A person wearing a wide-brimmed hat and a striped shirt is sitting on the grassy bank of a creek, holding a fishing rod. The water is shallow and clear, with some rocks visible. The background shows a dirt bank with some vegetation.

**OTWAY WATER
BOOK 27**

**Fish Studies and
Environmental Flows
Along Boundary Creek,
2015**



Stream Flow Gauging Station Number

233228 wier, 29 November 2014.

Disclaimer

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March 2015

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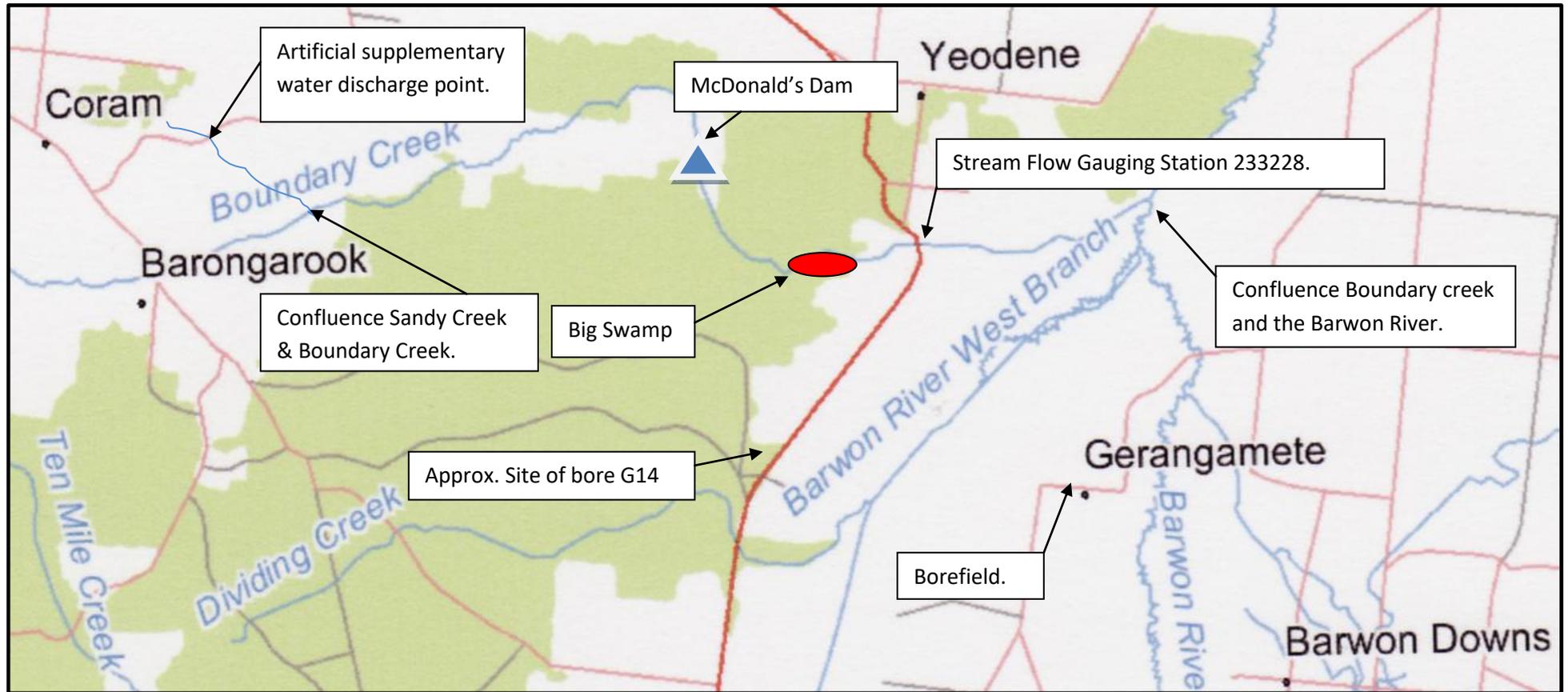


Introduction

Blackfish, platypus and spinyback crayfish used to abound, habiting the lower reach of Boundary Creek from the Barwon River up to the Big Swamp. Sadly, this is no longer the case. This section of the creek is now dry between four and six months of the year and only flows after heavy rainfall. Even when there is sufficient water the extremely low pH and heavy toxic metals being released from the Big Swamp ensure that the usual instream biota, as found in the Otway Ranges' streams, could not survive in this section of Boundary Creek.

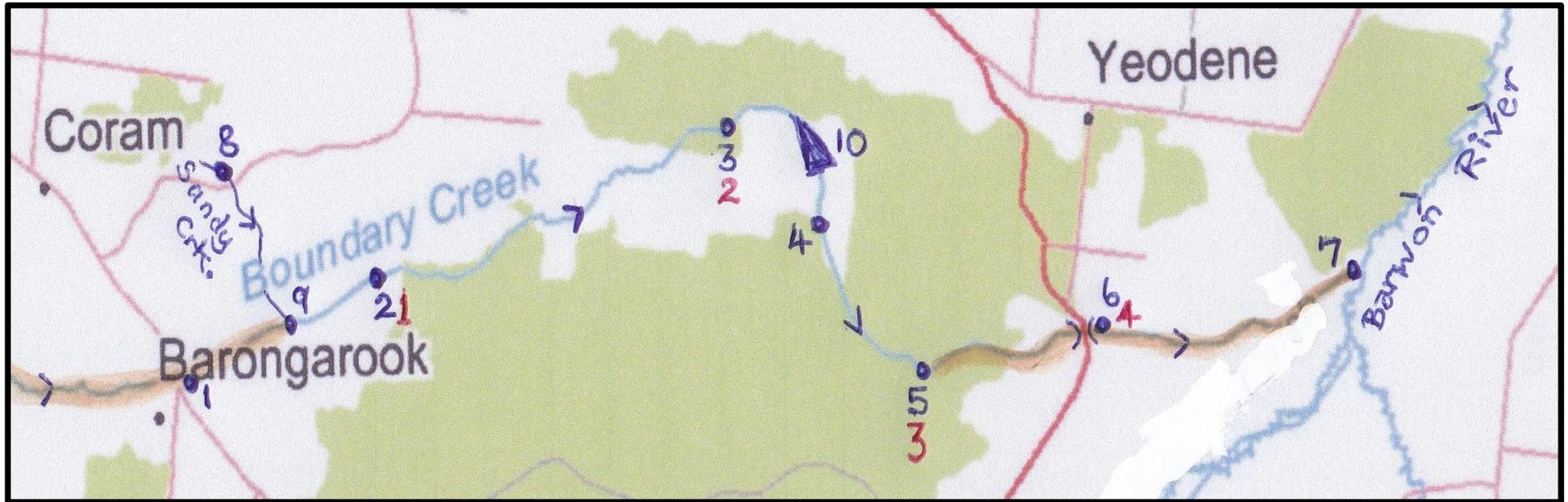
Otway Water Book 26 discusses aspects of the new monitoring programme Barwon Water is conducting in an attempt to have their groundwater extraction licence for the Barwon Downs Borefield renewed in 2019. This book, Otway Water Book 27, deals with another small part of this ongoing and sorry story about the way the waters of Boundary Creek are managed. It highlights a fact indicating that any genuine attempt to deal with the degradation taking place along Boundary Creek is still some considerable time off.





