Jennifer Bellinger
[redacted]

02/09/2020

To the Secretary
Legislative Council Select Committee – TWT
Legislative Council
Parliament House
Hobart 7000

twt@parliament.tas.gov.au

Dear Honourable

Tania Rattray MLC

Sarah Lovett MLC

Ivan Dean MLC

Robert Armstrong MLC

I am writing to you, that my documentation being sent via mail, be considered by the Committee for inclusion into the enquiry into TasWater.

I note that previously back in 2018, Major Howard had also asked for an enquiry.

In December 2019, a petition to call for an enquiry was submitted to the Honourable Tania Rattray MLC from the township of Pioneer and etal. The petition together with my correspondence to various entities over the years and photos, together with a copy of PJ Harvey, HK Handley, MP Taylor Research Article regarding '*Identification of the sources of metal (lead) contamination in drinking water in north-east Tasmania using lead isotopic compositions*'.

In December 2019, Dorset Council voted that a treated water system be delivered to Pioneer. TasWater have said this will take three years to complete. Our faith in this time line is little as the tank system took well over five years. Why can't the treated water system be sooner?

At the moment NO ONE has surety of water. Some houses have lead in their plastic tanks even with newly replaced rooves. Others should never have had plastic tanks connected due to their old and failing rooves.

We, felt that the Health Department were at all times in contact with TasWater? Apparently not.

Thank you for considering my submission to the enquiry into TasWater.

Yours faithfully,

Jennifer Bellinger

PETITION

To the Honourable the President and Members of the Legislative Council, in Parliament assembled.

The Petition of the undersigned

- Residents of the Municipality of Dorset and the Township of Pioneer

That your Petitioners ask That the Legislative Council conduct an inquiry into the issue of drinking water in the town of Pioneer
And your Petitioners request that the Legislative Council will support this issue.

NAME (Please print name)	ADDRESS (Please print address in full)	SIGNATURE
Lin Simpson	45 Main Rd Pioneer	
GRANT ELMER	29 MAIN RD PIONEER	
Vivienne John	29 Main Rd Pioneer	
Michelle Breen	10 Main Rd Pioneer	
Jenny Bellinger	16 Main Rd Pioneer	
JOHN WILLIAMS	7 ALFRED ST PIONEER	
SUE WILLIAMS.	1 ALFRED ST PIONEER	
Jenny Williams	1 Alfred St Pioneer	
WENDY HATTON	10 MOORE CT PIONEER	
Nick de Quincey	6 Alfred st Pioneer	
Carole McKenna	6 Alfred st Pioneer	
Ann Hazlewood	53 main Rd Pioneer	
Carol Wolfe	(61 main Derby St.) 20 Postal Alfred Pioneer.	" "
Eva Paget	12 Main Rd	
D. Mitchell	12 Main Rd Pioneer	
GRAEME JOHNSTON	59 MAIN RD PIONEER	
Kathy Butterworth	59 Main Rd Pioneer	
pp Steven Jackson	56 Main Rd Pioneer	

Permission by fax.

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And your Petitioners request that the Legislative Council will support this issue.

NAME (Please print name)	ADDRESS (Please print address in full)	SIGNATURE	
Jeanette Makin	46 Garibaldi Rd	Jeanette Makin	
Tracey Thompson	32 Main Rd Pioneer	T L Thompson	
Robert Williams	32 MAIN Rd Pioneer	R Williams	
Aaron Weynberg	19 Main RD Pioneer	Aweynberg	
DAVID WEYNBERG ON Behalf DONNA SINCLAIR	21 MAIN RD PIONEER	D Weynberg	
TREVOR J. BREEN	13 MAIN RD	Breen	
H. BREEN	13 MAIN RD	H Breen	
Carmel Huck	11 Main Rd Pioneer Post 1 The Flat St Marys		Permission by text.
TIM SLADE	8 MOORE STREET	T Slade	
Michael Huck	Re 11 Main Rd Pioneer Post 1 The Flat St Marys		Permission by text.
Katrina Davis	51 main rd Pioneer	K Davis	Permission given by text.
Jeff Catt	70 main rd Pioneer		
KEVIN WAGNER	71 MAIN Rd Pioneer		3 PROPERTY
DOUGLAS KAYE	60 MAIN Rd Pioneer		
Gary Watson	37 Main RD Pioneer	G Watson	
Melissa McKenzie	40 MAIN ROAD PIONEER		

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NAME (Please print name)	ADDRESS (Please print address in full)	SIGNATURE
A BLEANEY	Bivalve Bay St Helens	A Bleaney
Tim Slade for A. Bleaney	3 Marcus St, Pioneer Bivalve Bay, St Helens	T Slade
P. PERRY	11 MAIN RD. PIONEER	P. Perry

TASMANIAN LABORATORY SERVICES
DIAGNOSTIC SERVICES PTY. LTD.
ABN 26 009 503 100

1st FLOOR
37 FREDERICK ST.
LAUNCESTON
(03) 6334 3424

BELLINGER JENNY
C/O GPO WINNALEAH TAS 7265
Attn:

FINAL REPORT

Lab No. 80070971 Client Ref No. Date Reported: 26/09/2013
Submitted by The Client
Date Collected 22/09/2013 Date Received: 23-Sep-2013 Time:1450
Reason for Examination :

SAMPLE(s) ANALYSED AS RECEIVED

LABORATORY REPORT for: BELLINGER JENNY

No.	Specimen Details	Time	Date Testing Commenced	Units (Chem)	Tot. Pb
1	HOT WATER	17:00	23/09/2013	mg/L	0.215

MINERALS AND METALS BY ICP-OES - In-House Method TLc-48.

Accredited for compliance with ISO/IEC 17025.
NATA Accreditation no. 14410.

NATA

Signed .....
[M] Lethbo[illegible] (Sen. Chem)
[ ]J Riedl /[ ]S Harvey
[ ]S Golchatnikova

U102

Ms Jennifer Bellinger
16 Main Road
Pioneer 7264

5th October 2013

Tim Watson
General Manager
Dorset Council
3 Ellenor Street
Scottsdale 7260

Dear Tim and Dorset Councillors

Objection to Planning Application CT 131821/1 Gladstone Road HERRICK

As a resident of Pioneer, I wish to object to the above development. Tasmanian Irrigation Redevelopment application for the Frome Dam outlined three points.

1. 13.7 megalitres for the Pioneer township water
2. 700 megalitres of water Winnaleah Irrigation
3. 3,000 megalitres for a power station at Herrick

Why has point one the 13.7 megalitres to Pioneer township not been delivered? Point two has been delivered and now point three is to be undertaken.

Can please explain the high levels of lead in Pioneer.

A recent test on a hot water cylinder by Tasmanian Laboratory Services detected lead levels at 0.215 mg/L where world health standards are 10 mg/L. This has been reported to the Department of Health and Human Services Friday 27th September.

Lead levels of 20-40mg/L have been detected going through pipes.

Dam soil and water lead detected at 1690 mg/L, 540 mg/L and 470 mg/L which is TOXIC. The world health standard is 10 mg/L.

Could you please advise who signed off on the Frome Dam Redevelopment by Tas Irrigation? Without having delivered the 13.7 megalitres of water to the now Toxic Pioneer township.

Yours faithfully,

Jennifer Bellinger
residential address:
Lot 16 Main Road, Pioneer

mailing address:
C/- PO Winnaleah, 7265

28/04/2015

Deputy Vice-Chancellor (Research) Professor Sakkie Pretorius
Macquarie University
NSW Sydney 2109

sakkie.pretorius@mq.edu.au

Dear Professor Pretorius,

Thankyou for your interest in our problem in the Ringarooma River (Valley) system re-lead levels in our town waters, and for allowing Paul Harvey and Professor Mark Taylor to present to us Paul's research paper.

This whole process now restores faith to us that there is, yes, a real necessity for more research monies to go towards protecting our children and grandchildren's future.

Hopefully, we can provide a cleaner earth for them all, real jobs created cleaning up legacy sites of contamination and a mind-jolting wake up to us all, to be more careful within out homes.

Clean source -> clean pipes -> clean plumbing.

One concerned citizen phoned me regarding all plumbing "would using all stainless steel pipes and joiners and hot water cylinders be a more practical approach"? Thus creating another industry within Australia?

Thankyou and your team for restoring faith to us that somebody cared.

Regards

Jennifer Bellinger

On behalf of the concerned residents of Pioneer.

PS please find attached correspondence and please share with Paul and Mark

For your attention:

Media alert Pioneer Town meeting with TasWater 24/04/15. Now confirmed for 13/05/15 at 7pm

Attached to this email, correspondence sent to other parties by post after 24/04/15

Jennifer Bellinger
residential address:
Lot 16 Main Road, Pioneer

mailing address:
C/- PO Winnaleah, 7265
23/04/2015

Mr Stuart Heggie
State Manager
Environmental Heath

cc Mr Michael Brewster
CEO TasWater

Michael Ferguson MP

Thank you for attending Paul Harvey's presentation Tuesday 21st April, 2015.

Mr Heggie do you remember your original meeting in Pioneer in March of 2013? My memory recalls the tanks were an emergency option ONLY, while we explored other water sources. This was our feeling in the room this time and at no stage have we ever thought to have raw water in our town. We bought our houses with a reticulation system [a boil water supply]. If we had ever considered the tank only option none of us would have purchased in Pioneer.

Could you please tell us how now that Dr Roscoe Taylor plus 7 other personnel have left, how the new Health Department it will be restructured? This will affect us while we are fighting for running water.

Could you also please consider why does the National Lead Board only deal with air contamination (wind blown lead), surely water should be more important.

Are you aware of the cost for refilling 23,000 litre tank is $600, and totally unaffordable for the residents of Pioneer. TasWater own information states that the tank option provided would only supply 50% of household water needed in an average rainfall year, let alone a drought year, as per the GHD report. This is why we need a clean piped water source.

Pioneer is a high bushfire area. A ridiculous 10,000 litre tank would not put out anything, and cannot be accessed by owner.

Therefore could you please explain why TasWater has not seriously explored other sources of water for Pioneer, as per the GHD report?

The 1952 Waterworks Clauses Act does not include rainwater tanks. This was only an emergency option [band-aid approach] unit another source could be found.

Regards

Jennifer Bellinger

On behalf of the concerned residents of Pioneer.

Jennifer Bellinger
residential address:
Lot 16 Main Road, Pioneer
mailing address:
C/- PO Winnaleah, 7265
23/04/2015

Mr Michael Brewster
CEO TasWater
Hobart

cc Dorset Council –Barry Jarvis, Tim Watson

State Government – Will Hodgman MP, Peter Gutwein MP, Kim Booth MP, Michael Ferguson MP, Jeremy Rockliff MP, Dr Vanessa Goodwin MP

DHHS – Mark Veitch, Stuart Heggie, Cameron Dalgleish

Tas Irrigation – Paul Ellery

Media – James Brady, Neil Grose, Michelle Clark

Brian Wightman

Please be advised that the residents of Pioneer have been treated appallingly regarding our water situation. We are now aware that our Water Licence No. 7816 is in existence and is headed **Frome** and its **tributaries**.

Since the development of the Frome Dam [currently dysfunctional and potentially dangerous to the environment] at as it is leaking. The leak being from pipes put into a heritage listed race [see photos attached].

We have been receiving water as per licence **not from this Frome** source but another small creek system GREENSTONE CREEK, which is now dry and not flowing at all. Probably from logging in the area and could be seasonal [see photos attached].

When our holding dam was at a level of two feet (60cms) approximately in this Summer of 2015. TasWater only after many residents complaining that there was a dire emergency in our town, used the Ringarooma River to fill our toxic polluted dam with a diesel pump [see photos attached].

This source being much closer to our Water Licence No. 7816 as the Frome River runs into the Weld River and then to the Ringarooma River, NONE OF THESE RUN INTO GREENSTONE CREEK.

In November 2012 we had a Town Meeting with various members of TasWater and asked for an alternative source of freshwater as lead had been detected in our pipes. On town members request we asked TasWater to please test our dam for sources of lead. This returned a result of 1630 Health 10.

TasWater as per ABC News Friday 17/04/2015 will GIVE US A TANK – our opinion – that they will **gives us** a LIABILITY of ongoing refilling expenses of $600 to fill a 23,000 litres tank when needed.

This will happen in our town as per GHD reports commissioned at great costs by BLW/TasWater, stating that "**Pioneer does not have the rainfall**" to keep an average household in a normal year let alone drought years.

