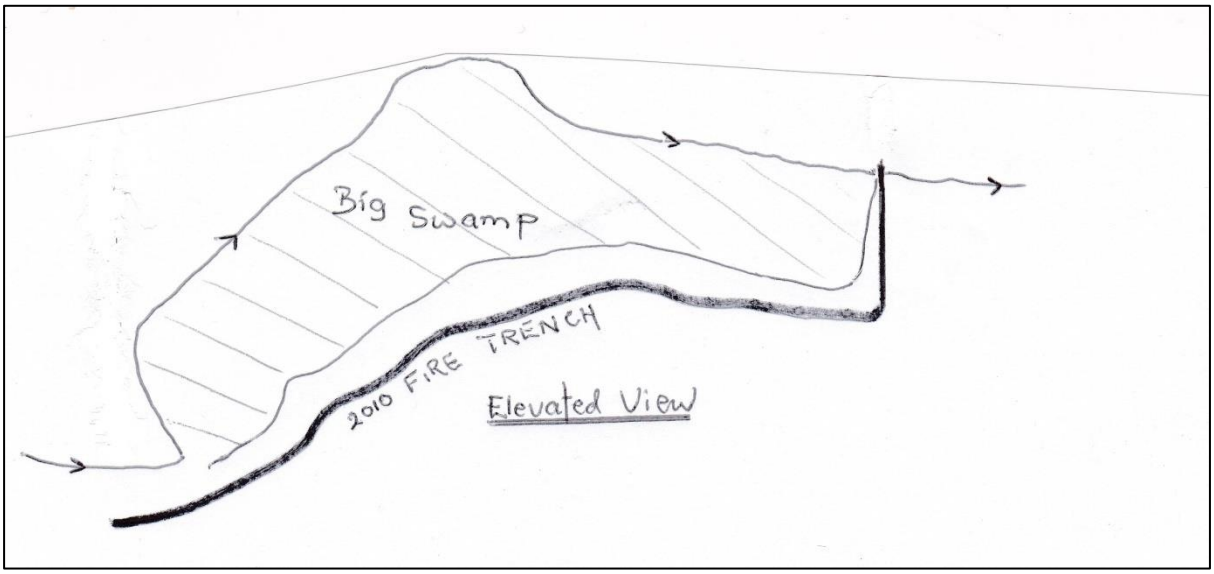
These pages of the Jacobs report deal with the recommended management strategy.

- It would be good to neutralise the acidity back to an "... ***environmental setting***...," but concentrating on the acidity levels excludes many of the additional problems created. The burnt peat and the extraordinary chemical changes brought about by this need to be considered. The heavy metals currently formed and continuing to be produced, require special consideration regarding their reaction to inundation. The mycorrhiza disruption that has taken place, a process critical to plant survival, needs to be studied as does the other stygofauna.

- Filling the fire trenches back to the Natural Surface Level (NSL) and then attempting to back fill these with water does not appear to take into consideration that the elevation rise from this NSL to the start of the Big Swamp Wetlands is at least 8m.

See page 44. ***There is considerable doubt that the 8 m rise is wrong.***





The southern fire trench has never had flowing water, only puddling after considerable rainfall events.

- One of the other problems with this option is the assumption that Boundary Creek flows actually dissipate across the Big Swamp from the west end. This is not normally the case unless there is considerable precipitation and Boundary Creek breaks its banks, with water that cannot be transported down the creek bed. This rarely happens. Boundary Creek flows around the Big Swamp Wetlands.
- Because Boundary Creek flows around the Big Swamp Wetlands, the flows recorded down stream at the Yeodene Stream Flow Gauging

Station (233228A), are not a true reflection of what is taking place in the Big Swamp Wetlands. Therefore most of the assertions, calculations and assumptions made at the top of page 57 would appear to be based on doubtful data.

