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Submission: NSW Coal Fired power station Environmental Protection Licence review 2023

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The Hunter Community Environment Centre was established in 2004 and provides a resource to community members engaged in work to protect the Hunters unique, abundant ecology and biodiversity. For nearly 20 years, we along with thousands of supporters in the region have participated in grassroots campaigns to defend clean water and air, take action to reduce emissions to address climate change, conserve threatened species habitat and marine sanctuaries, contest new offshore oil and gas extraction projects as well as promote unity and solidarity with the labour movement working to secure good conditions in the renewable energy sector set to continue the Hunter's legacy as a leading electricity generation region.

The HCEC have an established interest in the reduction of coal power stations environmental, community and climate impacts via effective regulation through our citizen science led investigations and published reports, and we remain committed to achieving improved outcomes for the ecosystems and communities subject to six decades of the thermal electricity sector's pollution impacts. We work with community members residing in the vicinity of coal power stations and ash waste dumps whose concerns span water pollution and marine species effects, land use and air quality from both particulates and wind-blown ash dust.

The HCEC recognize and rejoice in the continued connection to country of the Awabakal, Worimi, Wonnarua and Darkinjung people to their land and waters in the Hunter region.

It is the strength and independence of organizations like the NSW EPA on which our ability to achieve a healthy compromise across complex competing interests' rests and so we thank the regulator for the generous approach to public consultation taken to this year's NSW coal fired power station licence review process and for this opportunity to make a submission.

In 2021, HCEC Senior Researcher Paul Winn presented numerous lines of evidence showing extensive water contamination from NSW coal ash waste dumps at one of three public hearings comprising the *Upper House Inquiry into the Costs of Contamination of sites containing coal ash waste repositories*. This inquiry resulted in the publication of Baseline Contamination Assessments or Environmental Site Assessments (ESA's) undertaken by consultant Environmental Resources Management, commissioned by the NSW Government at the point of privatization of NSW power station assets in 2014-15.

The ESA's reveal elevated heavy metal concentrations in surface, groundwater and sediment surrounding all NSW coal ash waste sites. After being released to the public via the Inquiry, communities near ash waste dumps in NSW gained access for the first time to documents detailing the significant extent of contamination at coal power station sites, two of which are situated on the southern shores of Lake Macquarie, with those residing in Eraring, Wangi,

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Bonnel's Bay, and Mannering Park and Wyee on the frontline of ash dam impacts unknowingly. At the time of publication in 2021, the NSW Government and new power station operators had known about the contamination identified in the site assessments for seven years.

Whilst the Inquiry did represent a turning point enabling greater transparency, scrutiny and constructive planning to occur in relation to coal power impacts, allowing impediments to ash reuse to be aired, the situation which allowed the Baseline Contamination Assessments to remain hidden from public view for almost a decade embodies the broad lack of transparency applied to the impacts and the operation of coal power stations which persists, and in the eyes of those able to draw a comparison before and after the acquisition by private companies of NSW electricity assets, has only worsened since 2015.

To date not all recommendations of the Upper House Inquiry have been fulfilled to the satisfaction of community members who took part it, namely recommendations 6, 8, 10 and 11 which rest largely with departments and Government, the NSW EPA's work in recognition of the Upper House Inquiry recommendations is to be commended and overall, improvements proposed by Upper House inquiry are still coming to bear.

Origin Energy's coal-ash strategy document of November 2022 explicitly points to recommendation 10 (*That Transport for NSW review its procurement practices to, where feasible, mandate the use of recycled coal ash in government-funded transport infrastructure projects*) noting that "…significant progress on this initiative has not yet been made therefore it remains a barrier to increasing ash recycling." Origin also note that the NSW EPA "…sought to bring together government bodies including Transport for NSW and Infrastructure NSW to review its procurement practices to, where feasible, mandate the use of recycled coal ash in government funded transport and infrastructure projects.

HCEC acknowledge and encourage the work being undertaken to monitor the environmental conditions of Lake Macquarie, involving surface water quality sampling, surface sediment sampling, depth profiling and ecotoxicity testing as well as a benthic ecological assessment, and the fact that NSW coal power station license holders have been tasked with completing and submitting to the NSW EPA *Coal Ash Characterisation Reports* detailing "surface and groundwater (including seepage) discharges associated with coal ash repositories (including ash dams and former mine voids in the vicinity of the ash repositories) at the Premises."

We encourage the NSW EPA to make good on its commitment to propose "..health study types that are able to address the community's health concerns" [1] once the environmental conditions study is complete, and believe that this is the least the NSW EPA can do in this regard.

Lastly, we note the recent variation of EPL 779, 761, 1429, and 13007 to include a *Coal Ash Monitoring* condition "…requiring the licensee to monitor and report on the annual quantities of coal ash generated, deposited and/or stored on the premises, and transported from the premises for reuse." which we see as a long-overdue and welcome addition.