MAP ONE. Location Map – Boundary Creek.





MAP TWO

- A. Numbered sites **1, 2, 3, 4, 5 & 6** (marked in Blue) are the sites surveyed for fish in 1992, 1993 and 2001 (see Map Three, page 15).
- B. Sites **1, 2, 3 & 4** (marked in red) are the 2015 macro-invertebrate sites for Barwon Water's new monitoring program.
- C. Sites **2 & 3** (marked in red) are the sites for the new Barwon Water environmental flow investigations.
- D. Site **6/4** is the Stream Flow Gauging Station Number 233228.
- E. From site **7 to 6** is the reach that Llyod investigated in 2006 to determine environmental flows for Boundary Creek.
- F. Site **8** is the release point of the artificial supplementary flows out of the Otway to Colac Pipeline into Sandy Creek.
- G. Site **9** is the confluence of Sandy Creek and Boundary creek.
- H. Site **10** is McDonald's Dam. Since a change of ownership this dam is sometimes now called Buttigieg's Dam.



1912-1984

Boundary Creek, from sites **5 to 7**, was known as an all year round permanent flowing creek⁽¹²⁾.

1982-1983

The extraction of water from the Barwon Downs Borefield enabled the Greater City of Geelong to survive the 1982-83 drought.

1986

Quentin Farmar-Bowers wrote this... *“Currently water tables appear to be quite stable* (in the Boundary Creek region) *and there is little movement between seasons or years. (J.Leonard Pers. Com).”*⁽¹¹⁾

1986-1988

Barry Tunbridge of Arthur Rylah Institute was part funded by Barwon Water to conduct fish studies in the Barwon River catchment.⁽³⁶⁾ Tunbridge wrote that of all the tributaries of the Barwon River where he had conducted fish surveys, Boundary Creek was the only one that contained blackfish.⁽³⁶⁾⁽¹⁴⁾

1986-1990

The Barwon Downs Borefield stress test pump was conducted.

1992-1995

Saddler conducted three fish surveys for Barwon Water⁽²⁴⁾⁽²⁵⁾⁽²⁶⁾ as part of Barwon Water’s application for a licence to extract water from the Barwon Downs Borefield. Application successful 1995 – licence for 12 600ML/year (Stage One).



1997-1999

September '97 Barwon Water began extracting groundwater. October '97 it was recommended that the Permissible Annual Volume that could be extracted should be set at 4000 ML/year. Southern Rural Water officer states in 1999 that the Barwon Water extraction licence would be reviewed in light of the 40000 ML/year when the licence was up for renewal in 2001.⁽³⁴⁾

2000s Licence renewal Process for Stage Two begins

During the consultative process Nellie Shalley's assertion that blackfish had previously abounded in her family's reach of Boundary Creek (between Sites 6 & 7) was given no credence and ignored. No record of Nellie's assertions was recorded.

2001

Arthur Rylah Institute conducted a fish survey⁽²⁷⁾ for Barwon Water as part of the renewal process for the groundwater extraction licence. Application successful – 20 000ML/year granted in 2004.

2004

As part of the 2004 licence conditions Barwon Water had to supply 2ML/day of artificial supplementary water to Boundary Creek in the event that the flows at the Stream Flow Gauging Station, Number 233228, on the Colac/Forrest Road Bridge dropped below 1 ML/day. (This water is taken out of the Otway to Colac Pipeline.)

1984 – 2010

Between 1984 and 2010 Barwon Water extracted huge volumes of water from the Barwon Downs Borefield at Gerangamite. Over the last few years of the first decade of the 2000s drought, until the drought broke in late 2010, the average yearly extraction was over 11,000 megalitres (see Graph One). In 1997 the Permissible Annual Volume⁽¹⁷⁾ was set at 4,000 megalitres. In 2004 a 20,000 megalitres per year licence was granted to Barwon Water by Southern Rural Water⁽³³⁾.