- The statement "***The construction of fire trenches in Yeodene Swamp has altered the swamps drainage regime.***" Has to be looked at much more carefully. Historically there have been changes made to the water flowing out of the Big Swamp Wetlands into the Stewart property and from my understanding the construction of the fire trenches would have made little if any change to the drainage regime. This needs to be clarified by speaking to Neil Stewart. As at 12 December 2017 Neil has not been approached regarding the "Yeodene Swamp" report let alone been given a copy of the report outlining the options that will impact on his farming enterprise.
- The blocking of the recently constructed agricultural drain would return the NSL at the point of discharge into this drain which is presently acting as an outlet drain into Boundary Creek. However, without this drain functioning, in high flow periods the Big Swamp Wetlands will spill over into the secondary flow path of Boundary Creek that is marked as the "***Prior Path of Boundary Creek***" in Figure 5-6, page 58. This secondary flow path will then run through Stewart's revegetation block and farmland before returning to the main Boundary Creek flowpath.
- Neil Stewart the owner of the property downstream and to the east of the Big Swamp Wetlands, as stated earlier, has not be consulted or asked for any historical information regarding the drainage system, modifications or flow regimes through his property (pers. com).
- If it can be demonstrated that the fire trenches have made minimal change to the drainage regime out of the Big Swamp Wetlands why put in the NSL barrier? Why not just increase the Artificial Supplementary Flows to the 3 ML/day as recommended, and see whether this achieves what is being proposed. However, until the Lower Tertiary Aquifer potentiometric level is returned back to above the Big Swamp Wetlands this seems doubtful. Jacobs states that the LTA water table level is still 10-15 m below the area upstream of the Big Swamp Wetlands. Considering that the potentiometric level was approximately the same height above the Big Swamp Wetlands (10-15m) pre groundwater extraction this fact must surely impact upon the calculations, assumptions and assertions being made that are summarised as follows...

"***It is likely that returning Yeodene Swamp to similar conditions as those prior to 1999 would significantly increase the pH and decrease the concentration of dissolved metals both in the swamp, and from the swamp into Boundary Creek.***
A review of flows downstream of McDonalds Dam and Yeodene suggests that a discharge of 3 ML/day at McDonalds Dam may be sufficient to perennially inundate enough of Yeodene Swamp to have such an outcome. This effect could be further enhanced by blocking drainage lines formed during the excavation of fire trenches."

- If option 6 is adopted it is stated that "***Improvements in water quality are likely to take up to 6 months. Previous studies suggest that a return to such conditions could significantly improve water quality in Yeodene Swamp over a period of several months.***" A quote from the Australian film titled "The Castle" immediately springs to mind.

PAGE 60.
This page deals with the Conclusions and recommendations.
There are one of two points to consider.

1. "***The Boundary Creek catchment has experienced significant change including land clearing, construction of a dam, groundwater extraction, climate changes, and peat fires at Yeodene Swamp and the subsequent excavation of trenches to control fire. These changes have contributed to the drying of acid sulfate soils in Yeodene Swamp which has resulted in poor water quality (low pH, metalliferous water) as a result of borefield operation combined with reduced rainfall in the catchment.***"
   This last sentence is a little confusing as to what has caused the poor water quality. Has it been the 6 changes first mentioned, or the 2 described in the last sentence. i.e. borefield operation with reduced rainfall in the catchment.
   Putting the last sentence aside and dealing with the 6 changes first mentioned, the following chart has been prepared attempting to delineate the causes of poor water quality flowing down Reach 3 of Boundary Creek since 1990.

Change	Change Description	Data suggests impact.	Made the problem worse.
1	Land Use Change	No	No
2	Dam Construction	No	No
3	Groundwater Extraction	Yes	Yes
4	Climate Change	No	No
5	Peat Fires	Yes	Yes
6	Fire Trench Excavation	No	No

The only Land Use Change that could have had an impact on the water quality has been the possibility that the north/south drainage line that has recently been cleaned out in Stewarts property has lowered the Natural Surface level to a degree, allowing slightly more water in the lower end of the swamp to drain.
Since 1990 the dam construction has not been the problem with impact on water quality, but the manner in which water is released from this dam being of concern. Operated as required this would not have been a contributing factor.