Lin Simpson
Fookarri Inn
45 Main Street
Pioneer 7264

Mr Michael Brewster	Mr Miles Hampton	Mayor Barry Jarvis	Tim Watson
CEO TasWater	Chairman TasWater	Dorset Council	General Manager
Hobart	Hobart	Scottsdale	Dorset Council

cc State Government – Will Hodgman MP, Peter Gutwein MP, Michael Ferguson MP, Dr Vanessa Goodwin MP

Dear Sir or Madam:

In your recent letter date May 6th, 2015, you assert, "TasWater has always acted in the best interests of its Pioneer customers and will continue to do so."

If this is really the case, then you should be pleased to hear what we feel our best interests are, unless you think you know what's best for us better than we do.

I, for one, do not feel that it is in my interests to be provided with a second-rate or substandard water supply, instead of that which the township has been historically supplied with, and is I believe, entitled to be supplied with from the Frome Dam. Delivering this water from the Frome to Pioneer is clearly TasWater's job as it was previously Ben Lomond's and Dorset Council job as TasWater is the only Tasmanian Town Water Provider. Please refer to Water Licence No 7816, Frome and it's tributaries.

Whether you use the old race, a new pipeline laid in the old race or elsewhere, or pump from the Ringarooma River water than has been released form the Frome for this purpose is up to you, I guess with each option having its pros and cons, but this is the water supply Pioneer has always had and, therefore, shall continue to enjoy. Saying that it can't be done, is quite frankly, not good enough. TasWater is a water utility – do your job!

Further, your suggestion that "Tank replacement program has always been a community-driven option "is either" an honest mistake or a misinterpretation of the facts. We wanted our water supply fixed – not replaced with a down-graded or non-existent supply. Tanks were emergency ONLY with water to be restored to the town.

Your suggestion that "It has always been made clear to Pioneer residents that based on available consumption information likely be screened for residents to the supply payment the supply with tankered water, "is completely wrong as you will undoubtedly realise at the upcoming meeting. I was at the earlier meetings, which you were not at, and though the responsibility was mentioned in passing, a "<u>need</u>" based on average rainfalls was definitely not. Nor the impost of refilling a tank at the cost of $600.

Most importantly, your claim that "TasWater" considered a range of options ... Each of the alternatives ... required ... source water be treated to address **<u>both</u>** micro and heavy metal contaminant a significant cost." Is manifestly false, as shown by Professor Mark Taylor and Paul Harvey's research has shown. Neither the Frome (previous source) nor the Ringarooma River (potential source) showed significant heavy metal contamination. Please check with Dr Mark Veitch and Stuart Heggie regarding this.

Thus, both these source options would only require filtration and UV or similar sterilization, which would surely not be an unreasonable capital investment.

.../2

Jennifer Bellinger
residential address:
Lot 16 Main Road, Pioneer
mailing address:
C/- PO Winnaleah, 7265
06/05/2015

Mr Michael Brewster
CEO TasWater
Hobart

Mr Miles Hampton
Chairman TasWater
Hobart

cc Dorset Council –Barry Jarvis, Tim Watson

State Government – Will Hodgman MP, Peter Gutwein MP, Kim Booth MP, Michael Ferguson MP, Jeremy Rockliff MP, Dr Vanessa Goodwin MP

DHHS – Mark Veitch, Stuart Heggie, Cameron Dalgleish

Tas Irrigation – Paul Ellery

Media – James Brady, Neil Grose, Michelle Clark

Brian Wightman

In reference to the announcement by someone from within your department published in The Examiner on 06/05/02105, titled 'Water meeting delayed'.

I hereby request that you come to Pioneer and hold a public meeting, either on this date 13/05/2015 or as near as possible in the next week.

My presumption is you will be using GHD to do a full independent study of Paul Harvey and Professor Mark Taylor's SCIENTIFIC study of Pioneer's water reticulation supply/scheme. Would the independent findings then be the content of a public meeting?

By your own words you intend to decommission the town reticulation supply as advertised in The North Eastern Advertiser [copy attached]. The same system referred to in the tank supply option named as IRRIGATION SUPPLY [please go to your own records].

Have you informed the people of Pioneer that DECOMMISSIONING is eminent? I think NOT.

Schematic Plan Number 91, of Ben Lomond Water, Drinking Water Quality Options for Small Towns Options Study" May 2013, GHD, source of water from the Frome Dam [see attachment – Pioneer Water Scheme Plan].

As you are aware our source is GREENSTONE CREEK, which is not a tributary of the Frome Dam, is FILTHY, "STAGNANT WATER" as per DHHS Water Testing Results December 2012, contact Cameron Dalgleish.

- Water Entitlement Report Licence No. 7816 [see attachment – licence 7816]. Where has the metered water been going? Who has been paying for it? It is not reaching and cannot reach Pioneer. The race is filled with Tas Irrigation pipes
- Accommodation business owner, Lin Simpson, was given approval from Dorset Council to establish a guesthouse. Dorset Council would or should have had prior knowledge that the water supply was totally unacceptable and informed her she would require upward of 7-8 23,000 litre tanks to remain operational, in an average rainfall year, let alone a drought [as per GHD reports], at a cost of $600 to replenish each tank
- Polluted dam, polluted pipes, polluted household plumbing
- Toilet systems do not work for many of the 8 households, who have the LUXURY of a tank this summer. Therefore we must have running water to our houses a) toilet b) FIRE
- The tanks were ONLY EVER an emergency option until we had a clean source of water
- Public Health Act 1997, "Directory of Public Health can do anything to make water safe"
- Conflict of interest of Local Council owning water?

Lot 16 Main Road
Pioneer Tas 7264

Post c/o GPO
Winnaleah Tas 7265
13th May 2015

Att: Premier Will Hodgman MP
Honorable Peter Gutwein MP
Honorable Michael Ferguson MP
Honorable Kim Booth MP

Cc: DHHS – Cameron Dalgleish, Mark Veitch and Stuart Heggie
Tas Irrigation – Paul Ellery
TasWater – Michael Brewster, Miles Hampton

Dear Sirs,

In reference to the drinking water woes of the state of Tasmania I note that

a) TasWater does not make a profit of significant nature to fix the backlog of work needed and to allow the illusion of the "clean green image" to continue whilst people do not have safe, clean drinking water to their homes
b) Local councils do not have the money.

You yourselves have had a windfall from the Federal Budget today:

1) 70 million dollar accelerated payment for Tasmanian Irrigation following a $330 million dollar announcement in the budget published in the Examiner on May 13th 2015.
2) A 14.8 percent increase in payments from last year equalling an increase of $3.394 **billion** of **federal monies**.
3) Would it not be more appropriate to put some of this funding towards real jobs fixing the drinking water disasters of this state?
4) Plus $16 million dollars foregone by Cadbury to be spent on "other priorities".

I speak now for the township of Pioneer and Winnaleah – perhaps another treatment plant for Herrick, Pioneer and Winnaleah total of approx 200 houses with pickups of farmers and main road dwellers.

What we all need is a New Source -> New Reticulation -> New Plumbing. Based on a priority basis of towns that have "Do Not Consume" to "Boil Only". Tanks are not an option too, as this still makes "Boil Only Alert".

Tasmanian Irrigation stole the main water source from Pioneer from the Frome Dam. And secondly the new plant at Winnaleah as per a phone conversation today with TasWater (Launceston) must be trialled for twelve (12) months before it can be put into people's homes. If this were to work the reticulation system would still be contaminated, household plumbing contaminated especially the hot water services (lead gets worse in heat and by my own private testing multiples x 7 ie. 30 lead -> hot water system 215 -> Health 10.

It is completely unacceptable that the people you govern are not treated in a caring manner.

Thank you for considering this.

Jennifer Bellinger

Jennifer Bellinger
residential address:
Lot 16 Main Road, Pioneer

mailing address:
C/- PO Winnaleah, 7265
28/05/2015

Mr Michael Brewster	Mr Miles Hampton	Mayor Barry Jarvis	Tim Watson
CEO TasWater	Chairman TasWater	Dorset Council	General Manager
Hobart	Hobart	Scottsdale	Dorset Council

cc State Government – Will Hodgman MP, Peter Gutwein MP, Michael Ferguson MP, Dr Vanessa Goodwin MP

Dear Michael,

You have choices to make, as CEO of TasWater, which you will have to live with, which may define your career, and which gives you an opportunity to show the world who you really are.

One of these choices affects the water supply of several hundred of your fellow Tasmanians in the North–East townships of Winnaleah, Herrick, Pioneer and Gladstone.

Instead of seeing this as merely a bureaucratic financial or technical decision perhaps would help you to make the best decision if you consider how you would like to be treated, if you were living in one of these towns.

Local residents don't expect more from TasWater than it was created to deliver: safe, clean drinking water.

You have the power to make it happen sooner, or to stand in the way of progress and try to buy people off with third rate solutions, while the pressure on you continues to increase.

I am not an engineer, and I don't know which is the most cost–effective and durable way to meet this communities water needs, but I am certain that it can be done in a fair, reasonable and value–for–money manner.

Options might include:

a) Using the WIS pipeline and Ringarooma River (or its tributaries to bring water from the Frome Dam (which has plenty of spare capacity at present, and where 1 megalitre of water costs, as little as $1,300.00 – to say, plus the annual usage charge of $50-140/megalitre, and for which Pioneer already **has** a water right); and

b) Installing filtration and UV sterilization facilities at each township, or as best suits TasWater, and piping water where necessary, possibly reaching new customers in the process and thus opening up new potential revenue streams; or

c) Piping water from a central treatment facility, such as that being planned for Ringarooma, via the towns en-route, each with a sufficiently large holding tank to meet usage spikes (eg 250,000+ litres)

Whichever option is ultimately implemented, it is clear, however, that any lead contaminated infrastructure in the townships themselves will have to be reconditioned and/or replaced. This included both that belonging to TasWater, and that belonging to the residents, in the form of household plumbing.

Clearly TasWater, with possible assistance form the state government will need to finance the reticulation system repairs and/or upgrades, but what will this achieve if household plumbing is not replaced??

.../2

Jennifer Bellinger
residential address:
Lot 16 Main Road, Pioneer
mailing address:
C/- PO Winnaleah, 7265
06/05/2015

Mr Michael Brewster
CEO TasWater
Hobart

Mr Miles Hampton
Chairman TasWater
Hobart

cc Dorset Council –Barry Jarvis, Tim Watson

State Government – Will Hodgman MP, Peter Gutwein MP, Kim Booth MP, Michael Ferguson MP, Jeremy Rockliff MP, Dr Vanessa Goodwin MP

DHHS – Mark Veitch, Stuart Heggie, Cameron Dalgleish

Tas Irrigation – Paul Ellery

Media – James Brady, Neil Grose, Michelle Clark

Brian Wightman

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By your own words you intend to decommission the town reticulation supply as advertised in The North Eastern Advertiser [copy attached]. The same system referred to in the tank supply option named as IRRIGATION SUPPLY [please go to your own records].

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- The tanks were ONLY EVER an emergency option until we had a clean source of water
- Public Health Act 1997, "Directory of Public Health can do anything to make water safe"
- Conflict of interest of Local Council owning water?

Jennifer Bellinger
residential address:
Lot 16 Main Road, Pioneer

mailing address:
C/- PO Winnaleah, 7265
04/06/2015

Mr Michael Brewster
CEO TasWater
GPO Box 1393
Hobart

Dear Michael,

You keep referring to the "broad community support".

If you look at the 'tank option" there, was no other option. It was only ever an "EMERGENCY ONLY SITUATION" until TasWater were to return our 13.7 mega litres from the "FROME RIVER and Tributaries" License 7816 nothing to do with what you rattle on about. "Pioneer Dam and tributaries" this is colloquial only." "Pioneer Dam" GEOGRAPHICALLY is two kilometres in the opposite direction of our holding dam with slops coming from Greenstone Creek.

Looking forward to seeing you at the meeting.

Jennifer J Bellinger

Jennifer Bellinger
residential address:
Lot 16 Main Road, Pioneer

mailing address:
C/- PO Winnaleah, 7265
05/06/2015

Mr Michael Brewster and Board Members
CEO TasWater
GPO Box 1393
Hobart

cc State Government – Will Hodgman MP, Peter Gutwein MP, Michael Ferguson MP
DHHS – Mark Veitch, Stuart Heggie, Cameron Dalgleish
Media – James Brady, Neil Grose, Michael Atkin, Lauren Waldhuter, Matthew Denholm
Brian Wightman, Alison Bleaney, Isla McGregor

Dear Michael and all Board Members

Unfortunately none of you are "the political football" in the drinking water debacle in Tasmania ! We, the people of the small towns of Tasmania, are the victims in this entire water scandal.