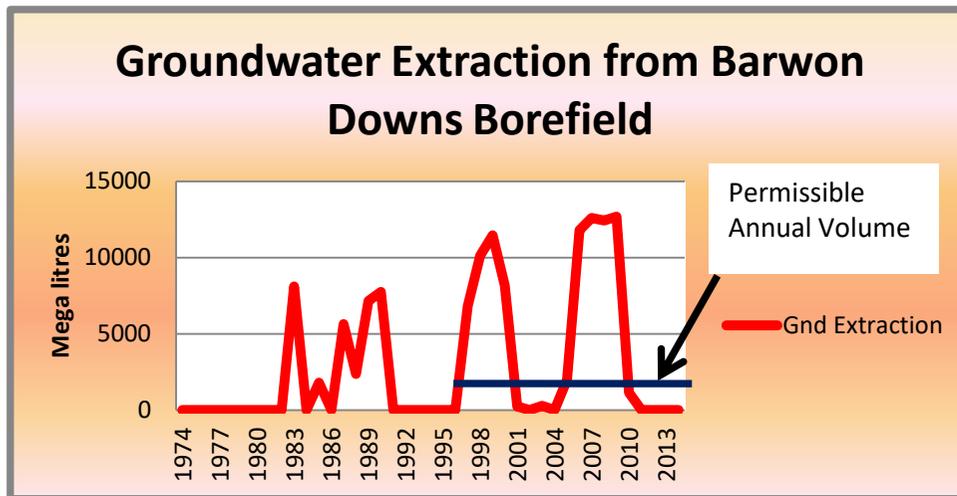


2012

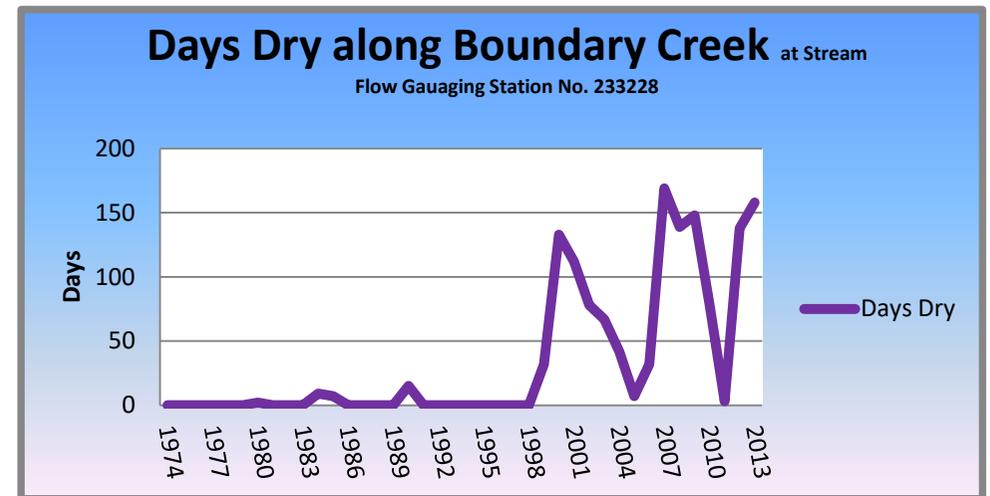
Barwon Water begins the preparation of its case for licence renewal in 2019, with the development and implementation of a new monitoring program. Part of this program involved an environmental flow component.

2013

As part of the implementation of Barwon Water's new monitoring program a Community Reference Group was set up in 2013.



Graph 1 . DATA SOURCE: Barwon Water



Graph 2. DATA SOURCE: Barwon water & Vic Water Data Warehouse.

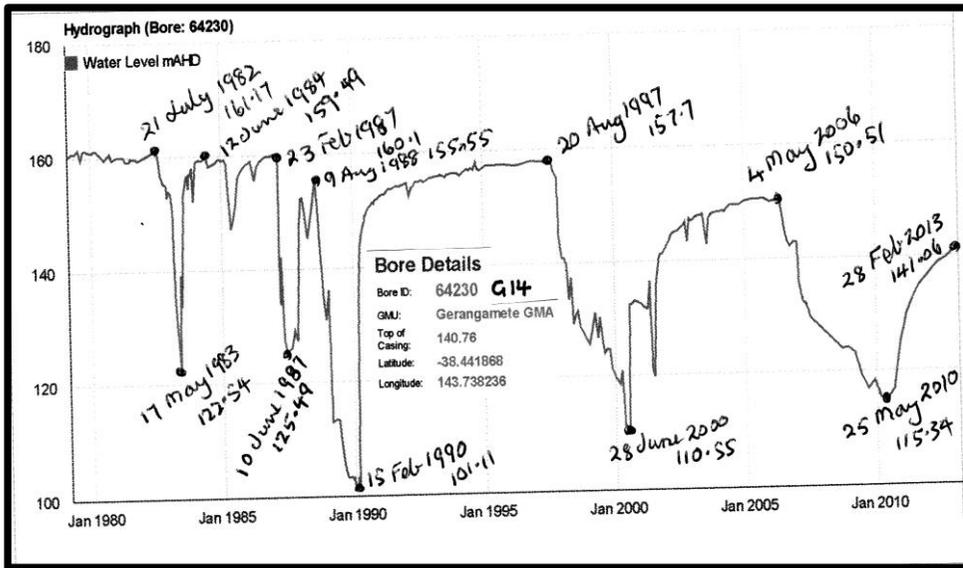
Since 1982 Barwon Water have extracted over 130 000 ML of groundwater from the Barwon Downs Borefield. Graph One depicts this. The Borefield was taken off line in August 2010 after one of the worst droughts on record. The Permissible Annual Volume (PAV) was set at 4 000 ML/year and later the PAV was changed to a Permissible Consumptive Volume allowing the extractions to be averaged out over a number of years, with disastrous results along Boundary Creek.⁽¹⁸⁾

Graph Two indicates a connection between the extraction periods and those days Boundary Creek has ceased to flow.

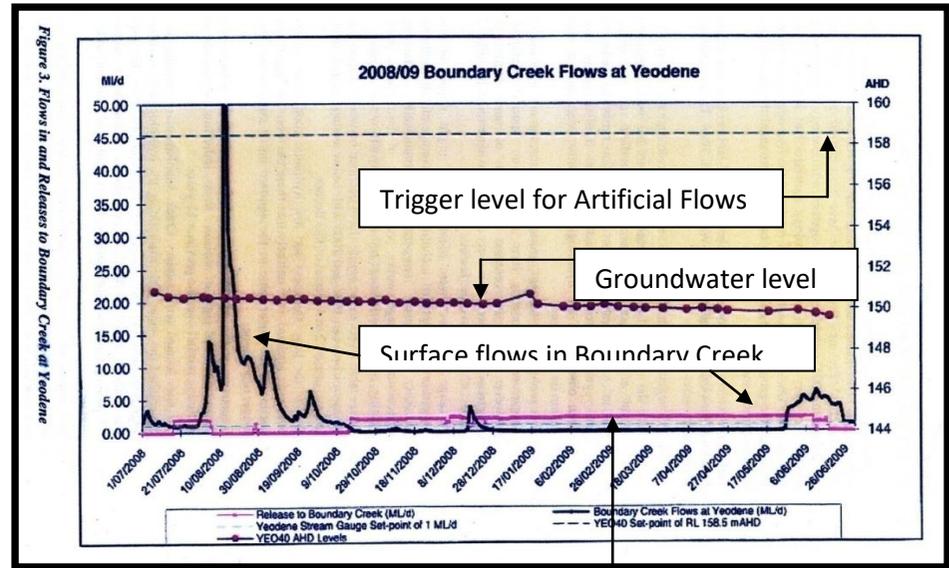


1. As the amount of extraction increases so do those days of no flow.
2. There is a time lag between the extractions and days dry. Research has found that groundwater extraction impact on surface streams can range from immediate to decades after extraction ceases.⁽¹⁰⁾

Observation bores across the region of the Barwon Downs Borefield sphere of influence display a similar pattern.⁽¹⁶⁾ Graph Three shows a typical hydrograph from one of these bores (see page 4 for approximate location of this bore.)