Provisions in EPL's must in 2023 include climate emissions reduction, rehabilitation, and cumulative impacts. With the closure of these long-running, highly contentious facilities imminent within the next five and certainly less than ten years, the public interest and scrutiny on the operational, compliance, future land use and rehabilitation considerations of coal power will continue, aided by the high rate of licence breaches and general frequency of water and air pollution incidences proffered by thermal coal.

Delta Electricity, Origin Energy, Energy Australia and AGL have, according to the NSW EPA Public Register since the last license review in 2019, been issued a combined nine notices of breaches of EPL conditions for events occurring as far back as 2017.

[1] https://www.epa.nsw.gov.au/working-together/community-engagement/coal-ash-dams/monitoring-environmental-condition-lake-macquarie

Vales Point has attracted three penalty notices, *(1587551/16 September 2019, 1592298/13 October 2020)* Eraring two, *(1575548/Feb 1 2019,1592461/March 17 2020)* and Bayswater has been issued three penalties and an Enforceable Undertaking for its ash pipeline spill into Bayswater Creek *(1583975/26 August 2019, 1609519/24 June 2021, 1625742/8 Feb 2023, EU/23 December 2020)*. No penalty notices have been levelled at Mt Piper according to the Public Register, however HCEC has been privy to documentation of an official caution being issued on December 23 2021.

Whilst the rate of fines which a penalty notice attracts do not fall within the scope of the EPL review, community feedback received by HCEC has revealed a general dissatisfaction with the quantum of fines that can be levelled for a breach of license conditions, particularly ones of a repeated or similar nature. Personal communications to HCEC representatives have often expressed the view that the most oft attracted fine of $15,000 is felt to be too low to actually disincentivise operators to comply with EPL conditions.[2]We note that Delta Electricity may face up to $1,000,000 in fines for its alleged breach of license condition (section 64 of the POEO Act) resulting in the Mannering Park fish kill of September.

Concentration limits

It is well established that Australian coal-ash contains a range of potentially toxic trace elements including heavy metals including arsenic, boron, barium, cadmium, chromium, copper, mercury, manganese, nickel, lead, selenium, thorium, thallium, uranium and zinc which are polluting surface and groundwater, posing a risk to aquatic species and birdlife populations in NSW.

The NSW EPA website states that “The NSW Government has adopted the National Water Quality Management Strategy (NWQMS) and national WQGs as the policy and technical framework to manage and assess water pollution.”

The strategy is informed by the Australia New Zealand Guidelines for Fresh and Marine Water Quality which sets out default guidelines for ecologically safe concentration levels of water pollutants, including metals and metalloids.

HCEC identified a discrepancy between concentration limits where they were applied to licenced discharge points for heavy metals/metalloids, and the recommended limits for a range of species protection scenarios published in the Australia New-Zealand Ambient Water Quality Guidelines (ANZEEC 2000) in 2018. We also identify a range of exceedances of the recommended concentration limits set out in the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ), 2000.

Our submission to the 2019 review process for Vales Point EPL 761 pointed to a glaring lack of concentration limits for heavy metals/metalloids at licenced discharge points, inconsistency with concentration limits recorded at a range of licenced discharge points with the NSW Water Quality Objectives and ANZECC trigger values, and an increasing trend for selenium between 2013 and 2018 shown in published monitoring results.

Following this review in July of 2020 limits on Copper (0.005ppm) Iron (0.3ppm) and Selenium (0.002ppm) were introduced to EPL 761 by the NSW EPA, aligning it with that of Eraring, EPL 1429.

[2] HCEC have publicly called for: a) The NSW Environmental Protection Authority (EPA) be adequately funded to ensure appropriate oversight and regulation of large corporate polluters, and enhance its ability to prosecute polluters. b) The $15,000 maximum penalty the EPA can issue under Infringement Notices be increased to $150,000.

Whilst monitoring has been expanded, concentration limits on some metals/metalloids emitted by NSW coal power stations Licenced Discharge Points remain absent, and those that are in place are not all consistent with ANZEEC and ARMCANZ) water quality guidelines.

For example, although we welcome the addition of a concentration limit of 5ppb being applied to Copper discharges, we note that ANZECC & ARMCANZ (2000) recommend a marine high reliability trigger value for copper of 1.3 µg/L (0.0013 mg/L) for 95% species protection in slightly-moderately disturbed systems.[3]

In this instance, the limit the EPA has set for copper is twice that of the limit published in our national water quality framework. This discrepancy is just one example of the disconnect between those conditions which NSW power stations are subject to, and what a wealth of scientific literature prescribes to limit species and ecosystem impacts.

But this is just the beginning of the discrepancies and a recent review by HCEC of monthly monitoring data for Vales Points groundwater bores between 2016 to 2023 show a significant increase in concentrations of ammonia, arsenic, copper, manganese, nickel, potassium, sodium, and zinc.