2. To state that an improved understanding of the chemical characterisation of both Boundary Creek and Yeodene Swamp is an over simplification. It has taken Phil Hirst and Richard Bush months of work to try and untangle the intricacies of the chemical characterisation of samples from a six hole transect taken across a north south section of the wetlands. They are still working on the project. This is the basis of another argument that suggests the projected options are based on a very limited data base.
3. It is difficult to understand how this statement can be made with any certainty. "***The most severe acid sulfate soils (highest acidity) occurred in the central and lower lying areas of the swamp.***" As can be seen in Aerial Photograph 5 on page 15 much of the Big Swamp Wetlands has not been assessed.
4. Data clearly shows that if there was no groundwater extraction, Boundary Creek would have continued to flow and the Big Swamp Wetlands would have remained inundated.

CONCLUSION

Until a comprehensive evaluation of the Big Swamp Wetlands is undertaken a appropriate management remediation plan cannot be claimed. This should be done as a matter of highest priority so that those doing the remediation know exactly what they are dealing with.

In the mean time "***It is noted that even brief periods (less than1 week) of drying and flow cessation in Boundary Creek are likely to result in significant acidification historically, and as such, should be avoided.***" Not to mention the high levels of heavy metals also being released into the surface and groundwaters.

APPENDIX ONE.

Memo

Colac Otway SHIRE

To: All Councillors

From: Jack Green, General Manager Sustainable Planning and Development

Cc: Rob Small, Chief Executive Officer
Neil Allen, General Manager Infrastructure Services
Colin Hayman, General Manager Corporate and Community Services

Date: 27 September 2010

Subject: **Trench – Yeodene Peat Swamp**

Our Ref: Fire Prevention GEN00179 General

Councillors will recall an issue raised by Cr Geoff Higgins at the Councillor Worksop briefing session last Wednesday 22 September 2010.

Cr Higgins raised the issue that the trench, which had been cut along the edge of the peat fire area at Yeodene, was not filling with water as he believed was intended to avoid future fires.

I explained to Cr Higgins, at the time, that I did not believe that to be the intention of the trench as all involved parties understood that the absorbent nature of the peat meant that no matter how much water was added to the trench it would be virtually swallowed up by the peat. I also explained that this was the reason for the sprinkler solution being proposed so that it could be activated on high fire risk days to dampen down the area to avoid fire spreading and that the main problem with that was also how to store water in the area so that adequate water was available to supply the sprinkler system if it was installed.

I also undertook to get back to councillors with some further information on the trench and the purpose for which it was dug.

The following is a response to that question from the CFA:

"On 2 March, 2010 under the influence of a southerly wind and moderate/high FFDI the area known as "Jurassic Park" or Yeodene peat swamp once again broke out from the peat area and burnt an area of approximately 80 ha to the north of Boundary Creek before it was contained by combined CFA and DSE crews. Fire investigators concluded that this fire was ignited from residual fire still remaining in the "Jurassic Park" area of peat on Boundary Creek, which would appear to have been smouldering deep underground since 1997.

Part of the plan to secure the peat area to the south of Boundary Creek called for some burning out of mixed species native forest to the boundary of Swan's (south) and Stewart's (east) private farms and these operations were conducted jointly by CFA and DSE resources. As considerable area (approx 5 ha) of peat was now on fire, some which had burned previously in 1997/8, it was also decided to also construct an excavated trench through the peat area close to the boundary of Stewart's property to prevent the possibility of the peat fire continuing east along Boundary Creek and potentially to the West Barwon River through private farmland with significant further peat deposits downstream on Boundary Creek. Further investigation and observation indicated that there was still a significant area of peat that was not yet on fire on the Sing/Lim property (Jurassic Park) that could be isolated by trenching the southern edge of the burning area of peat to lessen the long term impact of residual fire in the area and lessen some environmental impact on the eco system in the peat bed. As a consequence a 1 km trench was dug east-west along the southern boundary of the burning area and connected to the trench on the eastern extremity of the peat area on the Sing/Lim property (Jurassic Park) interrupting the travel of fire across the peat bed to the south.