The following is a short list of the major current problems with potable water supplies in the NE Tasmania:

- Pioneer – drinking water lead contamination results required for last 5 years and is currently still on 'do not consume'.
- Winnaleah – No update of lead results after apparently installing a water purifier in the town and now only after repeated requests for results, despite this town having a school (a significant number of children in the community).
- Avoca – a long standing promise of a pipeline to come from Fingal with potable water to bypass the metal contaminated water entering at Avoca from mining areas around Royal George; treatment for bacteria/cryptosporidium would be required for both towns.
- Whitemark/Lady Barron – TasWater has not as yet publically identified the source of the drinking water lead contamination or revealed what action it has taken to rectify the problem.
- Legerwood/Branxholm/Derby – TasWater statement reveals non-compliance of E Coli and "aesthetic" heavy metals, highly elevated.
- Ringarooma – 'Boil alert' only when lead at 210 (Health 10) were found in tap water in March 2014. Of course we all now know that heating/boiling water tends to increase the lead concentrations. This town also has a school.

All towns, according to the GHD reports, are contaminated with cryptosporidium and apparently need UV light to correct this pollution problem.

There are no results publically available for Springfield the source water of raw drinking water for Scottsdale, which is being delivered to Pioneer, Winnaleah and Ringarooma by tanker. Considering the present situation; this is unacceptable.

.../2

Jennifer J Bellinger
C/- PO Winnaleah, 7265
0427 112 225

23/06/2015

Mr Greg Howard
Acting Mayor Dorset Council
PO Box
Scottsdale 7260

Dear Greg,

If you would like to look at the documents below, please let me know–

a) TasWater results since 2010

b) Private testing results by residents since 2012

c) DHHS testing results 2012

d) Professor Mark Taylor and Paul Harvey's work about lead that is affecting Pioneer Ringarooma and Gladstone

e) Copies of petitions

Please also note that–

1) Ringarooma River is 200 metres from the current source

2) Water Licence No 7816 for the township of Pioneer is valid until 2053 and is headed Frome and its Tributaries – Ringarooma River Catchment

3) The Ringarooma River is one kilometre from the nearest power source

you will see this all on "google".

Do you realise the dam is cracked and now turned off from the filthy (lead) source that TasWater are currently going to put the lead source into tanks to run to our leaded pipes to run to our leaded household plumbing.

They (TasWater) say they want to get this right as they have eleven more towns to roll tanks out to in Tasmania. They would not answer the question "which towns". How can this be considered by TasWater to be upgrading all Tasmanians water supply, when their own research (GHD reports) stated that Pioneer does not have enough rainfall nor roof capacity. It is $600 to fill a tank.

Please help us

Jennifer J Bellinger

PS please find attached correspondence from TasWater regarding Winnaleah's water as of 16th June 2015

Jennifer J Bellinger
C/- PO Winnaleah, 7265
0427 112 225

01/07/2015

Mr Peter Gutwein MP
Level 9 Executive Building
15 Murray Street
Hobart 7000

Dear Mr Gutwein,

Thank you for your letter dated 23rd June 2015. I read with interest that you have an FOI registered with TasWater. It took us nearly eighteen months to get ours from TasWater and Dorset Council.

Please find a series of photos. It has been impossible for "the little person" to deal with TasWater and I now ask for your help.

Mr Priestly, who spoke against Professor Mark Taylor and Paul Harvey's work, which is now scientifically proven, was ill prepared and had incorrect information given to him by TasWater. He had no data of his own and was generally a waste of time.

As a third part of the agenda by TasWater, this we were not advised of in writing, please see their letter. Mr Brewster made an announcement that our holding dam was cracked and leaking, and they were currently working on it. The photos are the finished result leaving us a source that dries up October–March annually. Our water Licence is 7816 and is Frome River and its tributaries. We need water returned to our town of bulk quality.

You are well aware of our bushfire risk, please "google" this if you are not.

Please note the media alert released by Pioneer residents Safe Town Water for all Tasmanians (STAT).

The situation currently is untenable. I have sent my Tank Contract and Reticulation Irrigation Supply Contract to a solicitor in Queensland and I am awaiting his advice. If you would like a copy of these, they can be obtained from scottsec@internode.on.net

I now put our problem to you for assistance.

CLEAN SOURCE -> CLEAN PIPES -> CLEAN HOUSEHOLD PLUMBING

Perhaps you may find time to visit us to see our problems for yourself? If I am unavailable Lin Simpson phone 0417 238 671, will be more than happy to show you our diabolical problems.

We had a 10 mega litres capacity for grass fires/bush fires/household fire in our dam. We now have 24,000 litres x 3 = 72,000 litres, as per photos.

TasWater keeps referring to our tank option as if it has overwhelming support. In effect we did not have a choice and were never advised that they intended to decommission our water. Our understanding in March of 2013 was that the tank would be emergency only whilst they returned our Licence of 7816 allocation.

There was another disturbing point made by Mr Brewster that they (TasWater) intend to roll out tanks to eleven other Tasmanian towns. Was this why this company was set up???

Please advise

Jennifer J Bellinger

Cc Michael Ferguson, Will Hodgman, Stuart Heggie

Jennifer J Bellinger
C/- PO Winnaleah, 7265
0427 112 225

05/12/2016

Attn Mr Mike Brewster, CEO Tas Water
Mr Miles Hampton, Director Tas Water
Dr Mark Veltch, Director of Health

CC Mr Tim Watson, General Manager Dorset Council
Mr Greg Howard, Mayor Dorset Council
Premier Will Hodgman
Treasurer Peter Gutwein

Dear Sirs,

Please be aware that the township of Pioneer has not yet been supplied fully with tanks. Please explain, it is now over 4 years. We are now going into the summer period the testing of the water flowing from Greenstone Creek [of which you do not have a license to use] is worse than sewage as per your own testing results and is filthy.

Your latest correspondence indicated that you will be using the Ringarooma River in the summer months, which brings me to the fact that the township of Derby which sits beside the Ringarooma River. Derby is developing at a great rate with bike riders, whose untreated water and effluent is now, I suspect, being released into the Ringarooma River.

The township of Pioneer and Gladstone both relying on the Ringarooma River are down stream of Derby.

You have indicated that the pipeline [treated water from Ringarooma] coming to Winnaleah could be taken to Gladstone. I ask you to please refer to your own costings regarding the cost of this, which appears to be within your guidelines for the townships of Herrick, Pioneer, South Mt Cameron and Gladstone.

Are the people of Gladstone fully aware of the dangers of their water supply?

Awaiting your help and common sense approach to this issue.

For and on behalf of concerned citizens of Pioneer

Jennifer J Bellinger

Jennifer J Bellinger
Lot 16 Main Road
Pioneer, 7264
C/- PO Winnaleah, 7265
0427 112 225

07/08/2018

Attn
Honourable Mr Peter Gutwein MP
Public Building
53 St John Street
Launceston 7250 TAS

Dear Sir,

Please find attached

a) photocopy of NEA

b) response from TasWater to Tim

Please up date on my previous correspondence. It is with regret that your previous position of taking over TasWater has not been effected but I accept that your entry into TasWater may help our plight in Pioneer.

Mr Gutwein, at not time were we aware that the Economic Regulator would be involved in our plight. We believed that we would get tanks quickly and not over a five year period and that we would then "fight" for treated water, in effect the tanks being a temporary fix to our water problems. To now see Herrick and Gladstone equipped with treated water is "gut wrenching" excuse the pun.

At no time were we consulted about our dam being deregulated and a hole bulldozed through its wall and replaced by plastic tanks in a high bushfire prone area, to follow with the insult of deregulation from the Economic Regulator still without consultation to the townspeople.

Mr Gutwein, we ask you to help us get treated water from the Ringarooma River. This will require a plant larger than Herrick's as we are a township of forty houses, Herrick fifteen and a verification from you that this will be one of your first priorities when entering into TasWater ownership.

Please advise me on whether you can help with this?

With respect,

Jennifer J Bellinger

for and on behalf of the concerned citizens of Pioneer

CC Mayor Greg Howard, Dorset Council

Bulldozed Dam Wall "No Town Consultation"

Polluted water drained towards Ringarooma River. Gladstone getting their water out of downstream

Finally Water is pumped in the summer from Ringarooma R but reverts to Greenstone in winter

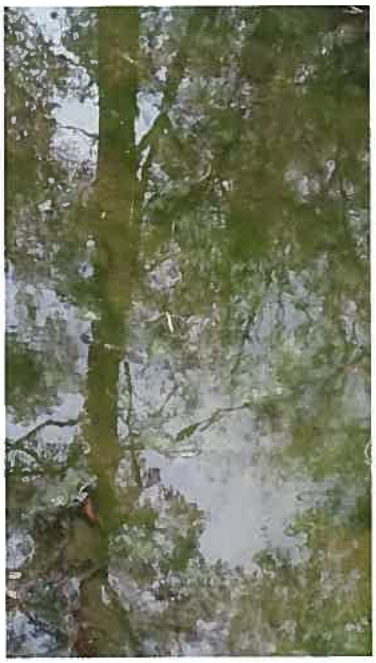


Flow in




ditch race from Greenstone Creek.

Winter storage ~~take~~ from Greenstone Creek



Flow from Green Stone Creek Ditch Dug in 1918









Head flow into tanks

run-off from tanks

3 tanks filling from Greenstone Creek

over flow

airflow

Since increases to 9 Tanks

Therefore gross under estimate 9 need 9 the town.

run-off, down hill towards Ringarooma River

Donna. Sargent@dpac.tas.gov.au

PETITION TO ANDREW BESWICK AT BEN LOMOND WATER AUTHORITY RE WATER QUALITY OF PIONEER TOWNSHIP TASMANIA

C.C . PETER GUTWEIN , WILL HODGMAN, MICHAEL FERGUSON ,TIM MORRIS, CAMERON DALGLEISH, DR ROSCOE TAYLOR, DR VANESSA GOODWIN AND BARRY JARVIS.

DEAR ANDREW

ARE YOU AWARE THAT WE HAVE HAD NO RUNNING WATER SINCE 2008 AND HAVE STAGNANT WATER RUNNING INTO OUR HOUSES FOR PERSONAL HYGIENE AND LAUNDRY PURPOSES APART FROM THIS PRIVATE TESTING RESULTS SHOW HIGH LEVELS OF E COLI ,ALUMINIUM, IRON, MANGANESE.YOU ARE ALREADY AWARE OF LEAD AND MANGANESE .YOU ARE ALREADY AWARE THAT OUR PIPES HAVE DANGEROUS LEAD LEVELS ABOVE HEALTH\ GUIDELINES

1) THERE HAS BEEN NO UPDATE OF TESTS DONE TO US SINCE 6/11/12

2) PEOPLE IN THE TOWN ARE ONLY USING THE CONTAMINATED WATER FOR FLUSHING THEIR TOILETS AND KEEPING THEIR GARDENS ALIVE.

3)PEOPLE OF THE TOWNSHIP ARE CONSIDERING NON PAYMENT FOR THE CONNECTION AND USAGE CHARGES UNTIL A SUITABLE SUPPLY IS ROUTED TO OUR HOUSES ACCEPTABLE FOR PERSONAL HYGIENE AND LAUNDRY PURPOSES.

4) THERE ARE TWO EASY ALTERNATIVE SOURCES CASCADE DAM APPROXIMATELY TWO KILOMETRES FROM OUR CONNECTION OR THE ALREADY ALLOCATED 13 MEGALITRE S FROM THE FROME DAM WHICH WOULD TAKE FIVE TO SIX KILOMETRES OF PIPING.

5) WE HAVE NO CONFIDENCE IN YOU PROVIDING GOOD DRINKING WATER TO OUR HOUSES AND ASK FOR YOUR HELP TO APPROACH DORSET COUNCIL REGARDING THE $36400 OWED TO US. OUR PROPOSAL IS THAT THIS MONEY WOULD BE DISTRIBUTED EVENLY BETWEEN THE RATEPAYERS TO OFFSET A DRINKING WATER TANK AND PRIVATE PERSONAL FILTERS

6) WE ASK AT THIS TIME THAT YOU CONSULT WITH DR ROSCOE TAYLOR REGARDING THE VERY INFERIOR TASMANIAN WATER QUALITY ACT AND TO PLEASE CONSIDER REWRITING OF THIS ACT.