Over the period of 60 years that Vales Point has been operating as an ash repository ash has been has been wet-sluiced using saline water pumped from Lake Macquarie to convey the ash along pipelines.[4] As a result, sediments in Mannering Bay have become contaminated with a number of toxicants, particularly, arsenic, cadmium, copper, manganese, nickel, and zinc and edible crabs have also been contaminated with Blue Swimmer and Mud Crabs being found with elevated concentrations of arsenic and cadmium.

Figure 1: EPL761 groundwater monitoring bores (#30, #31, #32, #33, #34)

In 2021, a consultant's report prepared for Delta Electricity in response to a complaint of contaminated groundwater seepage at a nearby nursery business, found elevated metal

[3] https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/toxicants/copper-2000

[4] Bunn T. F. and Chambers A. J., (1991), "Characterisation of Fly Ash Slurries", International Mechanical Engineering Congress, Sydney, NSW, Australia, 8 - 12 July, pp. 50 - 61.

concentrations (particularly aluminium, copper, lead, and zinc) at all wells closest to the groundwater seepage.

Similar elevated total dissolved metal concentrations were reported at other groundwater seepage discharge points and the Ash Dam Pipe, suggesting groundwater impact at these locations through the dissolution of metals from ash caused by acidic groundwater conditions.

The consultant's report suggests:

"…it is likely that over this time the ash in the Dam have experienced anaerobic conditions resulting in sulfate-reducing bacteria in the ash converting dissolved sulfate present in the pore water to react with metals, particularly iron, resulting in the formation of metal sulphides (principally pyrite). It is likely that wet-sluicing of the ash for disposal has resulted in RIS oxidation, and the resultant lowering of groundwater pH and the dissolution of trace metals and metalloids. Groundwaters and surface water affected by RIS oxidation can be characterised as highly saline, low pH and have elevated metal concentrations."

The report recommended ceasing wet-sluicing of ash as soon as possible and the investigation of preferential groundwater migration pathways noting that it is likely that one exists through fractures, joints and/or bedding planes in the weathered Munmorah Conglomerate rock.

The ash transport process known as wet-sluicing used at Vales Point has been abandoned elsewhere in Australia and the world due to the higher volumes of toxic ash leachate it produces compared to transport processes known as "dense phase" ash transport.

Below we present charts plotting monthly groundwater monitoring at Vales Point showing exceedances of ANZECC & ARMCANZ 2005 trigger values for ammonia, arsenic, cadmium, copper, manganese, nickel and zinc. Multiple of these exceedances represent the highest concentrations identified in groundwater since monitoring commenced.

A fuller exploration of these results and HCEC's surface water, sediment core and recent crab sample results are set out in an Appendix, 'The case for reducing water in the Vales Point Ash Dam' to this submission in which increases in sodium and potassium at EPL 761 groundwater monitoring bores are also discussed.

Ammonia

Delta Electricity's quarterly monitoring results for October 2023 identifies a spike in ammonia at three of the five groundwater monitoring points. Samples from a further monitoring bore identifies a spike in concentrations of ammonia in July 2023. These are the highest ammonia concentrations identified in groundwater since July 2020, when EPL groundwater ammonia monitoring began.

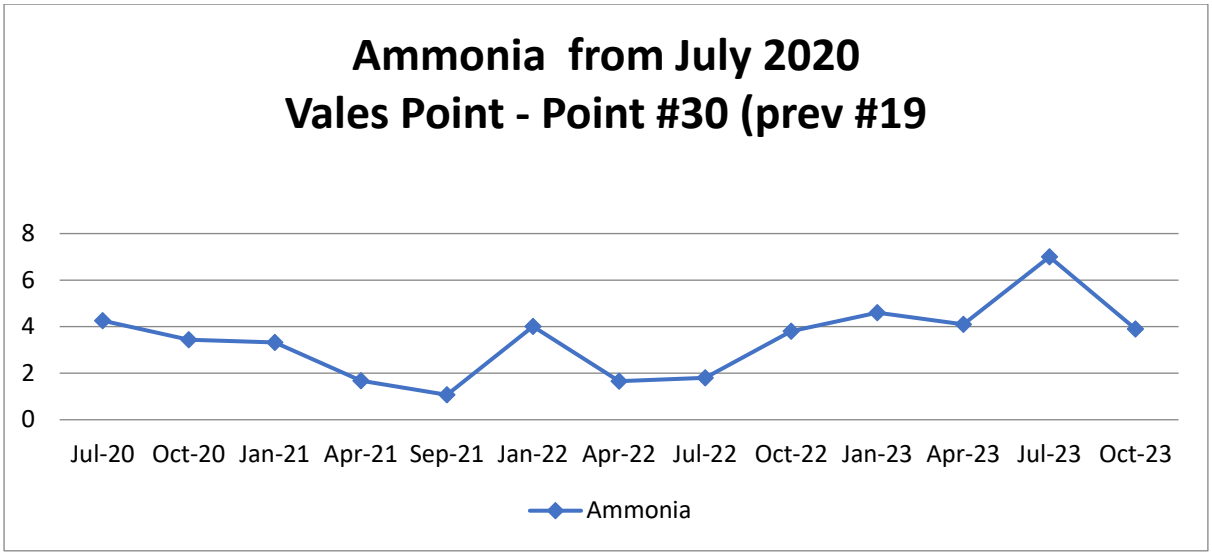

Chart 10a: Groundwater ammonia concentrations July 2020 to October 2023 at EPL Monitoring Point 30 Units in mg/L (1 mg/L = 1000 µg/L) (Source: Appendix - The case for reducing water in the Vales Point Ash Dam, HCEC)