Graph 3. SOURCE: Southern Rural Water. (Bore 64230 also known as G14.)



Graph 4. SOURCE: Barwon Water

The Graph Three hydrograph shows a drawdown of approximately 60 metres at one stage with recovery periods following each cessation of pumping. A time lag following the commencement of groundwater extraction is evident in the no flows recorded in Boundary Creek similar to the time lag as seen in the observation bores.



Graph Four depicts a very similar set of data as seen in every Barwon Downs Borefield annual report between 2004-2013.

1. The Yeo 40 Observation Bore level of 158.5 mAHD triggering the release of the artificial flows has been exceeded. Under natural conditions the groundwater level in Yeo 40 used to be in the low 160s mAHD range. It was calculated that dropping below the 158 m level would seriously impact on Boundary Creek.⁽¹⁾
2. The groundwater level in Yeo 40 now hovers around the 150 mAH mark, way below the trigger level.
3. For much of the recorded period the surface water flow drops below the 1 ML/day recorded at the 233228 Stream Flow Gauging Station. This low surface flow with the low groundwater levels experienced in Yeo 40, triggers a licence condition requiring a 2ML/day release of artificial supplementary flows from the Otway to Colac Pipeline. However, the water disappears into the Big Swamp.
4. The artificial supplementary flow release (pink line) of 2 ML/day does not reach the 233228 Stream Flow Gauging Station as a surface flow. The surface flow disappears into the Big Swamp during summer dry periods.
5. The surface flow at the 233228 Stream Flow Gauging Station is zero for much of the year. The gauging station is downstream of the Big Swamp.

2004 Licence Conditions & Boundary Creek Flows.

Licence conditions regarding flows in Boundary Creek were placed on the extraction of groundwater from the Barwon Downs Borefield. It was determined that flows in Boundary Creek would cease if the water table in observation Bore Yeo 40 was lowered below the 158 m/AHD level. As a result a half metre tolerance was adopted and the trigger was set at 158.5 m/AHD. In the event that the trigger level was breached and the passing flows at the Stream Flow Gauging Station Number 233228 dropped below 1 ML/day, Barwon Water had to provide a 2 ML/day supplementary supply of water for Boundary Creek until the flow at the stream flow gauging station return to at least a 1 ML/day flow. Unfortunately the artificial supplementary flows disappear into the groundwater depleted Big Swamp long before they reach the stream flow gauging station. The Big Swamp lies at a level below the 158.5 m/AHD mark.



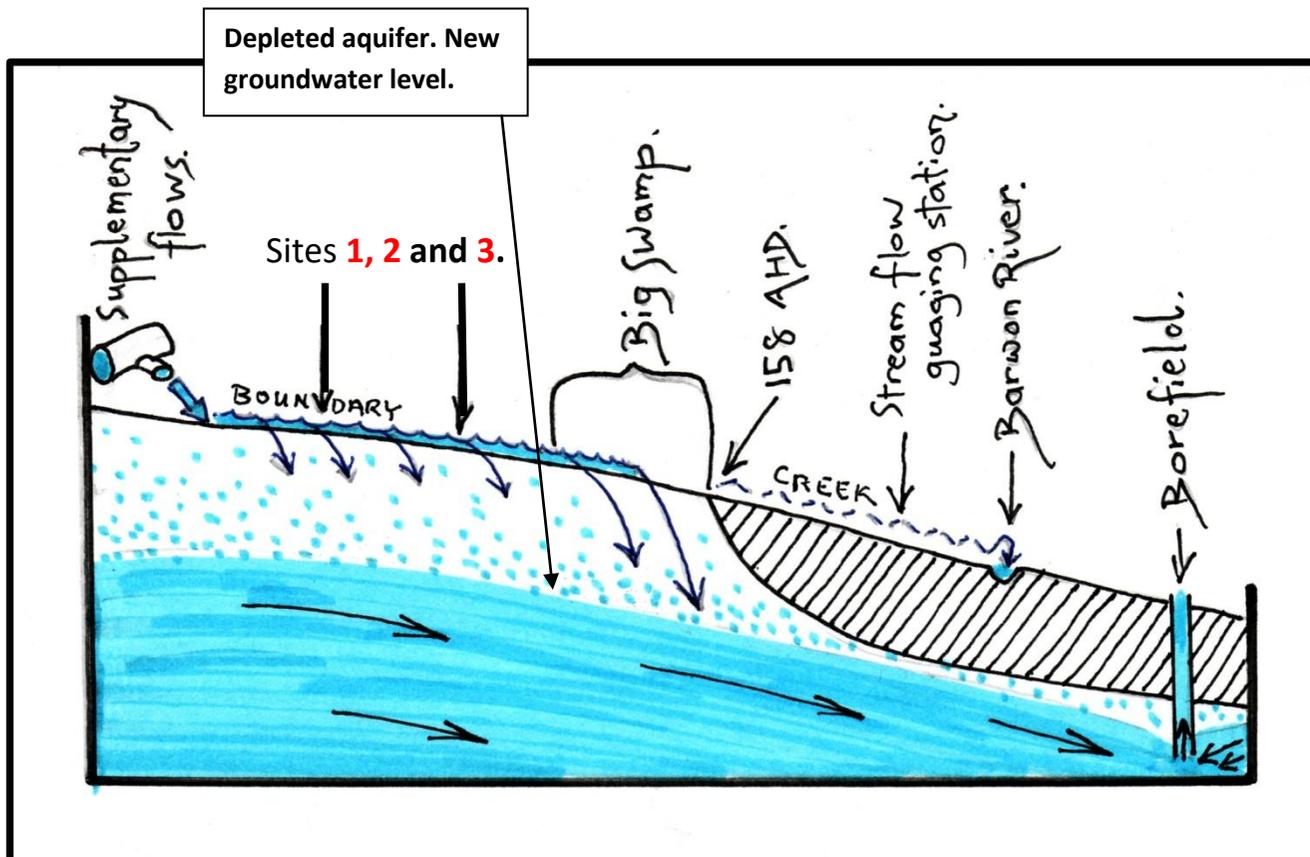


DIAGRAM ONE: Representation of direction of flow of the artificial supplementary flows.