WATER SHOULD GO HAND IN HAND WITH HEALTH AND NOT BE A PROFIT MAKING VENTURE

TEST RESULTS TO THE CONSUMER COULD BE POSTED IN A PUBLIC PLACE IN EACH TOWN AS SOON AS THEY ARE RECEIVED BY YOU PLEASE REMEMBER THIS IS FOR PUBLIC INFORMATION ACTUALLY NOT A SECRET FOR YOU AND DR ROSCOE TAYLOR ONLY.WE THE UNDERSIGNED

Name	Address	Phone	Signature
MANDY STRACHAN	17 main Rd Pioneer	0457542164	M. J. Strachan
MARK SIMPSON	45 MAIN RD PIONEER	0419535082	M. Simpson
Barry Curtis	46 Main Rd Pioneer	0428783419	B. Curtis
Dalas Cook	31 main Rd Pioneer	0430842410	D. Cook
Kristina Otello	31 Main Rd Pioneer	0430847916	K. Otello
Michelle Brown	10 Main Rd Pioneer	0400370165	M. Brown
Stacey Smith	15 main Rd Pioneer	0418141900	S Smith
Cheryl Smith	15 main Rd Pioneer	0429899624	C Smith
Carol Piccini	27 Main Rd Pioneer	0439377436	C. Piccini
JANINE MILNER	27 MAIN RD Pioneer	0439377436	J. Milner
[illegible]	869 GLADSTONE ROAD PIONEER	0458 006 809	[illegible]
JASON NOLAN	" "	" "	Jason Nolan
Kimberlee Nolan	" "	0401948731	K. Spencer
~~N. Spencer~~ Nick Spencer	" "		N. Spencer
Beth Brownrigg	" "	0419102092	B. Brownrigg
Luke Hawkins	4 MOORE STREET PIONEER	0488552253	L. Hawkins
bill ponting	"	0429852559	B. Ponting
Max CRANE	12 Main Rd Pioneer	036-431742	P.P. Jenny Crane
DOROTHY CRANE	" "	036-431742	R.P. Jenny Crane
Brett Dwyer	37 main Rd Pioneer	0417201951	B. Dwyer

1/3 GT

PETITION TO ANDREW BESWICK AT BEN LOMOND WATER AUTHORITY RE WATER QUALITY OF PIONEER TOWNSHIP TASMANIA

C.C . PETER GUTWEIN , WILL HODGMAN, MICHAEL FERGUSON ,TIM MORRIS, CAMERON DALGLEISH, DR ROSCOE TAYLOR, DR VANESSA GOODWIN AND BARRY JARVIS.

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Name	Address	Phone	Signature
CARMEL LUCK	11 Main Rd, Pioneer 726A	6354-1060	C Luck
MICHAEL LUCK	11 MAIN RD PIONEER	6354-1060	M. E. Luck
HEATHER BREEN	13 MAIN RD PIONEER	63542427	H Breen
TREVOR BREEN	13 MAIN RD PIONEER	63542427	T Breen
B J BALDWIN	32 MAIN RD PIONEER	0487494476	B J Baldwin
Jenny Belling	LOT 16 Main Rd Pioneer	0427112225	
Lyn Simpson	45 Main Rd Pioneer	0417238671	L Simpson
Dion Hazlewood	353 Pioneer	63542393	Hazlewood
Annette Hanks	58 Main Rd Pioneer	0400513095	
TIM HANKS	AS ABOVE	AS ABOVE	
GRAEME JOHNSTON	59 MAIN RD PIONEER	0400108603	
Kathy Butterworth	59 MAIN RD PIONEER	0400823825	K. Butterworth
Sally Warren	57 MAIN RD PIONEER	63542406	
TIM SLADE	8 Moore St Pioneer	63542200	T. Slade
Colin Inglis	1 Moore St Pioneer	N/A	
Wendy Halton	10 Moore Pioneer	63542193	
Jenny Belling	602 Main Rd Pioneer	0427112225	
Jeff Watt	70 main rd Pioneer	63542215	
Mikayla Breen	10 main rd pioneer	63542301	
Alison Strachan	17 main rd Pioneer	0457542189	A. Strachan
Adam Strachan	17 Main RD Pioneer	0417207902	

ISQ

PETITION TO MR ANDREW BESWICK BEN LOMOND WATER AUTHORITY AND DR ROSCOE TAYLOR DEPARTMENT OF HEALTH AND HUMAN SERVICES FROM THE RESIDENTS OF PIONEER TOWNSHIP TASMANIA

DEAR SIRS

PLEASE BE AWARE THAT TASMANIAN IRRIGATION HAVE ALLOWED AN ALLOCATION OF ONE MEGALITREOF WATER MONTHLY FROM THE FROME DAM TO THE TOWNSHIP OF PIONEER . WOULD YOU PLEASE ADVISE US WHEN YOU ARE GOING TO BE ORGANISING THIS. ACCESS IS ALLOWED FROM THE HERRICK CONNECTION .PLEASE CONTACT PAUL ELLERY AT TASMANIAN IRRIGATION REGARDING THIS .WE UNDERSTAND THAT THERE IS AN ALLOWANCE OF THIRTEEN MEGALITRES ANNUALLYTHE PSI AT HERRICK IS 300 AND WOULD NEED REDUCERS FOR THE 5/6 KILOMETRES OF PIPING

C.C PETER GUTWEIN WILL HODGMAN MICHAEL FERGUSON TIM MORRIS CAMERON DALGLEISH DR VANESSA GOODWIN MICHELLE OBYRNE LARA GIDDINGS

WE THE UNDER SIGNED

Name	Address	Phone	Signature
CARMEL LUCK	11 Main Rd, Pioneer, 7264	6354-1060	
MICHAEL LUCK	11 MAIN RD PIONEER 7264	6354-1060	
TREVOR BREEN	13 MAIN Rd PIONEER 7264,	63542427	
HEATHER BREEN	13 MAIN RD PIONEER	63542427	
B BALDWIN	82 MAIN RD PIONEER	0481494476	
Jenny Bellinger	Lot 16 Main Rd Pione	0427112225	
Lyn Simpson	45 Main Rd Pioneer	0417238671	
Ann Hazlewood	353 Pioneer	0363582393	
Annette Hanks	58 Main Rd Pioneer	0400513095	
TIM HANG	AS ABOVE	AS ABOVE	
GRAEME JOHNSTON	59 MAIN RD PIONEER	0400108603	
D. Warden	57 MAIN RD PIONEER	63542406	
TIM SLADE	8 Moore St Pioneer	63542290	
COLIN INGLIS	4 Moore St Pioneer	NIL	
Wendy Hatton	10 Moore St. Pioneer	63542193	
Jenny Bellinger	62 Main Rd Pioneer	0427112225	
Jeff Gatt	70 main rd Pioneer	63542215	
Mikayla Brown	10 main rd pioneer	63542301	
PETER STRACHAN	17 MAIN Rd PIONEER	0457542189	
MANDY STRACHAN	17 MAIN RD PIONEER	0457542189	
Alison Strachan	17 main rd Pioneer	0457542189	A. Strachan
Adam Strachan	17 Main RD Pioneer	0417207902	
MARK SIMPSON	45 MAIN RD PIONEER	0419535082	
Garry Curtis	46 Main Rd Pioneer	0428783419	
Dale Cook	81 Main RD Pioneer	0480842410	
Kristina Orello	81 Main RD, Pioneer	0480842410	
Michelle Breen	16 Main Rd Pioneer	0400370163	
Stacey Smith	15 main Rd Pioneer	0418144900	
Cheryl Smith	15 Main Rd Pioneer	0429899624	
Carol Pirani	82 MAIN RD. Pioneer	0459377434	
WAYNE MILNER	22 MAIN RD PIONEER	0459377434	
Patricia Spencer	964 GLADSTONE ROAD Pioneer	0450006469	
Jason Nolan	11		
Nick Spencer	11		N. Spencer
Beth Brownrigg	11 "	0419102092	

TION TO MR ANDREW BESWICK BEN LOMOND WATER AUTHORITY AND DR ROSCOE TAYLOR DEPARTMENT OF HEALTH AND HUMAN SERVICES FROM THE RESIDENTS OF PIONEER TOWNSHIP TASMANIA

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C.C PETER GUTWEIN WILL HODGMAN MICHAEL FERGUSON TIM MORRIS CAMERON DALGLEISH DR VANESSA GOODWIN MICHELLE OBYRNE LARA GIDDINGS

WE THE UNDER SIGNED

Name	Address	Phone	Signature
Kimberlee Nolan	"	0409418731	
Jason Nolan	469 Gladstone Road Pioneer	0456 006 909	
Luke Havens	4 main street pioneer	0488522550	
Bill Dobbins	"	0429852559	
MAX CRANE	12 Main St Pioneer	0364313742	
DOROTHY CRANE	12 Main St Pioneer	0364313742	
Brett Dwyer	37 main ROAD Pioneer	0417201951	

BS.

Environ Sci Pollut Res
DOI 10.1007/s11356-015-4349-2

RESEARCH ARTICLE

Identification of the sources of metal (lead) contamination in drinking waters in north-eastern Tasmania using lead isotopic compositions.

P. J. Harvey[1] · H. K. Handley[1] · M. P. Taylor[2]

Received: 4 December 2014 / Accepted: 9 March 2015

Abstract This study utilises a range of scientific approaches, including lead isotopic compositions, to differentiate unknown sources of ongoing lead contamination of a drinking water supply in north-eastern Tasmania, Australia. Drinking water lead concentrations are elevated above the Australian Drinking Water Guideline (10 μg/L), reaching 540 μg/L in the supply network. Water lead isotopic compositions from the town of Pioneer ($^{208}Pb/^{207}Pb$ 2.406, $^{206}Pb/^{207}Pb$ 1.144 to $^{208}Pb/^{207}Pb$ 2.360, $^{206}Pb/^{207}Pb$ 1.094) and Ringarooma ($^{208}Pb/^{207}Pb$ 2.398, $^{206}Pb/^{207}Pb$ 1.117) are markedly different from the local bedrock ($^{208}Pb/^{207}Pb$ 2.496, $^{206}Pb/^{207}Pb$ 1.237). The data show that the lead in the local waters is sourced from a combination of dilapidated drinking water infrastructure, including lead jointed pipelines, end-of-life polyvinyl chloride pipes and household plumbing. Drinking water is being inadvertently contaminated by aging infrastructure, and it is an issue that warrants investigation to limit the burden of disease from lead exposure.

Keywords Drinking water · Lead isotopes · Pipes · Pioneer · Ringarooma River · Tasmania

Responsible editor: Philippe Garrigues

Electronic supplementary material The online version of this article (doi:10.1007/s11356-015-4349-2) contains supplementary material, which is available to authorized users.

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[2] Department of Environmental Sciences, Faculty of Science and Engineering, Macquarie University, Sydney NSW 2109, Australia

Introduction

Globally, an ever greater strain is being placed on the limited availability of safe and clean drinking water resources due to growing population, increased urbanisation and industrialisation and mismanagement of natural resources (WHO 2013). At the same time, disease from unclean or contaminated drinking water continues to be problematic with an estimated 768 million people not having access to potable water of acceptable standards (WHO 2012; 2013). Contamination of drinking water by metals remains a persistent issue in many urban environments as point source contamination, industrial activities, aging pipe infrastructure and other sources contribute to elevation of these metals above health guideline values (Triantafyllidou and Edwards 2011). Lead contamination of drinking water typically occurs where lead service lines, lead fittings or lead solder are used in the infrastructure (Del Toral et al. 2013). The prevalence of lead contamination of drinking water supplies in Australia is relatively unknown with only a small number of studies available, many of which focus on rain water tanks as a supply source (e.g. Magyar et al. 2014; Rajaratnam et al. 2002). A study that examined three houses in Sydney and a small cohort in Broken Hill concluded that drinking water was not a major contributor to the burden of disease from lead in Australia (Gulson et al. 1994). However, the limited and two-decade old data from this study is insufficient to draw meaningful conclusions on Australia, particularly where the infrastructure is aged. A more recent study investigating lead concentrations in tap water of new homes found 60 % of homes tested to be above the Australian Drinking Water Guideline (ADWG, 10 μg/L) (NHMRC 2011; Rajaratnam et al. 2002). Extensive evidence from international studies, including examples in Europe (e.g. Cirarda 1998; Englert and Höring 1994; Zietz et al. 2001), South America (e.g. Jane Wyatt et al. 1998), the UK (e.g. Graham

Published online: 22 April 2015

et al. 1996) and the USA (e.g. Maas et al. 2005) show that a lead-contaminated water supply can contribute significantly to the body lead burden.

The Ringarooma River catchment, located in north-eastern Tasmania, Australia (Fig. 1), is the subject of an ongoing and unresolved drinking water lead contamination issue (GHD 2013a). The town of Pioneer is one of the towns affected by lead-contaminated drinking water. In 2011, the state suburb of Pioneer recorded 137 people, 30 of which were children (0–14 years old) (ABS 2011).