In July 2023, at a measured pH of 6.2, ammonia concentrations reached 7 mg/L (7000 µg/L), up from a previous high of 4 mg/L (4000 µg/L) in January 2022 and January 2023, representing concentrations above the recommended marine moderate reliability trigger value of 5.9 mg/L at this pH level by ANZECC (2000).

Arsenic

Arsenic III is highly soluble in water and can easily dissolve in groundwater. Inorganic arsenic III compounds are highly toxic and have been linked to various health problems such as skin lesions, cardiovascular disease, and some types of cancer. While arsenate (arsenic V) is not as toxic as arsenite (arsenic III), it can still pose a risk to human health through long-term exposure.

A significant spike in groundwater arsenic concentrations was identified between July 2019 and January 2020. In July 2020, Delta began publishing quarterly monitoring results for the two oxidation states of arsenic - arsenic (III) and arsenic (V)[5].

ANZECC & ARMCANZ (2000) does not provide a marine trigger value for total dissolved arsenic. However Section 8.3.4.5 of the ANZECC & ARMCANZ (2000) provides an Environmental Concern Level (ECL) of 2.3 µg/L (0.0023 mg/L) for As (III) in marine waters, suggesting it could be adopted as a marine low reliability trigger value. A low reliability marine guideline trigger value of 4.5 µg/L (0.0045 mg/L) for As (V) is also recommended, as an indicative interim working level.[6]

Arsenic III and arsenic V are the most commonly found oxidation states of arsenic, total dissolved arsenic can thus be found by adding the two oxidative state concentrations. This would result in a combined trigger value of 6.8 µg/L (0.0068 mg/L).[7]

[5] In water, arsenic normally occurs in the oxidation states III and V. Therefore, a total arsenic measurement is a combination of the concentration of arsenic III and arsenic V

[6] https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality toxicants/toxicants/arsenic-2000

[7] https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality toxicants/toxicants/cadmium-200