The trenches were excavated to a depth of between 1 – 3m deep over the entire length with a view of getting down to non organic soil types e.g. clay or mineral earth to prevent the spread of fire. The only area where this would appear not to have been achieved was in the eastern trench on Boundary Creek where excavation to 3m. depth was still showing signs of compacted organic material similar to the early stages of brown coal. It was decided to not go deeper due to the saturated nature of this layer and the possible serious instability of the trench itself without any shoring.

The important thing to note is that although some sections of the trench do hold water the original idea was to dig down deep enough to create a physical break in the peat layer in order to stop the fire spreading. It was not the original intention to fill the trench with water. This idea has been subsequently discussed but it was not considered to be a preferred management option. The sprinkler approach is currently considered to be the preferred management option but it needs a reliable water supply. The bore is the preferred option but this may not be ready for this fire season so other water supply options are being investigated."

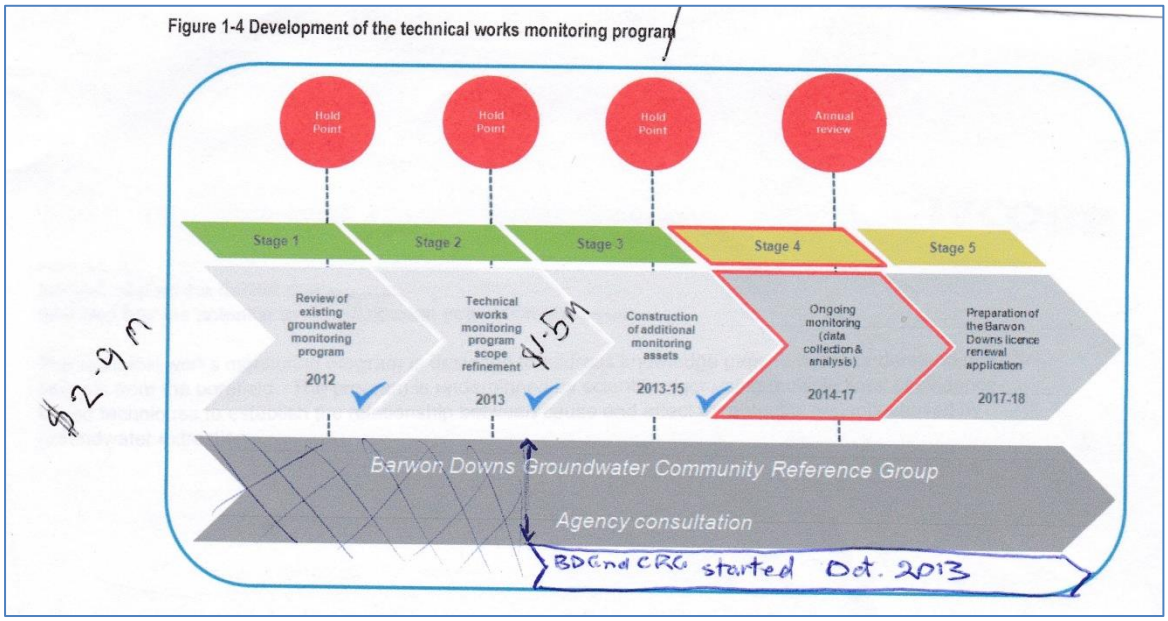
I hope that this information makes the issue a little clearer to Councillors and in particular answers the issues that have been raised by Cr Higgins in this instance.

If you have any further enquiries on this matter please give me a call.