The town of Pioneer was first placed on a Do Not Consume notice stemming from lead contamination of the drinking water supply in mid-November 2012 (Beswick 2012). This notice followed 2 years of irregular testing by the water utility showing occasional drinking water lead concentrations detected above the ADWG (NHMRC 2011) of 10 μg/L (Taswater 2013). A public notice advised residents that a temporary water supply (communal tank) had been installed at the community hall, which remains the drinking water supply for Pioneer (Beswick 2012). A pipe-scouring program to remove the alleged responsible sediment from the pipes was conducted on November 21, 2012 (Beswick 2012). Despite these remedial works, the source of drinking water lead contamination in Pioneer remains unknown, although it has been attributed to numerous origins including the natural geology and historic tin mining in the catchment (GHD 2013a; b).

This study uses a forensic, deductive approach to identify the source of lead contamination in the drinking water supply in Pioneer, including analysis of water, soils and sediment from the upstream catchment, the river supplying the drinking water, and within the township. The complexity of the water supply scheme for the town of Pioneer, including former mine water races, aging infrastructure and multiple diversions, provides a unique opportunity to apply various geochemical tools, including lead isotope compositions, to resolve this water contamination problem. To our knowledge, this is the first study published in the peer-reviewed literature examining broad-scale water lead contamination of this kind in Australia. The techniques implemented in this investigation can be applied in other such scenarios identified nationally and internationally.

Study setting

The Ringarooma River catchment (~1620 km^2) is located in north-eastern Tasmania, Australia (Fig. 1). Ringarooma River extends from near Mount Maurice in the upper catchment for 107 km to Ringarooma Bay on Tasmania's northern coastline (Fig. 1). Ringarooma River has a number of tributaries, including the Cascade and Frome rivers that have been historically, and are currently, regulated (Knighton 1987, 1989, 1991, 1999). The underlying bedrock of the catchment is dominated by basaltic and granitic rocks (Black et al. 2010). Medium-to-coarse-grained (0.5–2.0-mm diameter) sediment dominates the floodplain alluvium, into which the Ringarooma River is incised (Knighton 1989). Land use in the catchment consists of forestry, agricultural, historic tin mining and residential uses. The Ringarooma River's alluvial tin (in the form of alluvial cassiterite) mining heritage has resulted in a vast network of dilapidated water races across the catchment, which divert flow from the main channel to backwater areas near former mining leases (Knighton 1991).

Materials and methods

This study quantifies a range of elements (As, Cu, Pb, Sn) in water, soil, sediment and the local bedrock, which have been identified as potential environmental contaminants in the Ringarooma River catchment. Lead isotopic compositions have also been determined to elucidate the source of lead contamination.

Water

Water samples were collected from 49 sites in the upper and middle catchment (Fig. 1). Sites were selected using the following criteria: proximity to contemporary and historic forestry activity, key geomorphic features (river confluences) and proximity to infrastructure (roadways, bridges and water races) to capture the input from the various land uses and tributaries in the study area. Sampling was conducted in October 2013 and March 2014. These two separate events encapsulated seasonal variability in the water race of Pioneer. On the first occasion, water samples were collected as a dissolved (<0.45 μm) and total (unfiltered) fraction. There was limited difference between the two fractions for lead so only total (unfiltered) samples were collected on the second visit. Water pH and temperature were measured at each site using a Hanna® HI 9023C pH meter.

Water samples were collected in pre-washed Nalgene™ LDPE low metals or Teflon sample bottles. Bottles were first cleaned in Liquinox™ detergent (Alconox, USA) then rinsed with 18.2 MΩ/cm at 25 °C Milli-Q™ (Milli-Q) water before soaking in 10 % HNO_3 for 24 h. The bottles were then rinsed three times in Milli-Q water in a trace metal clean laboratory at the Geochemical Analysis Unit (GAU), Department of Earth and Planetary Sciences, Macquarie University. River water samples were collected using a 0.45-μm Sartorious™ Minisart® cellulose membrane syringe filter (for filtered samples). Samples were collected from as close as possible to the centre of the channel.

Volunteers for kitchen tap water sampling were sought from the local population. Volunteers were instructed how and when to collect samples. First draw samples were

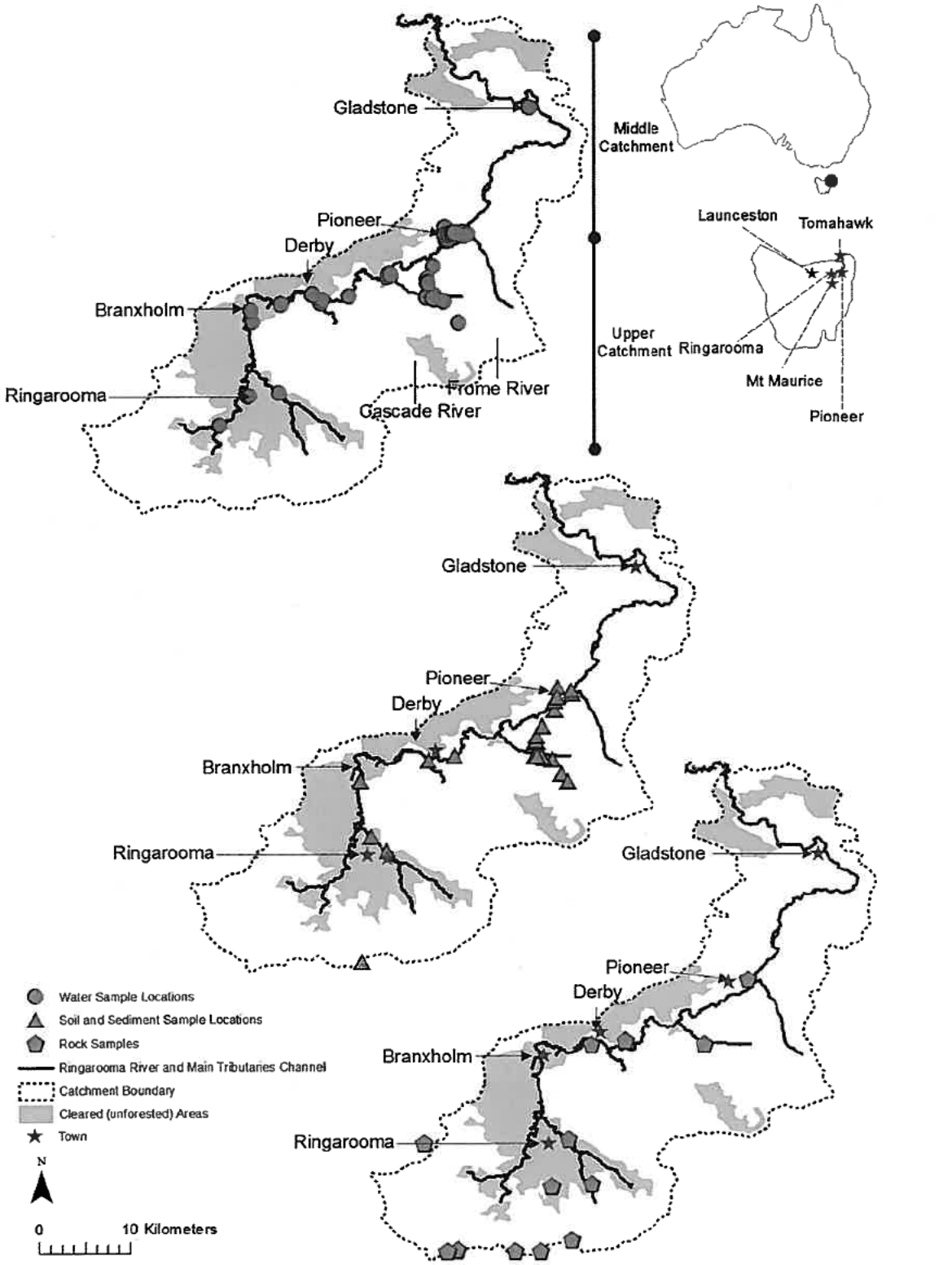

Fig. 1 Ringarooma River catchment, north-eastern Tasmania. Sampling locations for water, soil and sediment and rocks are presented in separate diagrams. Inset figure of Australia, illustrating the location of Tasmania and the study catchment

collected after an 8-h stagnation time on the first sampling trip. Along with first draw samples after the 8-h stagnation time, the sampling protocol was adjusted on the second trip to also capture any local infrastructure influence at the kitchen tap. A flush period of either 30 s (sample 2) or 3 min (sample 3) was applied to evaluate samples for potential contamination from the service lines and the trunk main, respectively.

Sample replicates, duplicates, trip and field blanks were collected (n=17). Trip blanks comprised a clean bottle containing Milli-Q water, which was carried to the field but never exposed. Field blanks used Milli-Q water as a pseudo-sample and were treated in the same manner as a filtered sample in order to determine contamination from sampling method or instruments. All samples were acidified to pH 2–3 using concentrated HNO_3 prior to storage at <4 °C. Water samples were analysed using solution inductively coupled plasma mass spectrometry (ICP-MS) at the National Measurement Institute, North Ryde, Australia, procedure 1 (Supplementary Data 1).

All 17 field and trip blanks returned concentrations below the instrument limit of detection (BLD) concentration (Supplementary Data 2).

Soil and sediment

Soil and sediment samples (approximately 200 g) were collected from 48 sites (Fig. 1) using a plastic trowel that was cleaned two times using distilled water and sample site normalised by passing through adjacent soil or sediment. Samples were dried at 50 °C for 48 h and then analysed using a portable X-ray fluorescence spectrometer (pXRF) at the X-ray laboratory of Macquarie University, Australia, following procedure 3 (Supplementary Data 1).

A subset of samples were analysed by solution ICP-MS at the GAU to validate the pXRF results for lead. Aliquots of sample were obtained using the quadrat sample division method, with three repeats. Samples were then ignited in a furnace at 550 °C for 3 h to remove organic matter followed by analysis using a pXRF following procedure 3 and then solution ICP-MS by procedure 4 (Supplementary Data 1).

Bedrock

In situ rock samples (n=13) were collected to represent the range of rock types observed in the catchment. Samples were cut in half using a hardened steel rock saw to expose a clean face and then analysed for the elements of interest (As, Cu, Pb and Sn) using procedure 3 (Supplementary Data 1).

Pipe surfaces

Nine samples were collected from the large water supply pipes in the Pioneer water race, particularly around the Moorina Power Station. These included surface scrapings, joint material and inner linings. The pXRF procedure 3 (Supplementary Data 1) was used as a screening method for these samples to determine the presence of lead, the principal element of interest.

Isotopic analysis

Five samples: three tap waters (from one property and two public toilets) and two solids (a joint material and surface covering from the Moorina Power Station pipeline) were selected for lead isotope composition (PbIC) analysis. Samples were analysed according to the published methods for solutions and solids, PbIC procedure 2, involving HCl extraction and analysis by solution ICP-MS at the NMI (Supplementary Data 1, Evans 2013; Kristensen et al. 2014, 2015). High sample lead concentrations did not warrant pre-concentration.

Results

Trace element concentrations in water

Trace element concentrations and pH of water samples from each site are summarised in Table 1 and reported in full in Supplementary Data 2. Lead concentrations are shown in Figs. 2, 3 and 4. Lead concentrations in the Ringarooma River were BLD at each location sampled, except for site 20 (Fig. 2). Lead is detected in samples from the drinking water infrastructure at a number of sites which included the town of Ringarooma (7.9, 36 and 13 μg/L), the town of Pioneer (range 2.7 to 220 μg/L), Pioneer water race (range 7 to 540 μg/L) and the town of Gladstone (2.1 and 13 μg/L) (Figs. 2 and 3). Water lead concentrations vary, although only slightly, between the two sampling periods at some locations (e.g. locally named Cesspit #1, <1 and 1.6 μg/L). The highest concentration of lead is detected at the Moorina Power Station (540 μg/L), in the water race channel below the pipe network (Fig. 3). A low lead concentration is detected at the Frome Dam input south channel (1.4 μg/L) with no other lead detected upstream of the Frome Dam wall. Lead concentrations in the town of Pioneer are generally elevated above those measured in samples from the up flow water race (Fig. 4).

Copper concentrations in the water samples generally mirror those of lead. Peaks in lead correspond to measurable copper concentrations. Copper concentrations were highest in waters collected from within the infrastructure network (Fig. 5). For example, one house that contained 25 μg/L lead also contained 1700 μg/L copper (Supplementary Data 2). Some copper concentrations approached the water quality guideline (ADWG, 2000 μg/L) and one sample from the Pioneer public toilet exceeded this concentration

Table 1 Water copper and lead concentration data summary for samples collected in the Ringarooma River catchment. UF = unfiltered, F = filtered, Rep = repeat sample, Dup = duplicate sample.