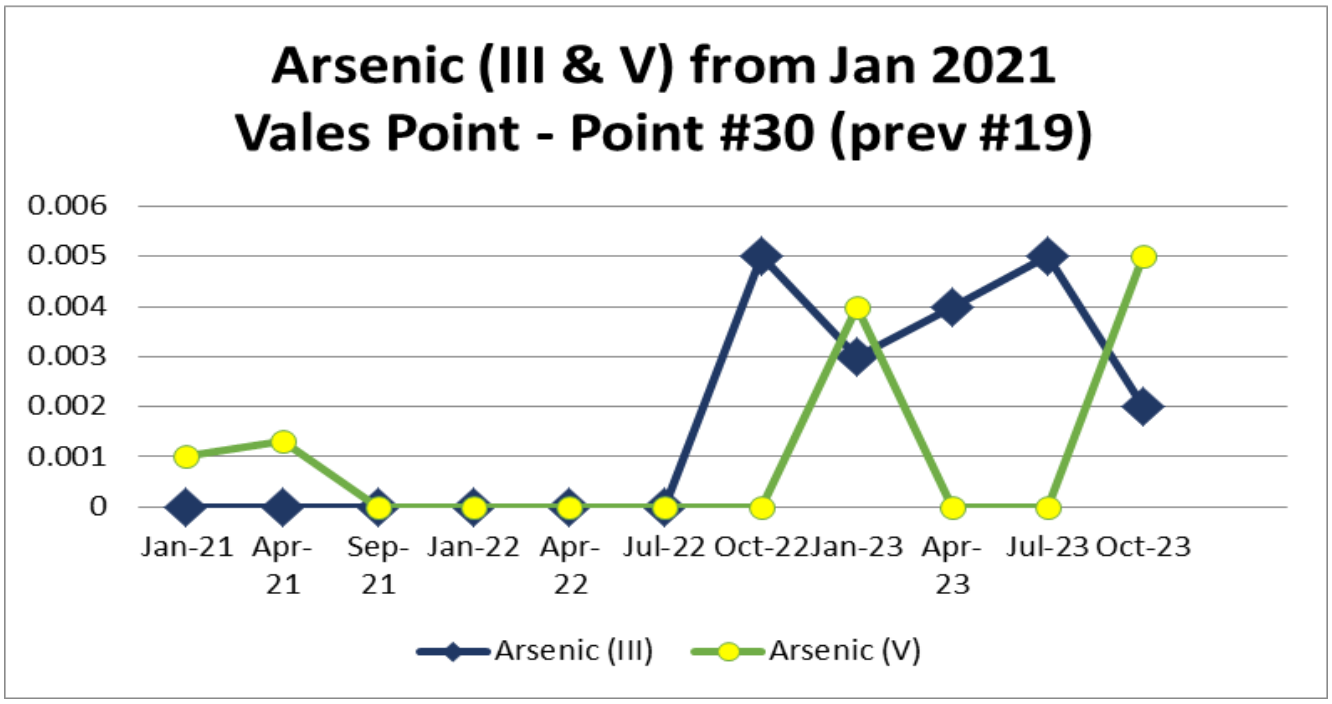

Chart 11b: Groundwater arsenic concentrations October 2016 to April 2020 at EPL Monitoring Point 30. Units in mg/L (1 mg/L = 1000 µg/L) (Source: Appendix - The case for reducing water in the Vales Point Ash Dam, HCEC)

Concentrations of arsenic III at Point #30 spiked to 0.005 mg/L (5 µg/L) in July 2022 and again in July 2023, double the ANZECC (2000) ECL. This is an indicative interim working level, further study into the impacts this concentration may have on aquatic species in Mannering Bay and Wyee Bay is warranted.

Results recorded for Point #31 between October 2016 to April 2020 at EPL for Arsenic show a spike in total dissolved arsenic concentrations in April 2020, when it reached 0.02 mg/L (20 µg/L), and results recorded between July 2020 and October 2023 show a spike in Arsenic III in October, reaching concentration level of 0.011 mg/L (11 µg/L) which is 4 times the ANZECC & ARMCANZ (2000) ECL of 2.3 µg/L.

This is an indicative interim working level and further study into the impacts that this concentration may have on aquatic species in Mannering Bay and Wyee Bay is warranted.

Cadmium

ANZECC & ARMCANZ (2000) recommend a high reliability marine guideline value for cadmium of 5.5 µg/L for 95% protection. However, to protect against chronic toxicity and bioaccumulation of cadmium to related species, the 99% protection level of 0.7 µg/L is recommended for slightly to moderately disturbed ecosystems. If in an area where shellfish are likely to be used for human consumption, the trigger value should be reduced to 0.2 µg/L.[8]

[8] 16 See https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality toxicants/toxicants/cadmium-2000

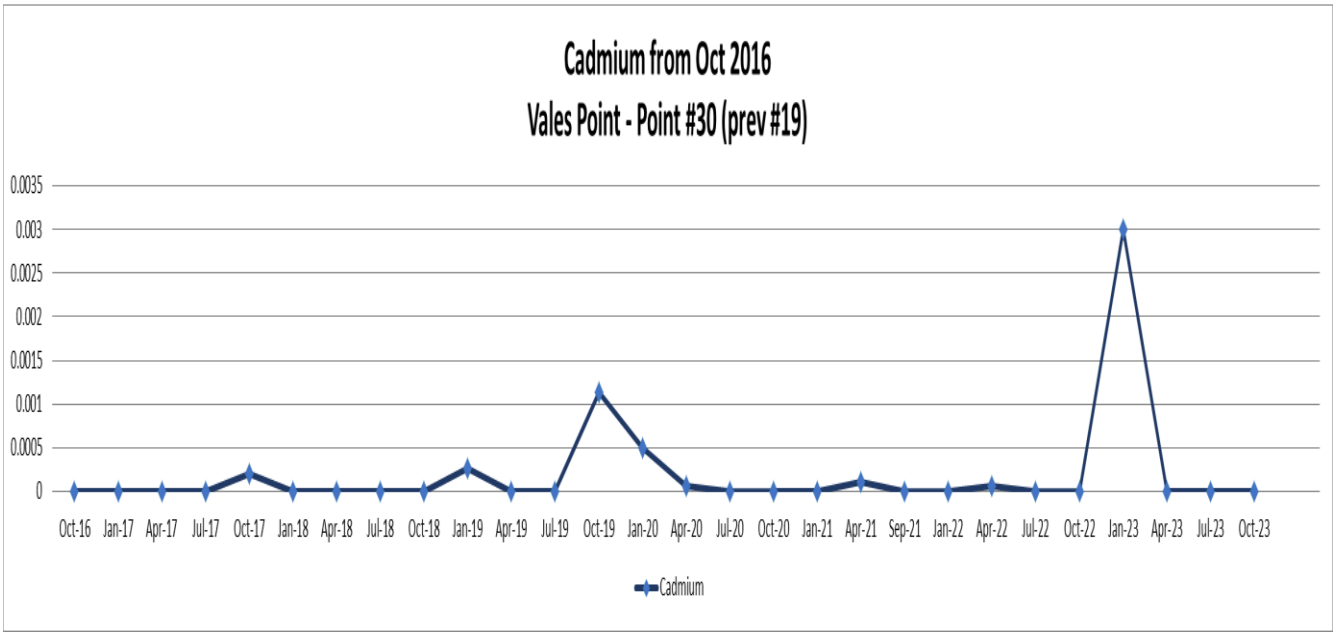

Chart 12a: Groundwater cadmium concentrations October 2016 to October 2023 at EPL Monitoring Point 30 (formerly 19). Units in mg/L (1 mg/L = 1000 µg/L). (Source: Appendix - The case for reducing water in the Vales Point Ash Dam, HCEC)