This diagram represents the releasing of the artificial supplementary flows that travel down Boundary Creek and then disappear into the Big Swamp long before reaching the Stream Flow Gauging Station Number 233228. The Big Swamp's altitude is in the order of 154 mAHD and as Graph 4 indicates the groundwater table level is in the region of 150 mAHD. The only time that Boundary Creek now flows past the Stream flow Gauging Station is during significant rainfall events or periods of sustained rainfall.



BARWON WATER'S NEW MONITORING PROGRAM

Barwon Water is preparing its case for licence renewal in 2019 for the Barwon Downs Borefield. Part of the new monitoring program, the results of which are to be used to justify renewal, includes:

1. environmental flows for Boundary Creek (approximate cost \$55 000),
- and 2. Macro-invertebrate surveys along the creek (approximately \$8 700).

The environmental flows sites are marked on Map Two as **2 & 3**. The environmental flows that Lloyd developed in 2006⁽⁷⁾ have been cited by SKM/Jacobs as unrepresentative and will only be used as a reference by SKM/Jacobs.⁽³⁰⁾⁽³¹⁾ **“Assessment site not representative of high value reach and is too far downstream.”**⁽³⁰⁾ Conducting the environmental flows work in the section of Boundary Creek impacted from the artificial supplementary flows does not appear to any more representative than Lloyd's. It is curious why all reaches of Boundary Creek are not being investigated.

Lloyd's work for the Corangamite Catchment Management Authority, was conducted in the Boundary Creek reach between points **6/4 to 7**, Map Two. Lloyd's determination for an environmental flow includes two fortnightly periods of NO FLOW,⁽⁷⁾ supposedly to support the existence of large fish such as Blackfish. Platypus and Blackfish do not survive in a dry creek bed that naturally used to flow at an average rate of 3.2 ML/day during summer months.



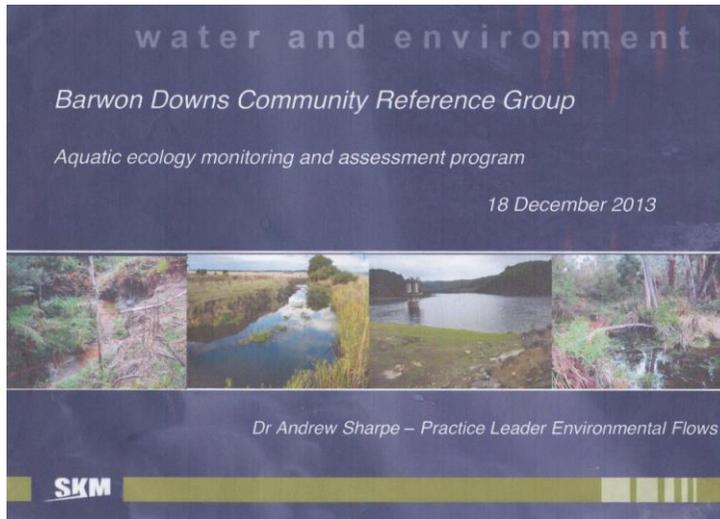
Both the Lyoyd and current Jacobs study wrongly claim to follow the FLOWS procedure and Jacobs also claim erroneously that this is the best method for determining a minimum environmental flow for Boundary Creek.⁽⁴²⁾

The Jacob's macro-invertebrate sites **1, 2, & 3**, Map Two, are also to be conducted in reaches that are impacted by the artificial supplementary flows. The reaches in Boundary Creek above and below the artificial supplementary flows impact are not included in the environmental flow investigations and site **4** of the macro-invertebrate surveying is the only site not impacted by the artificial supplementary flows.



Photograph of the artificial supplementary flows from the Otway to Colac Pipeline.

Part of the new monitoring program.

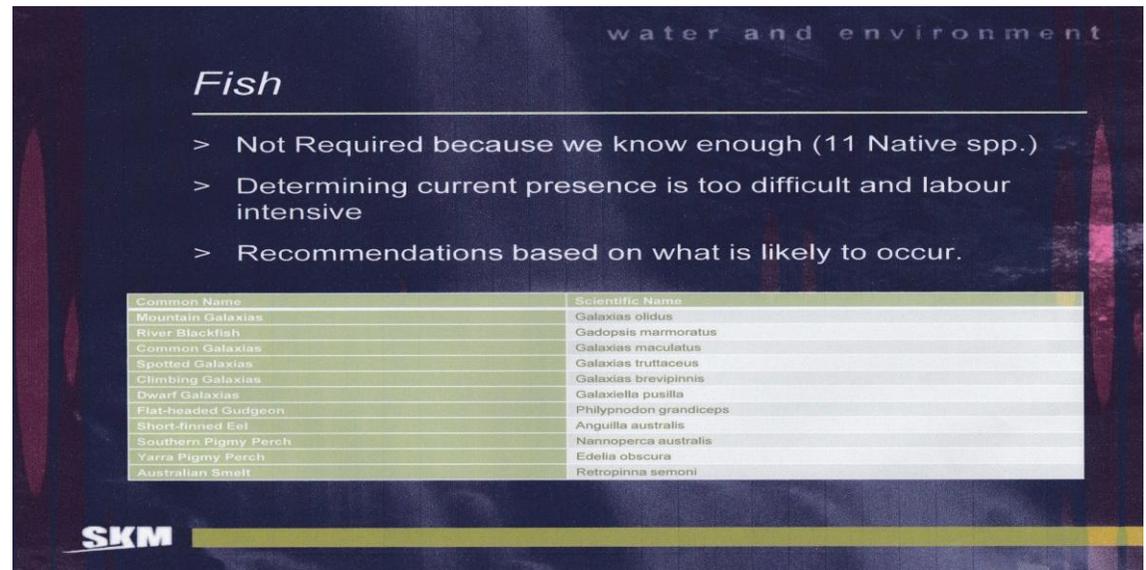


The “Fish” statement below,⁽³⁰⁾ is most baffling when considering one and a half million dollars is being spent on the new monitoring program for the Barwon Downs Borefield, and a fish study is not being included. Not carrying out a fish survey because it “...*is too difficult and labour intensive*” is quite strange as the sites being investigated are easily accessible, with only a maximum flow of 2 ML/day released during the dry summer months. The cost would be minimal and take no longer than a day for each sampling effort. Because the creek reaches upstream and downstream of the artificial flows are dry in the summer months, little would be achieved “fishing” these reaches.