Sample	Copper (μg/L)	Lead (μg/L)
Pioneer house 1	450.0	18.0
Pioneer house 1 sample 2	5.5	1.9
Pioneer house 1 sample 3	11.0	27.0
Pioneer house 2 sample 1	1700.0	25.0
Pioneer house 2 sample 3	130.0	4.2
Pioneer house 4	28.0	9.3
Pioneer house 5 sample 1	52.0	9.6
Pioneer house 5 sample 3	16.0	2.0
Pioneer house 6 UF	1500.0	210.0
Pioneer house 6 F (household filter)	26.0	10.0
Pioneer house 7	220.0	17.0
Pioneer house 8	4.3	<1
Pioneer town end flow valve	550.0	120.0
Pioneer public toilet	2200.0	220.0
Ringarooma public toilet	310.0	13.0
Gladstone public toilet	310.0	13.0
Frome Dam south input	1.1	1.4
Frome mid dam	1.5	<1
Blue Tier weir at river	<1	<1
Frome Dam input north	<1	<1
Cesspit lower dam	<1	<1
Cesspit #1	<1	1.6
Moorina Power Station water race downstream	1.8	<1
End of Power Station pipe	<1	<1
Greenstone creek	<1	<1
Moorina Power Station below pipe	150.0	540.0
Frome Dam above wall	<1	<1
Frome lower weir	1.1	<1
Ringarooma shop	590.0	36.0
Pioneer town tank UF	<1	<1
Pioneer town tank F	<1	<1
W1 F	<1	<1
W1 UF	<1	<1
W2 F	<1	<1
W2 UF	<1	<1
W3 F	<1	<1
W3 UF	<1	<1
W4 F	<1	<1
W4 UF	<1	<1
W5 F	<1	<1
W5 UF	<1	<1
W6 F	<1	<1
W6 UF	<1	<1
W7 F	<1	<1
W7 UF	<1	<1
W7 UF Dup	<1	<1
W8 F	1.2	<1
W8 UF	<1	<1
W9 F	<1	<1
W9 UF	<1	<1
W10 F	<1	<1
W10 UF	<1	<1
W10 UF Dup	<1	<1
W11 F	<1	<1
W11 UF	<1	<1
W12 F	<1	<1
W12 UF	<1	<1
W12 UF Dup	<1	<1
W13 F	<1	<1
W13 UF	<1	<1
W13 F Rep	<1	<1
W14 F	<1	<1
W14 UF	<1	<1
W14 UF Rep	<1	<1
W15 F	<1	<1
W15 UF	<1	<1
W16 F	<1	<1
W16 UF	<1	<1
W17 F	<1	<1
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W18 F Rep	<1	<1
W19 F	<1	<1
W19 UF	<1	<1
W20 F	<1	<1
W20 UF	350.0	6.5
W20 UF Dup	230.0	6.1
Gladstone public toilet F	3.2	<1
Gladstone public toilet UF	9.7	2.1
Greenstone creek F	1.2	<1
Greenstone creek UF	1.1	<1
Cesspit #1 F	1.0	<1
Cesspit #1 UF	1.1	<1
Cesspit #1 lower dam F	15.0	<1
Cesspit #1 lower dam UF	38.0	7.0
Ringarooma public toilet F	130.0	6.6
Ringarooma public toilet UF	150.0	7.9
Derby public toilet F	56.0	<1
Derby public toilet UF	71.0	<1
Pioneer house 8 F	220.0	17.0
Pioneer house 8 UF	390.0	31.0
Pioneer house 9 F	190.0	2.9
Pioneer house 9 UF	150.0	2.7

Complete data available in Supplementary Data 2

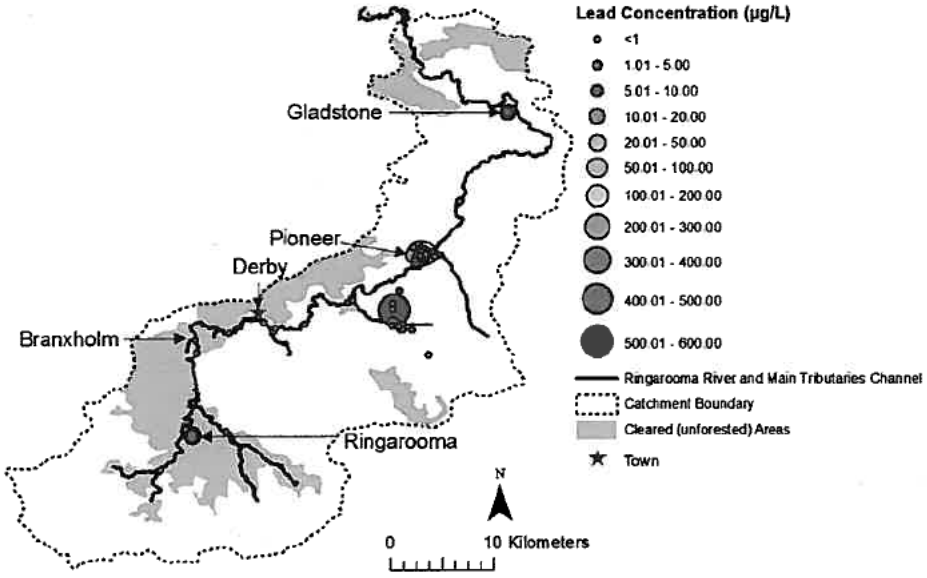

Fig. 2 Lead concentrations in water samples from the Ringarooma River catchment and towns (Tasmania)

(2200 µg/L). When the Moorina Power Station outlier (lead - 540 µg/L) was removed, water copper concentrations had a strong correlation with water lead concentrations (r=0.84).

Tin concentrations are below the limit of instrument detection (BLD <1 µg/L) in the Ringarooma River. Tin is detected in the water race infrastructure of Pioneer and Ringarooma public toilets. The Pioneer Cesspit #1 contains 3.1 µg/L; Pioneer end of town flow valve contains 6.1 µg/L; Pioneer public toilet has 18 µg/L; Ringarooma public toilet contains 1.7 µg/L; and Moorina Power Station (below the pipe) has 11 µg/L.

Trace element concentrations in soil, sediment, bedrock and pipes

Element concentrations in soils and sediments are given in Supplementary Data 3. Analysis of soil and sediment in and around Pioneer Dam shows low lead (range BLD–84 mg/kg, n=48). Similarly, the sediment collected from the Ringarooma River returned negligible lead concentrations (range 22–42 mg/kg, n=3). Soil analysed at Joint 0, at sampling distance 0 cm (directly below the pipe) of the Pioneer input pipe contains 84 mg/kg lead while soil 20 cm away from the same joint contains 47 mg/kg. The concentrations in soil at the pipe are moderately elevated compared to those at distance, suggesting that the pipe joint has contributed to soil lead concentrations.

Concentrations of tin were detected for the majority of the catchment ranging up to 693 mg/kg. The greatest concentrations were related to the historic tin mining practices (e.g. slag heaps) of the Ringarooma catchment, including around the Blue Tier and Frome Dam (102–693 mg/kg).

Samples analysed for lead concentration by pXRF and then by solution ICP-MS for comparison show only small differences in elemental concentrations between the two instruments (Supplementary Data 4).

Rock samples collected in the Ringarooma River catchment show low concentrations of all elements of interest in this study (Supplementary Data 5). The mean concentration of lead for each specimen did not exceed 47 mg/kg.

Sections of the pipelines throughout the water race above Pioneer examined for lead show that they contain significant lead concentrations, particularly in the joint welds (Table 2).

Lead isotopic compositions

Lead isotopic compositions of water samples collected from the Ringarooma public toilet (RingPT) ($^{208}Pb/^{207}Pb$=2.398, $^{206}Pb/^{207}Pb$=1.117), Pioneer house ($^{208}Pb/^{207}Pb$=2.406, $^{206}Pb/^{207}Pb$=1.144) and Pioneer public toilet (PionPT) ($^{208}Pb/^{207}Pb$=2.360, $^{206}Pb/^{207}Pb$=1.094) are presented in Fig. 6 and Table 3. The isotopic compositions of the tap waters are significantly displaced from local and regional bedrock values towards lower $^{208}Pb/^{207}Pb$ and $^{206}Pb/^{207}Pb$ compositions, lying at an intermediate point along the linear trend defined by local and regional bedrock and the major Australian lead ore mine sites (Broken Hill and Mount Isa). Lead isotopic compositions of scrapings collected from the Moorina Power Station joint ($^{208}Pb/^{207}Pb$=2.421, $^{206}Pb/^{207}Pb$=1.141) and the Moorina Power Station Pipe surface material ($^{208}Pb/^{207}Pb$=2.451, $^{206}Pb/^{207}Pb$=1.171) have similar compositions to the water samples collected in Pioneer house and Ringarooma public toilet.

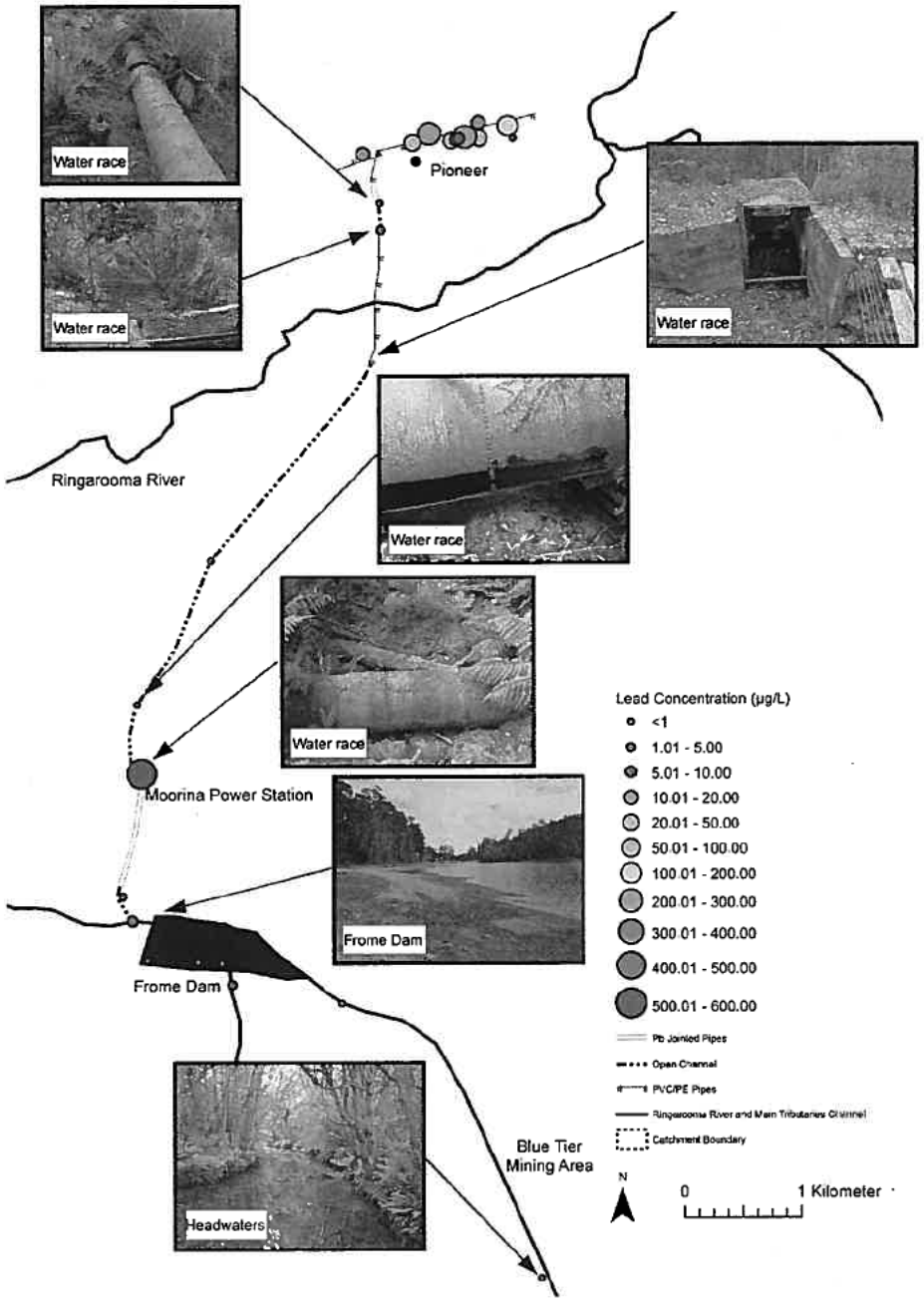

Fig. 3 Lead concentrations in water samples from the Frome Dam and Pioneer subcatchment (Tasmania)

Discussion

The source of the lead contamination of the drinking water supply in the Ringarooma River catchment has, until this study, been unknown. By applying a forensic and deductive approach to quantify a range of elements (As, Cu, Pb, Sn) and the lead isotope compositions in water, soil, sediment and the local bedrock, sources of drinking water contamination in the Ringarooma have been identified.