Chat 12a above shows a spike in cadmium concentrations at Point #30 to 0.003 mg/L (3 µg/L) in the monitoring results for January 2023 - the highest concentrations of cadmium since October 2016 and 4 times the ANZECC & ARMCANZ (2000) recommended high reliability marine guideline value for cadmium of 0.7 µg/L, which is to protect against chronic toxicity and bioaccumulation of cadmium, particularly bivalves and crustaceans.

As this monitoring point is near to an area where shellfish are likely to be used for human consumption, a case could be made for the trigger value to be reduced to 0.2 µg/L. The January 2023 monitoring results for this bore is 15 times this human consumption trigger value.

Results for groundwater monitoring Point #33 show a spike in cadmium concentrations in October 2020 reaching 0.003 mg/L (3 µg/L), three times the ANZECC & ARMCANZ (2000) recommended high reliability marine guideline value for cadmium of 0.7 µg/L for slightly to moderately disturbed ecosystems, and 15 times the reduced marine guideline value of 0.2 µg/L recommended for areas where shellfish are likely to be used for human consumption.

Copper

Delta Electricity's quarterly monitoring results for October 2023 identifies a spike in copper at two of the five groundwater monitoring points representing the highest copper concentrations identified in groundwater since October 2016, when EPL 761 groundwater copper monitoring began.

ANZECC & ARMCANZ (2000) recommend a marine high reliability trigger value for copper of 1.3 µg/L (0.0013 mg/L) for 95% species protection in slightly-moderately disturbed systems.

In January and October 2020 and October 2023, substantial spikes in copper concentrations are recorded in monthly groundwater bore monitoring data representing exceedances of up to 90 times the ANZECC & ARMCANZ (2000) recommended trigger value of 1.3 µg/L (0.0013 mg/L) for slightly-moderately disturbed systems.

The January 2020 concentration of copper at Point #34 was 0.12 mg/L (120 µg/L), more than 90 times the ANZECC & ARMCANZ (2000) recommended trigger value of 1.3 µg/L (0.0013 mg/L) for slightly-moderately disturbed systems.