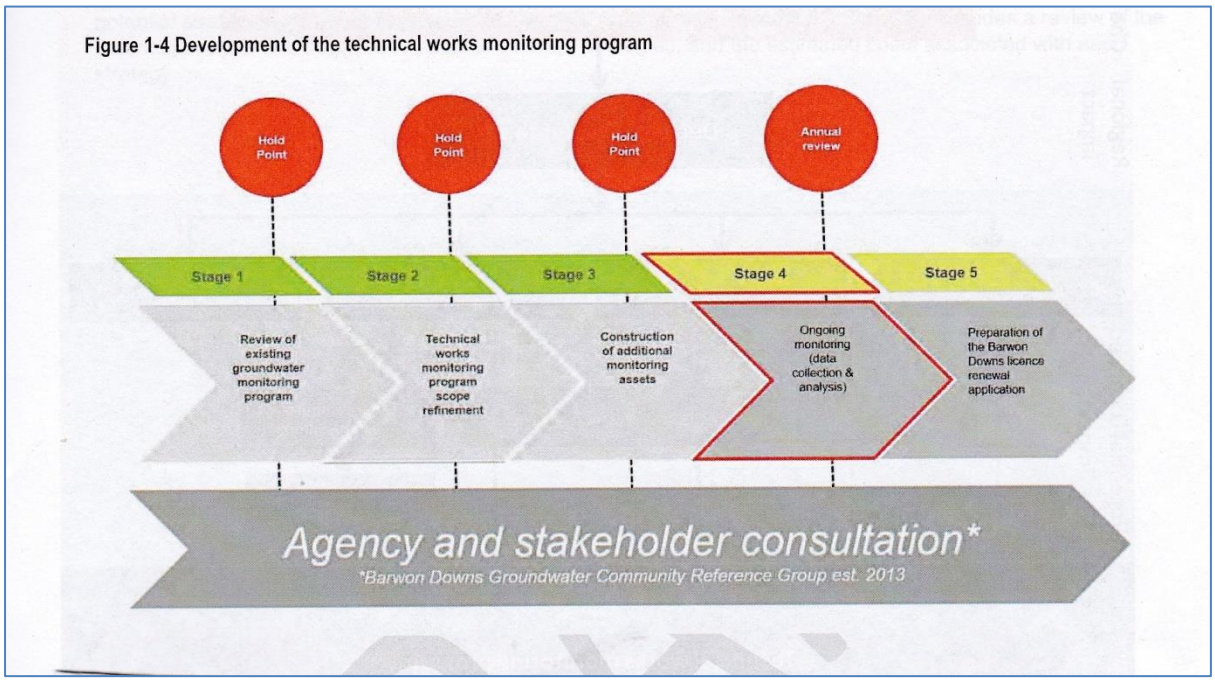
Regards

Jack Green
General Manager Sustainable Planning and Development

APPENDIX TWO.



Up to 9 November 2017 version used extensively.



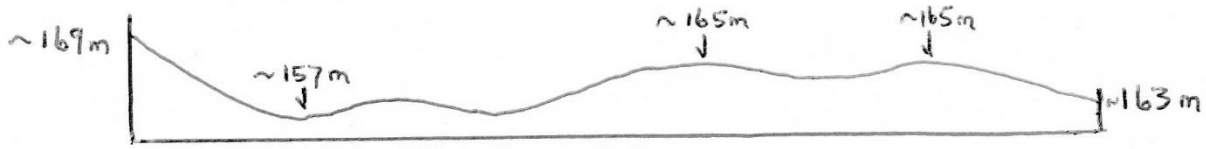
Modified 9 November 2017 version.

The Eight Metre rise over the length of the Big Swamp Wetlands.

When the six options for the remediation of the Big Swamp were being presented to the Barwon Downs Groundwater Community Reference Group meeting, it was stated by Jacobs staff that the elevation of the Big Swamp Wetlands from front to back was eight metres.

This was taken at face value and resulted in the sketches and comments found on pages **4** and **36**. However, after having thought that Book 42 was finished a colleague was showing me some aspects of Google Earth which lead to looking at the Big Swamp Wetlands elevation profile. Surprise. Whatever the accuracy of the AHD levels displayed on Google Earth, it was quite obvious that some considerable doubt should be placed upon a gradual eight metre elevation between the front and back ends of the swamp.

The sketch below is by no means 100% accurate but it is a close representation to the elevation profile found on Google Earth. The Big Swamp Wetlands has



many dips and rises further emphasising how little is known about the wetlands (see pages **13** – **15** for a list of unknowns.). In fact, what this topsy turvy profile suggests, as discussed on pages **8** and **9**, is that the Big Swamp contains quite varied and distinctly different vegetation and water dependent areas.

Part of the swampland is lower than both the entrance and exit of Boundary Creek to the area. Much is to be learnt before any form of successful remediation is possible.

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