Also, to state that a fish study is not required because enough is known of 11 native species is a totally misleading statement. This statement gives the impression that there are 11 native species known to exist in the Boundary Creek Catchment. This is most definitely not the case.

FISH SPECIES FOUND ALONG BOUNDARY CREEK.

Tarmo Raadik of the Arthur Rylah Institute provided a list of fish species found along



Boundary Creek. This list was current as February 2015. Only four native freshwater fish species have ever been recorded in Boundary Creek.

1. **River Blackfish** (*Gadopsis marmoratus*). Recorded by Tunbridge in 1986.⁽³⁶⁾ None have been recorded since 1986.
2. **Mountain Galaxias** (*Galaxias olidus*). Recorded by Sadlier on three occasions between May 1992 and June 1993,⁽²⁴⁾⁽²⁵⁾⁽²⁶⁾ AND by the Freshwater Ecology Section of the Arthur Rylah Institute in December 2001.⁽²⁷⁾
3. **Southern Pigmy Perch** (*Nannoperca australis*). Recorded by Sadlier on three occasions between May 1992 and June 1993,⁽²⁴⁾⁽²⁵⁾⁽²⁶⁾ AND by the Freshwater Ecology Section of the Arthur Rylah Institute in December 2001.⁽²⁷⁾
4. **Short Finned Eel** (*Anguilla australis*). Recorded by Sadlier on three occasions between May 1992 and June 1993,⁽²⁴⁾⁽²⁵⁾⁽²⁶⁾ AND by the Freshwater Ecology Section of the Arthur Rylah Institute in December 2001.⁽²⁷⁾

In a 2014 research document Tarmo Raadik determined that the fish species described as *Galaxias olidus* recorded in the Barwon River Catchment system, is in fact *Galaxias ornatus*.⁽²⁸⁾ Future reference to any *Galaxias* found in the Barwon River Catchment needs to keep this piece of research in mind.

LAWROC Landcare Group has been given a quote for electrofishing at a daily rate of \$3000. The 2001 fish study conducted by Arthur Rylah Institute was a one off effort and on that basis a follow up study should not be too costly, difficult or labour intensive to conduct. However, Barwon Water has made the decision not to conduct a fish survey.

1992-2001 Fish Studies.

The next four pages (15, 16, 17, 18) have been taken from the Freshwater Ecology Section of the Arthur Rylah Institute's report prepared for Barwon Water in 2001.⁽²⁶⁾ Up until February 2015 Barwon Water acknowledged only 3 native fish



species to habitat Boundary Creek. Barry Tunbridge's finding regarding Blackfish discovered in Boundary Creek in 1986 has never been included in any of Barwon Water fish studies, studies that have been presented as supporting argument for licence renewal applications.

Map 1. Location of the study sites .



Map produced by C. Howie, Strategic Planning, Barwon Region Water Authority Ref. sur/10733/9-4037.dgn



Study sites

All sites were located on Boundary Creek, a small tributary of the Barwon River, situated approximately 10 km south east of Colac in southern Victoria. Sites extended from Barongarook (approximately 5 km from the origin of Boundary Creek), downstream to Yeodene, covering a distance of around 11 river km. Location details of all sites, including grid reference and altitude is presented in table 1. Location of all sites is also presented in map form in Map 1.

Table 1. Location and altitude information of each site surveyed on Boundary Creek during May 1992, October 1992, June 1993 and October-December 2001.

| Site number | Map no. | Grid reference | Altitude (m) |
|-------------|---------|----------------|--------------|
| 1 | 7621 | 277/440 | 220 |
| 2 | 7621 | 295/447 | 197 |
| 3 | 7621 | 333/457 | 165 |
| 4 | 7621 | 341/451 | 159 |
| 5 | 7621 | 345/438 | 154 |
| 6 | 7621 | 365/437 | 138 |



Results

A total of four fish species were captured from the six sites surveyed. These included three indigenous species, the most common of which was the Mountain galaxias *Galaxias olidus* (captured from five of the six sites surveyed), Short-finned eel *Anguilla australis* and Southern pigmy perch *Nannoperca australis* (both of which were captured from two sites). The introduced Redfin (English perch) *Perca fluviatilis* was also captured from two sites. At each site, decapod crustacea were also recorded. A complete species list is presented in table 2.

Table 2. List of species (including common and scientific names of fish and decapod crustacea) captured from Boundary Creek during October-December 2001.

| Scientific name | Common name |
|--------------------------------|----------------------|
| INDIGENOUS FISH SPECIES | |
| <i>Anguilla australis</i> | Short-finned eel |
| <i>Galaxias olidus</i> | Mountain galaxias |
| <i>Nannoperca australis</i> | Southern pigmy perch |
| INDIGENOUS CRUSTACEA | |
| <i>Engaeus sp.</i> | Land yabbie |
| <i>Paratya australiensis</i> | Freshwater shrimp |
| INTRODUCED FISH SPECIES | |
| <i>Perca fluviatilis</i> | Redfin |