Sources of lead contamination in the drinking water supply

Natural environment

The Ringarooma River catchment is occupied predominantly by rural land uses proximal to the river channel. The catchment is bound by densely forested mountainous terrain through which a number of river tributaries pass. One of these

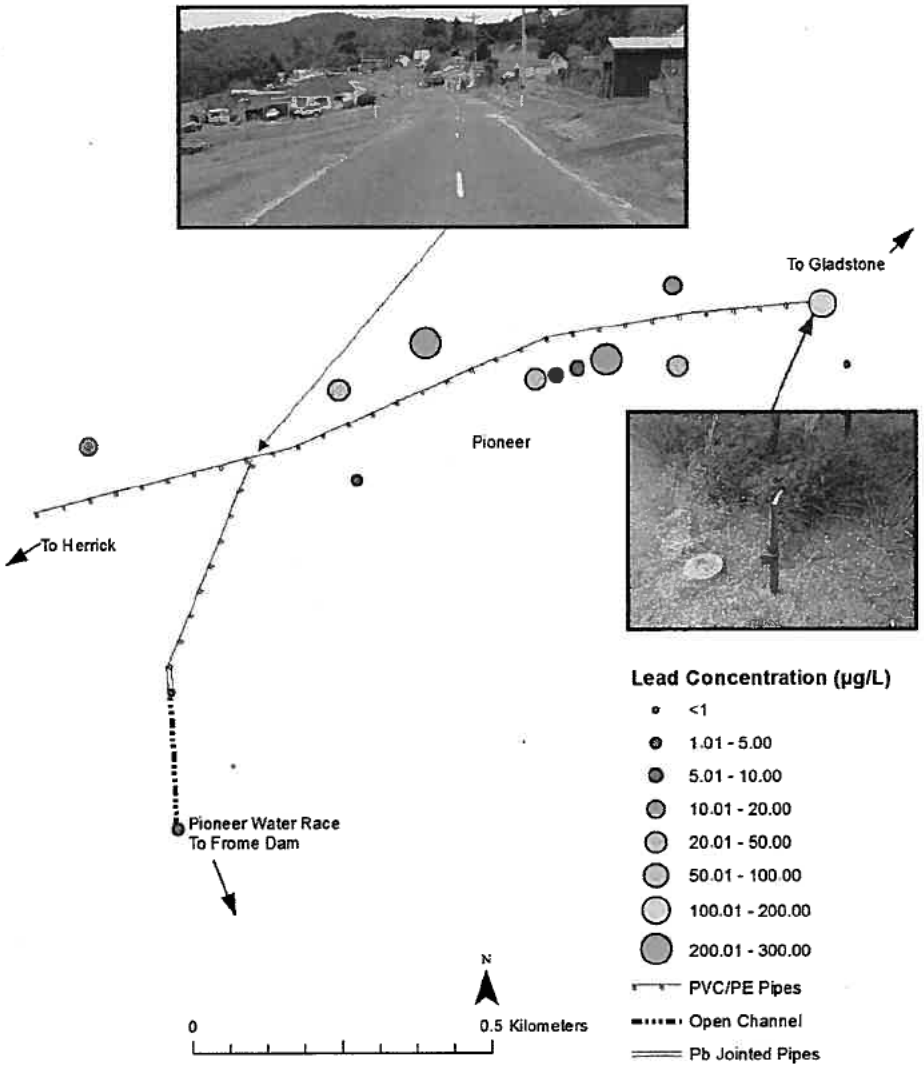

Fig. 4 Lead concentrations in water samples collected from houses and infrastructure in Pioneer town, Tasmania

tributary subcatchments, draining from the Blue Tier rock sequences, is dominated by the Frome Dam and forms the Pioneer water supply. Source water samples from the Ringarooma River did not have detectable concentrations of lead (Supplementary Data 2). Rock samples collected in this study from the Ringarooma River catchment contain element concentrations similar to the natural background concentrations as identified in Blue Tier sequences (Black et al. 2010). Thus, the source of contamination in the drinking water is unlikely to be natural as there is no evidence of the elements of interest existing in high concentrations in source water samples or the local bedrock.

Mining

Water in the Pioneer subcatchment drains the historic Blue Tier tin mining area. Sediment samples collected from slag deposits in the Blue Tier mining area and along the river channel above the Frome Dam show lead concentrations consistent with the bedrock lead concentrations of the Blue Tier identified in this study and also measured by Black et al. (2010). Higher than background tin concentrations are recorded in the sediments (max 693 mg/kg) in the channel above the Frome Dam, which continue to be elevated downstream below the dam for approximately 400 m before returning to background concentrations (~50 mg/kg). Water samples collected in the Blue Tier mining area contain, overall, undetectable lead concentrations. However, lead in water (9 µg/L) was detected immediately downstream of the Frome Dam wall, after passing through a 60-m concrete culvert which contains a ~3.5-m iron pipe (Debenham 1910). Low levels of lead (1.4 µg/L) are also detected at the south tributary above the Frome Dam, which is supplied by runoff from the Tasman Highway approximately 400 m upstream. Tin was not

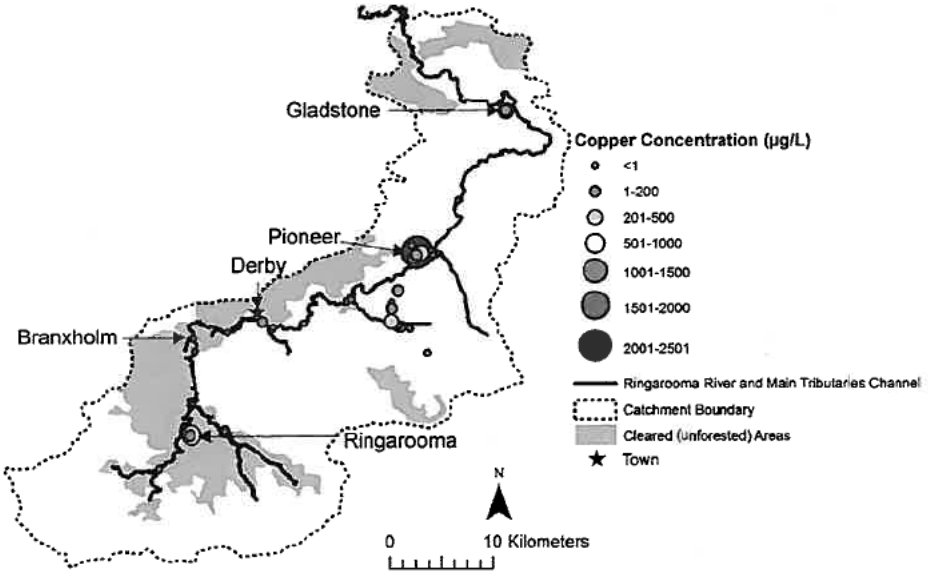

Fig. 5 Copper concentrations in water samples from the Ringarooma River catchment and towns (Tasmania)

detected in any of the water samples. The presence of lead at background concentrations in the sediments and the low lead concentrations in water samples from above the Frome Dam indicates that water lead contamination cannot be originating from sediment-bound lead in the Blue Tier sequences. The data indicate that the remnant slag heaps and associated material of the historic mining activities within the Pioneer subcatchment are not contributing significantly to elevated lead concentrations in the drinking water supply.

Water race pipelines

The large pipelines associated with the Frome Dam, the Moorina Power Station and the Pioneer holding ponds all contain lead. The majority of the pipes were installed during the Frome Dam and Moorina Power Station construction, which was completed in 1909 (Smith 1992). Many of these pipes are now heavily degraded and convey water poorly. Lead joints and fittings to the pipes were common in Tasmania at the time of construction, with the nearby Mount Cameron Water Race, built only 12 years prior to the Frome Dam and Moorina Power Station schemes in 1888, containing lead joints (Dickens 1990). Large water supply pipelines containing lead joints have been shown to cause significant environmental contamination (Harvey et al. in review). Analysis of the joints along sections of the Pioneer pipelines, including one internal joint surface sample, shows lead in significant concentrations, sufficient to generate contamination of the drinking water supply. A water sample collected in the channel below a degraded pipe at the Moorina Power Station contained 540 µg/L lead. The evidence suggests that the water race infrastructure contributes to the lead contamination of drinking water in Pioneer.

Table 2 Lead content of pipe sections from the Pioneer water race infrastructure

Sample	Lead concentration (mg/kg)
Frome Dam metal section a	126
Frome Dam metal section b	1372
Pioneer Cesspit #1 lower dam pipe joint 2 (test 1)	92
Pioneer Cesspit #1 lower dam pipe joint 2 (test 2)	474
Pioneer Cesspit #1 lower dam pipe joint 2 (test 3)	284
End of Power Station pipe (inner lining)	537
Moorina Power Station pipeline joint surface (test 1)	261
Moorina Power Station pipeline joint surface (test 2)	241
Moorina Power Station pipe joint	424

Analysis was undertaken using a portable X-ray fluorescence spectrometer (Olympus® InnovX Delta series, 4 W 50 kV, geochem mode)

Polymeric vinyl chloride pipes

Polymeric vinyl chloride (PVC) pipes were first introduced into the Australian Building Standards in the late 1970s in response to the end-of-life breakdown of older asbestos cement and clay pipes (Heathcote 2009). These pipes contained up to 1.8 wt% lead in the form of heat stabilisers (lead sulphate, lead phosphite, lead phthalate and lead stearate) added during the production phase (Heathcote 2009). The World Health Organisation (WHO 1973) evaluated the ability of lead to leach from PVC piping into drinking water and recommended that the use of metal-based stabilisers be decreased

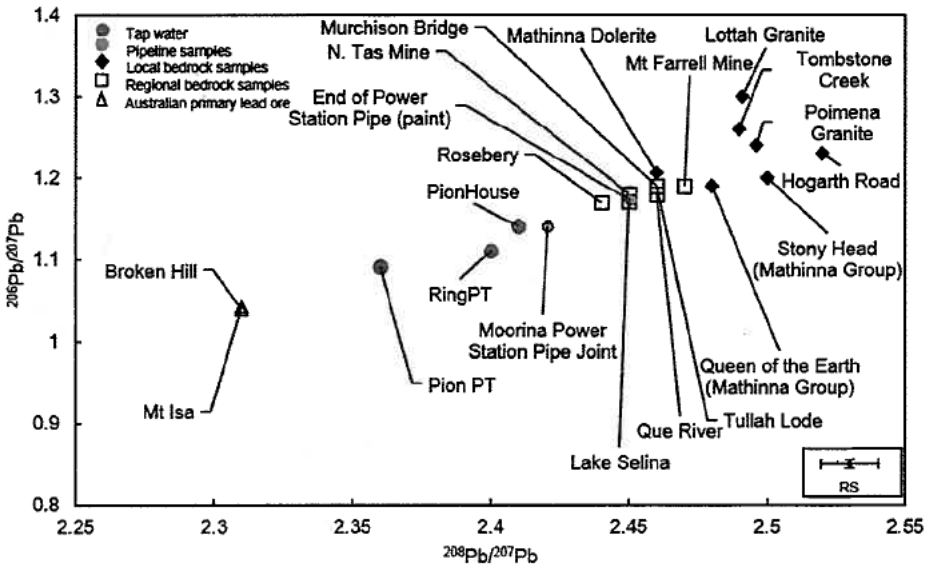

Fig. 6 Lead isotope compositions of samples collected in field relative to local bedrock (Black et al. 2010; Gulson 1986; Hergt et al. 1989) and Australia's largest lead ore mines, Broken Hill (Townsend et al. 1998) and Mount Isa (Gulson 1985). Indicative relative standard deviation (RSD): $^{206}Pb/^{207}Pb$ 0.33 %, $^{206}Pb/^{204}Pb$ 0.57 % and $^{208}Pb/^{207}Pb$ 0.41 %

(WHO 1973). A more recent study by Al-Malack (2001) showed that PVC pipes containing lead as a stabiliser can leach approximately 1000 µg/L of lead after 48 h exposure of pH 5 water to the pipes. Lasheen et al. (2008) showed that pipe age influences lead leaching from the pipes, with older pipes leaching 120 µg/L compared to new pipes that leached 95 µg/L over a 72-h study period.