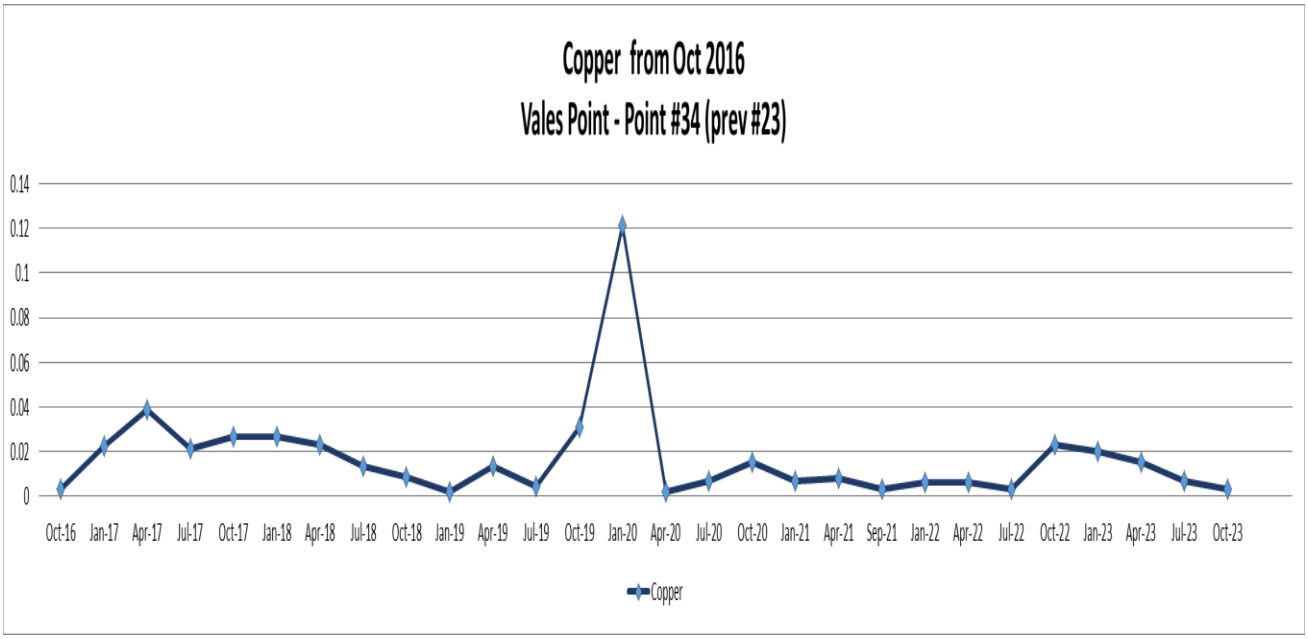

Chart 13e: Groundwater copper concentrations October 2016 to October 2023 at EPL Monitoring Point 34. Units in mg/L (1 mg/L = 1000 µg/L). (Source: Appendix - The case for reducing water in the Vales Point Ash Dam, HCEC)

Later that year in October, the monitoring result for copper at Point #33 was 0.05 mg/L (50 µg/L), 45 times the ANZECC & ARMCANZ (2000) recommended trigger value of 1.3 µg/L (0.0013 mg/L).

The October 2023 monitoring result for copper at monitoring Point #30 was 0.085 mg/L (85 µg/L), almost 70 times the ANZECC & ARMCANZ (2000) recommended trigger value of 1.3 µg/L (0.0013 mg/L) for slightly-moderately disturbed systems[9] and at Point #31 in the same month, concentrations reached 0.09 mg/L (90 µg/L), again most 70 times the ANZECC & ARMCANZ (2000) recommended trigger value.

Manganese

Delta Electricity's quarterly monitoring results for 2023 identify a spike in manganese concentrations at three of the five groundwater monitoring points which again, show the highest manganese concentrations identified in groundwater since October 2016, when EPL 761 groundwater manganese monitoring began.

At point #30, manganese concentrations peaked at this bore in January 2023 at 6 mg/L (6000 µg/L) and in October 2023 it was recorded to be 75 times the ANZECC & ARMCANZ (2000) recommended marine low reliability trigger value of 80 µg/L (0.08 mg/L). This is an indicative interim working level and further study into the impacts this concentration may have on aquatic species in Mannering Bay and Wyee Bay is warranted.

[9] Copper in freshwater and marine water (waterquality.gov.au)

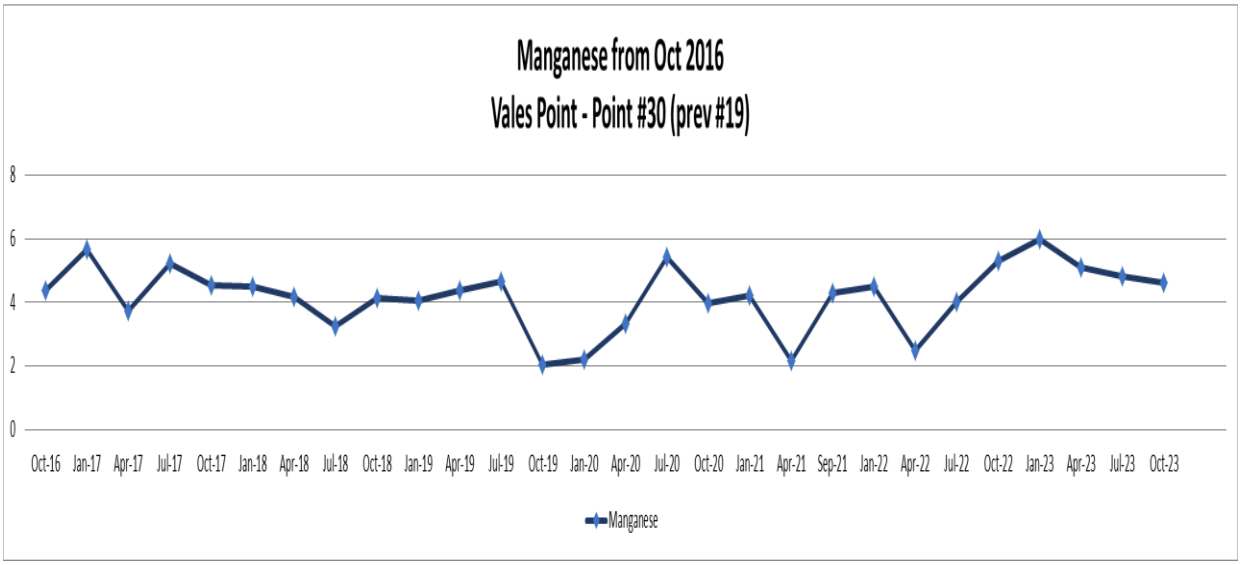

Chart 14a: Groundwater manganese concentrations October 2016 to October 2023 at EPL Monitoring Point 30 (formerly 19). Units in mg/L (1 mg/L = 1000 µg/L). (Source: Appendix - The case for reducing water in the Vales Point Ash Dam, HCEC)

At Point #31, manganese in July 2023 is recorded to reach 4.7 mg/L (4,700 µg/L), almost 60 times the limit of 80 µg/L (0.08 mg/L) and in October the concentrations reached 12 times the limit.