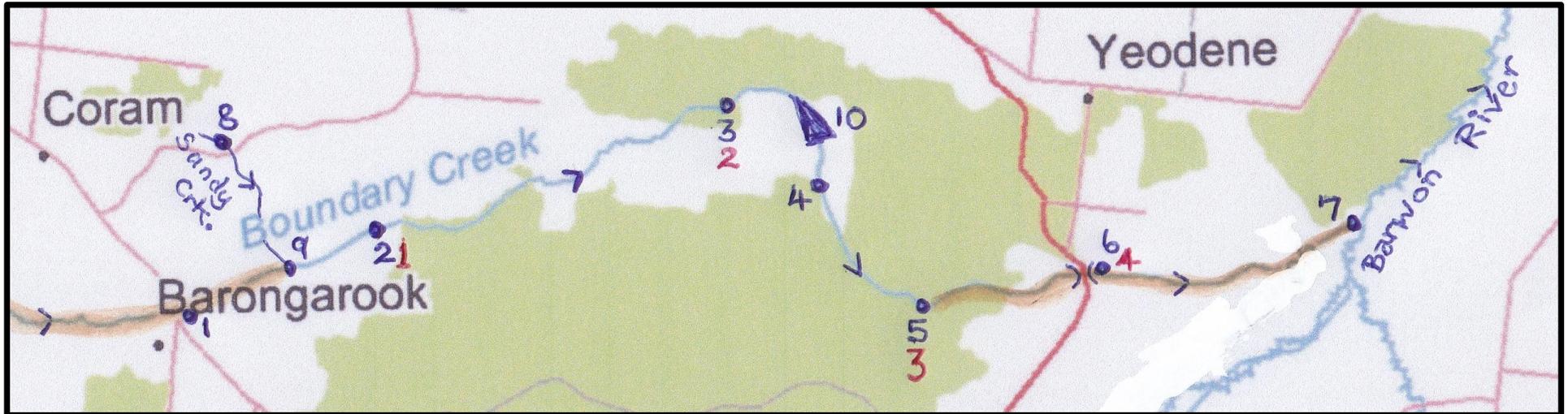
Table 3. Summary of fish species captured from sites 1-6 in Boundary Creek on four sampling occasions from May 1992 to December 2001.

| Site | Species captured | Sampling date | | | |
|------|-----------------------|---------------|----------|-----------|---------------|
| | | May 1992 | Oct 1992 | June 1993 | Oct /Dec 2001 |
| 1 | Anguilla australis | | 2 | | 1 |
| | Galaxias olidus | 14 | 19 | 51 | 2 |
| | Nannoperca australis | 6 | 1 | 46 | 16 |
| | Engaeus sp. | 6 | ~70 | 5 | 30 |
| 2 | Galaxias olidus | 49 | 21 | 98 | 12 |
| | Nannoperca australis | 10 | | | |
| | Engaeus sp. | 4 | ~35 | 9 | 25 |
| 3 | Galaxias olidus | 48 | 10 | 90 | 36 |
| | Nannoperca australis | | | | 20 |
| | Engaeus sp. | 1 | | | 8 |
| | Paratya australiensis | ~50 | | | |
| 4 | Anguilla australis | 1 | 5 | 1 | 8 |
| | Galaxias olidus | 1 | | 91 | 12 |
| | Perca fluviatilis | 1 | 9 | 4 | 49 |
| | Paratya australiensis | ~50 | | | |
| 5 | Anguilla australis | 1 | 1 | | |
| | Galaxias olidus | 3 | 1 | 42 | 1 |
| | Perca fluviatilis | | | | 1 |
| | Engaeus sp. | | 17 | | 29 |
| 6 | Anguilla australis | 1 | 2 | | |
| | Galaxias olidus | | 1 | 58 | |
| | Engaeus sp. | 3 | 14 | | 1 |

By 1992 Blackfish had disappeared from Boundary Creek. Of note is the fact that Barwon Water part funded the study that found Blackfish in the lower reaches of Boundary Creek in 1986.



In Summary



Map Four

Boundary Creek can be broken up into four reaches.

1. Reach One. This section is upstream from Point 9, Map Four.

Historically this reach would have no flows during summer unless there were summer rains. Some springs, soaks and creek pools would survive through a normal summer.

2. Reach Two. From Point 9 to 10.

Since the artificial supplementary flows this reach maintains a consistent flow throughout the year. Pre these artificial flows this reach was similar in characteristics to Reach One with the possibility of a small contribution from overflow discharge out of the Eastern View Aquifer Formation.

3. Reach Three. From 10 to 5.

In 2004 an agreement reached between Southern Rural Water and Michael McDonald, the owner of McDonalds Dam, was that during the summer months whatever flowed into McDonald's Dam had to be released as passing



flows. Throughout the 2000s drought to 2010 the water always reached point 5. However, for some unaccounted reason after the drought had broken and the extraction was temporally suspended, the flows began to disappear approximately 800 metres upstream of point 5.

4. Reach Four. From 5 to 7, Map Four.

From point 5 the artificial supplementary flows decrease and cease within the boundaries of the Big Swamp during the drier periods of the year. This can be up to four months or more at a time.

Since 1912 up to the explorative 1970s and urban water groundwater extractions, Boundary Creek from point 5 was a perennial creek and the Big Swamp was continually inundated from discharge out of the Eastern View Aquifer Formation. Farmers in this reach of the creek had a continual and reliable source of surface water. Over time this situation deteriorated to such a degree that this reach of Boundary Creek, when flowing, often contains water with acid levels down as far as 1.5 pH with toxic heavy metals and metalloids from the groundwater depleted Big Swamp.

Fish studies have been conducted in all reaches of Boundary Creek with only four native species being recorded. The *Galaxias olidus* has since been renamed, *Galaxias ornatus*.

At the Barwon Water Community Reference Group meeting in Feb. 2015 it was finally acknowledged that Blackfish had also frequented Boundary Creek. Flat headed gudgeon were also stated as habituating Boundary Creek. No fish study has been found to support this assertion.

A LAWROC Landcare fish study⁽³⁷⁾ of Boundary Creek along Reach Four in 2013, confirmed the Group and local landholders' fears, that Blackfish could not survive in this section of the creek. This reach was where Tunbridge recorded blackfish in 1986.⁽³⁶⁾

The new monitoring program being implemented by Barwon Water does not include fish surveying of Boundary Creek because SKM/Jacobs hold the belief "***Determining current presence is too difficult and labour intensive.***"⁽³⁰⁾ Having spent



hours in the Boundary Creek area and having observed fish survey work being conducted on numerous occasions along reaches of the Gellibrand River Catchment, I would find it extremely difficult to support this statement. It is further bewildering to note that part of the new monitoring program being implemented by Barwon Water is “...*to provide suitable habitat and flow conditions for the native fish that have previously been recorded or that could potentially occur in the catchment.*”⁽³⁾ and yet the relatively simple task of surveying fish in Boundary Creek is not being done.