This study shows that lead in the Pioneer drinking water supply increases significantly within the town, which is consistent with a change in the infrastructure from open channels and metal pipes to PVC and polyethylene pipes (PE) (GHD 2013a). The release valve at the intersection of Main Rd and Alfred Street in Pioneer contained a lead concentration of 120 µg/L after a 5-s purge (pH 5.6). Between the water source and the valve, PVC and PE pipes are used exclusively. Without connection to any other plumbing (e.g. households), the data shows that a source of the high lead concentration at the valve is a result of acidic water causing lead leaching from the PVC component of the pipeline that transfers water through the town of Pioneer.

Table 3 Lead isotope compositions for water and solid samples analysed in the Ringarooma River catchment (Tasmania)

Sample	$^{208}Pb/^{207}Pb$	$^{206}Pb/^{207}Pb$	$^{204}Pb/^{206}Pb$
Ringarooma public toilet (RingPt)	2.398	1.117	0.0580
Pioneer house (PionHouse)	2.406	1.144	0.0556
Pioneer public toilet (PionPT)	2.360	1.094	0.0599
Moorina Power Station pipe joint	2.421	1.141	0.0545
End of Power Station pipe surface material	2.451	1.171	0.0565

Internal property plumbing

Plumbosolvency of internal plumbing is commonly reported in the literature (Lee et al. 1989; Lyon and Lenihan 1977; Murrell 1985; Neff et al. 1987; Schock and Neff 1988; Subramanian and Connor 1991; Triantafyllidou and Edwards 2011). Internal plumbing of older properties typically comprises copper pipes with brass fittings that can contain up to 8 % lead (Lytle and Schock 1993). Nguyen et al. (2010) demonstrate that corrosion and lead contamination of water can be increased by intense galvanic reactions in water pipes that have adjoining copper and lead containing components. Kitchen tap water samples collected in Pioneer were elevated above the ADWG for lead, up to 210 µg/L. High lead concentrations correlate with a significant increase in copper concentration in the tap water samples (e.g. 2200 µg/L copper in the Pioneer public toilet sample which contains 220 µg/L lead, water pH 6.2) indicating the occurrence of galvanic reactions and increased pipe corrosion. First draw samples were also compared to time-delayed, repeat draw samples. Variability in the first-draw lead concentrations at the kitchen taps indicate localised variability in the contamination source, likely to be the usage of different plumbing materials. The time-delayed, repeat-draw samples show that the lead concentration declines in water that has not stagnated in the household plumbing. High concentrations of lead in water after standing within the internal property plumbing suggests that another major source of household water lead contamination is derived from domestic plumbing. While a proportion of the lead contamination of the drinking water is

entering the potable system from the mains infrastructure, it is evident that the internal plumbing of the houses (many circa 1900–1930s in age) is also a contributory factor.

Lead isotope analysis

Lead isotopes are used to fingerprint the origin of the lead contaminating the drinking water supply. Isotopic analysis of water samples from three locations (Pioneer house, Pioneer public toilet and Ringarooma public toilet) within the Ringarooma catchment show similar lead compositions. The isotope compositions of these samples are, however, displaced from local bedrock lead isotope ratios (taken from Black et al. 2010), suggesting the lead is from an another source. The lead isotopic compositions of the Pioneer Public Toilet sample are further displaced away from the local bedrock isotopic ratio, indicating that water in this part of the infrastructure has been exposed to a secondary lead source within the town. The data indicate a large proportion of the lead used in the Pioneer infrastructure was likely sourced from Broken Hill type ores (Fig. 6). The source for ores of this composition is probably the Broken Hill mine that started producing lead ore in 1885. The industrial production of Broken Hill ore coincided with the original construction period of the Pioneer water infrastructure (Jaquet 1894). In order to further characterise the source of the lead in the drinking water, lead isotope compositions were measured in samples from the degraded lead joints and also the surface material of the Moorina Power Station pipeline. The Moorina Power Station pipeline joints have an isotopic composition similar to the water samples collected in Pioneer house and Ringarooma public toilet. This suggests that the lead measured in the potable water supplies is of a similar origin, most likely being the water supply infrastructure.

Using the average local bedrock lead isotope compositions of Black et al. (2010) and the lead isotope compositions for Broken Hill type ores, a two-dimensional vector-based source apportionment calculation (Larsen et al. 2012) was derived for the Moorina Power Station joint sample. This showed that 43 % of the lead isotope composition in the joints can be attributed to Broken Hill type ores. The model data apportions 93, 47 and 76 % of lead measured in Pioneer house, Pioneer public toilet and Ringarooma public toilet water samples to the lead used in the Moorina Power Station joints.

Drinking water contamination is a widespread issue

Lead contamination of drinking water is not isolated to Pioneer. Additional sampling during this investigation showed detectable lead concentrations in the drinking water supply at Ringarooma and Gladstone on both occasions (Supplementary Data 2). Ringarooma public toilet tap water contained 7.9 μg/L lead in October 2013 and the Ringarooma public toilet and shop tap water samples contained 13 and 36 μg/L lead, respectively, in March 2014. The lead isotope ratios of the 2013 sample collected from the public toilet are similar to lead isotope ratios of the Pioneer water samples. Gladstone public toilet tap water contained 2.1 μg/L lead in October 2013 and 13 μg/L lead in March 2014. Winnaleah, also in the Ringarooma River catchment, was identified as having drinking water contaminated by lead in March 2014 (TasWater 2014), showing that the problem is not a spatially or temporarily isolated issue within the catchment. Throughout Tasmania, five other towns—Avoca, Whitemark, Royal George, Rosebery and Lady Baron—also have water supplies contaminated by metals including lead, arsenic and cadmium (DHHS 2014a; b; GHD 2013a). Thus, it is clear that north-eastern Tasmanian drinking water lead contamination appears to be a widespread geographic problem spanning a number of rural communities.

Beyond Tasmania, a recent unpublished survey (MP Taylor) of a residential property at Barellan, New South Wales, revealed a maximum drinking water lead concentration of 270 μg/L on first draw, 220 μg/L after a 30-s flush and 15 μg/L after a 3-min flush period. A second unpublished study in the town of Lue, New South Wales, showed tap water lead concentrations up to 12 μg/L (copper 1600 μg/L) (MP Taylor). These values are significantly in excess of the ADWG for lead of 10 μg/L. These studies show that metal contamination of drinking water is not an issue isolated to individual Australian communities and warrants further study.

The burden of disease from lead contaminated drinking water in Pioneer

In the 2011 census, the Australian Bureau of Statistics recorded 30 children in the Pioneer state suburb (22 % of the population), 11 of which were 0–4 years of age (ABS 2011). Children are most susceptible to the negative impacts from lead exposure (Lanphear et al. 2000, 2005). A number of these health impacts include renal damage, anaemia, neuropathy and encephalopathy. Population-based lead testing was not conducted in the town of Pioneer as the contamination event was deemed "short-lived and infrequent" (personal communicaton to C. Luck; O'Byrne 2013). Due to the lack of blood lead testing, the exposure toxicology of the drinking water lead contamination event is not known.

Water contamination, a risk in global development

The widespread distribution of contaminated drinking water supplies presented in this study highlights the need for greater global recognition and testing for drinking water contamination (WHO 2012). The current study has illustrated multiple infrastructure sources of drinking water contamination in a relatively small distribution system and highlights multiple

contaminant pathways from various infrastructure components. These issues are unlikely to be geographically isolated to the Pioneer catchment and are probably replicated across Australian rural communities, especially those characterised by old household plumbing systems. Poor regulation of drinking water networks, particularly in regions of low economic prosperity like those identified in the drinking water improvement program Millennium Development Goal 7c, often leads to the installation of low-quality infrastructure components, which may act as a contamination source (Balazs and Ray 2014; Johri et al. 2014; UNDG 2010). Attention needs to be given to the types of plumbing infrastructure installed for all connections globally to ensure these do not produce a legacy contamination risk.

Conclusion

The lead contamination of the drinking water supply in Pioneer, Tasmania, is not naturally occurring. The evidence in this study suggests that lead in the water supply can be attributed to three sources: (1) the water race infrastructure including the large lead jointed pipelines of the Frome Dam, the Moorina Power Station and the Pioneer holding dams; (2) the PVC pipes that connect the Pioneer holding dams to the residential service lines; and (3) lead-contaminated fittings and fixtures within individual properties. Metal contamination of drinking water is not isolated to Pioneer and remains a global issue, placing a risk of disease on many populations. Wider usage of PVC pipes in response to the Millennium Development Goal 7c has increased, inadvertently, the risks for drinking water contamination. This study illustrates the need for further consideration of the currently understudied problem of water lead contamination globally.

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Ethics statement The Australian National Health and Medical Research Council National Statement of Ethical Conduct in Human Research does not require ethics approval for collection of environmental samples (including tap water, soils or dust) as they do not relate specifically to human health, medicine and human research. Informed consent was however sought from all participants who provided a water sample in this study. Animals were not used in this study.

Conflict of interest The authors declare no conflict of interest.

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(03) 6334 3424

JENNY BELLENGER
POST OFFICE WINNALEAH TAS 7265
Attn:

FINAL REPORT

Lab No. 80065831
Submitted by The Client
Date Collected 02/12/2012
Reason for Examination :

Client Ref No.
Date Received: 03-Dec-2012

Date Reported: 06/12/2012
Time:1410

SAMPLE(s) ANALYSED AS RECEIVED

LABORATORY REPORT for: BELLENGER JENNY
Extracted from the Australian Drinking Water Guidlines

Based on aesthetic problems caused by post-fl occulation, the concentration of acid-soluble aluminium in drinking water should not exceed 0.2 mg/L. Water authorities are strongly encouraged to keep acid-soluble aluminium concentrations as low as possible, preferably below 0.1 mg/L.

Based on aesthetic considerations (precipitation of iron from solution and taste),
the concentration of iron in drinking water should not exceed 0.3 mg/L.
No health-based guideline value has been set for iron.

Based on aesthetic considerations, the concentration of manganese in drinking water
should not exceed 0.1 mg/L .Manganese would not be a health consideration unless the concentration exceeded 0.5 mg/L.
Tot Coliforms/E. coli - Enzyme Substrate: TLW-14/TLW-23
MINERALS AND METALS BY ICP-OES - In-House Method TLc-48

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LABORATORY REPORT for: BELLENGER JENNY

No.	Specimen Details	Time	Date Testing Commenced	Coliforms	E. coli	Units (Chem)	Tot. Al	Tot. As	Tot. Ca
1	CESSPIT WATER	15:30	04/12/2012			mg/L	0.201	<0.0125	1.45
2	CESSPIT WATER & SLUDGE	15:30	04/12/2012			mg/L	2.25	<0.0125	1.81
3	CESSPIT INLET	15:30	04/12/12	>2419.6 /100mL	99 /100mL	mg/L	0.756	<0.0125	2.36

No.	Specimen Details	Time	Date Testing Commenced	Tot. Cd	Tot. Cr	Tot. Co	Tot. Cu	Tot. Fe	Tot. K	Tot. Mg
1	CESSPIT WATER	15:30	04/12/2012	<0.010	<0.005	<0.010	<0.015	1.04	3.76	4.47
2	CESSPIT WATER & SLUDGE	15:30	04/12/2012	<0.010	<0.005	<0.010	<0.015	6.12	4.03	4.59
3	CESSPIT INLET	15:30	04/12/12	<0.010	<0.005	<0.010	<0.015	1.65	3.87	4.94

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SAMPLE(s) ANALYSED AS RECEIVED

LABORATORY REPORT for: BELLENGER JENNY

No.	Specimen Details	Time	Date Testing Commenced	Tot. Mn	Tot. Na	Tot. Ni	Tot. Pb	Tot. Se	Tot. Zn	Tot. P	B
1	CESSPIT WATER	15:30	04/12/2012	0.039	39.8	<0.005	<0.01	<0.030	<0.030	<0.105	0.019
2	CESSPIT WATER & SLUDGE	15:30	04/12/2012	0.705	40.6	<0.005	<0.01	<0.030	0.035	0.110	0.020
3	CESSPIT INLET	15:30	04/12/12	0.042	42.8	<0.005	<0.01	<0.030	<0.030	<0.105	0.019

No.	Specimen Details	Time	Date Testing Commenced	S	Fe	Sr	Mo	Sb	Ba
1	CESSPIT WATER	15:30	04/12/2012	1.76	<0.010	0.019	<0.015	<0.025	<0.010
2	CESSPIT WATER & SLUDGE	15:30	04/12/2012	2.02	<0.010	0.024	<0.015	<0.025	0.019
3	CESSPIT INLET	15:30	04/12/12	1.84	<0.010	0.034	<0.015	<0.025	0.018