Three of the four macro-invertebrate study sites are being conducted in reaches of Boundary Creek being maintained in a relatively pristine state by the artificial supplementary flows. In all probability this reach will be found to support a healthy and abundant macro-invertebrate population. This does not necessarily mean that fish species still inhabit this reach or any reach of the creek. From the early 1980s Boundary Creek had numerous days of no flow in all reaches during summer periods. Supplementary flows were not released into the creek until after the issuing of the 2004 groundwater extraction licence Stage Two. Verification that fish species still exist in any reach of Boundary Creek seems an important objective that should be included in the new monitoring program.

How an environmental flow can be determined for Boundary Creek without studying all reaches of the stream is quite astounding and especially so when the two study sites are located within the impact area from the artificial supplementary flows. If the 2006 work of Lloyd was indeed unrepresentative then the same argument has to be applied to the way SKM/Jacobs plans to use parts of the FLOWS method for the two sites along Boundary Creek and then credit it as a FLOWS method study.

If the environmental flow is to be determined using the FLOWS method then the Boundary Creek Catchment system as a whole, should be included. “... *decide on the reaches and sites for the Environmental water requirements as they provide a representative basis for determination of Environmental water requirements for the system.*”⁽³⁹⁾ (FLOWS Manual)

The SKM/Jacobs study must look at the Boundary Creek **system** as a whole with reaches to include sites that will provide an overall **representation** of the system. Including the reaches above and below the artificial supplementary flows is most important. These additional sites would provide a true representation of the present conditions.



The FLOWS method also states that...*“Flow recommendations should be framed for individual reaches...”* and *“Overall there is recognition that the health of aquatic ecosystems will be maintained by aiming to restore the fundamentals of the natural flow regime.”*⁽³⁹⁾ It is difficult to see how the present method of releasing artificial supplementary flows fits into a natural flow regime. Barwon Water is adamant that no move will be undertaken to turn off these artificial supplementary flows until the licence is reviewed in 2019.

An aim when applying the FLOWS methodology is to restore and or sustain an ecologically healthy river. *“This means that during the process of developing objectives, consideration must be given to identifying and restoring where necessary the environmental assets which would support a healthy river rather than maintaining of current condition.”*⁽³⁹⁾ Studying one reach in isolation will never achieve this.

Other significant parts of the FLOWS method are also being ignored.⁽⁴²⁾ By not following the prescribed method any environmental flow study determination cannot claim to be a FLOWS method study. And, *“The FLOWS method was developed to provide a consistent statewide approach for assessing the flow requirements of environmental assets associated with waterways.”*⁽³⁹⁾ Any environmental flow levels determined by the new monitoring program being implemented by Barwon Water will slip back into the inconsistent category.

An example of this inconsistency applicable to the present study is the attempt to determine a minimum environmental flow. SKM/Jacobs on numerous occasions states⁽³⁹⁾ that the FLOWS method is being adopted to determine minimum environmental flows.

“...recommended that a new FLOWS study be conducted to determine the minimum flows that are required to maintain aquatic habitat and aquatic biota in Boundary Creek.”⁽³⁾

However, the FLOWS method manual⁽³⁹⁾ emphasises many times it is not designed for determining minimum environmental flows but rather a much broader environmental flow regime.



The FLOWS method manual states...*“The method developed is called the FLOWS method and is based around the philosophy of describing flow components as part of a recommendation for an environmental flow regime, rather than a minimum flow recommendation.”*⁽³⁹⁾

Final Word on the FLOWS method.

If the methodology as outlined in the FLOWS method was strictly followed when dealing with Boundary Creek, any concern voiced from stakeholders regarding this study, would be adequately addressed. Community, stakeholder involvement in a FLOWS method study is one of its strong points. How this is achieved is also very specifically outlined in the method. The status of fish is one such community concern that is not being dealt with as prescribed. Another concern closely associated with fish health is the health of Boundary Creek as a whole ecosystem, not just that region being supported by artificial supplementary flows.

The definition adopted by the FLOWS METHOD as an environmentally healthy river is: *“A river which retains the major ecological features and functioning of a river prior to European settlement and which would be able to sustain these characteristics into the future.”*⁽³⁹⁾ The Boundary Creek system must be dealt with in its entirety and if the present environmental flow study being implemented by Barwon Water is to claim that the FLOWS method is being adopted then the method must be strictly adhered to.

In response to a question during discussion at the February 2015 meeting of the Barwon Water Groundwater Community Reference Group, it was stated that the Community Reference Group was also acting as the FLOWS method Project Advisory Group. This was the first I had heard of such a thing and having attended all meetings of the Community Reference Group, this was of some surprise. This was most definitely not a role of the Community Reference Group when set up. And, if a change of roles and responsibilities were to be undertaken then the Group should have been informed. The environmental flows component of the new monitoring program was muted way back in 2012 and if following the FLOWS method, this is when the Project Advisory Group should have been formed, not three years later.



CONCLUSION

Since the start of pumping from the Barwon Downs Borefield in 1982 there have been numerous days when Boundary Creek has failed to flow. Until the releases of artificial supplementary flows in 2004 fish species would have had to survive in any pools that made it through these dry creek bed periods. Also, during this period any remnant fish populations would have had to deal with high acid and heavy metal levels being released from the Big Swamp. The likelihood of any fish surviving seems most unlikely. However, a Barwon Water 2014 scoping report indicated that there were 11 native species known to habitat Boundary Creek. Or at least that was the impression given, “... *we know enough (11 Native spp).*”

In 2015 Barwon Water finally acknowledged that Blackfish, at some stage, had been found in Boundary Creek. Flat headed gudgeon was also added to the list at this time, making it 13 native species. However, extensive research could only find four native species of fish having been found in Boundary Creek.

Conducting work determining which species have survived to this day has been ruled out as, “*Determining current presence* (of fish) *is too difficult and labour intensive.*” Considering there is only a small section of the creek that now flows all year conducting a fish survey is neither difficult nor labour intensive. Also, preparing an environmental flow regime for fish that may or may not be present, using dubious methodology, is not sound scientific practice.

Taking into account the short length, narrow breadth and moderate flows in Boundary Creek, the entire length of the creek should be included in the environmental flow study. This work should encompass fish surveys and strictly follow the FLOWS Method manual if findings and recommendations are to be taken seriously.



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