At point #32, manganese concentrations recorded between 2016 and 2023 show in October 2023 a concentration of 1.5 mg/L (1500 µg/L), 12 times ANZECC & ARMCANZ (2000) recommended high reliability marine guideline value, and finally at point #33 a peak in manganese concentrations of 1 mg/L (100 µg/L) occurred in July 2017.

Nickel

Three of five groundwater monitoring bores identify spikes in nickel in the October 2023 monitoring data, representing the highest concentrations identified in groundwater since October 2016, when EPL 761 groundwater nickel monitoring began.

The ANZECC & ARMCANZ (2000) specifies a 99% protection level of 7 µg/L for slightly to moderately disturbed marine systems for nickel.[10]

The peak concentration of 0.8 mg/L (800 µg/L) recorded at Point #30 in October 2023 is ten times the ANZECC & ARMCANZ (2000) recommended high reliability marine guideline of 70 µg/L at 95% protection, and 100 times the 99% species protection level recommended for slightly-moderately disturbed marine systems, to give sufficient margin of safety from acute toxicity in some species.

[10] Nickel in freshwater and marine water (waterquality.gov.au)

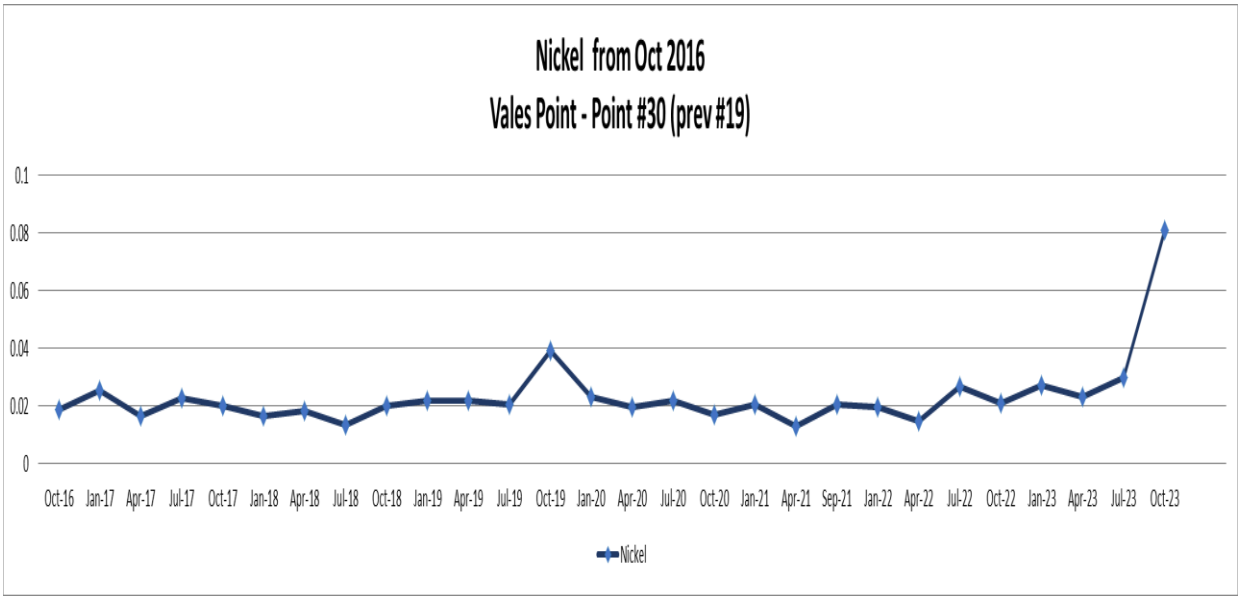

Chart 15a: Groundwater nickel concentrations October 2016 to October 2023 at EPL Monitoring Point 30. Units in mg/L (1 mg/L = 1000 µg/L). (Source: Appendix - The case for reducing water in the Vales Point Ash Dam, HCEC)

Exceedances of this guideline for 95% and 99% protection value are also recorded at points #31, #32 and #33 across the seven year period between 2016 until October 2023.

Zinc

Spikes for zinc were recorded in one of five groundwater monitoring points, again representing the highest zinc concentrations identified in groundwater since October 2016 when EPL groundwater monitoring began for this pollutant.

ANZECC & ARMCANZ (2000) derived a very high reliability Default Guideline Value (DGV) for zinc in marine water from chronic (long-term) toxicity data for 16 species. The DGVs for 95% species protection is 8.0 µg/L. The 95% species protection DGV may be under-protective for key sensitive species (e.g. bivalve molluscs, cnidarians) and the 99% species protection DGV of 3.3 µg/L could be adopted if there are concerns about the protection of key sensitive species.[11]

[11] https://www.waterquality.gov.au/sites/default/files/documents/zinc_marine_dgv_technical-brief.pdf

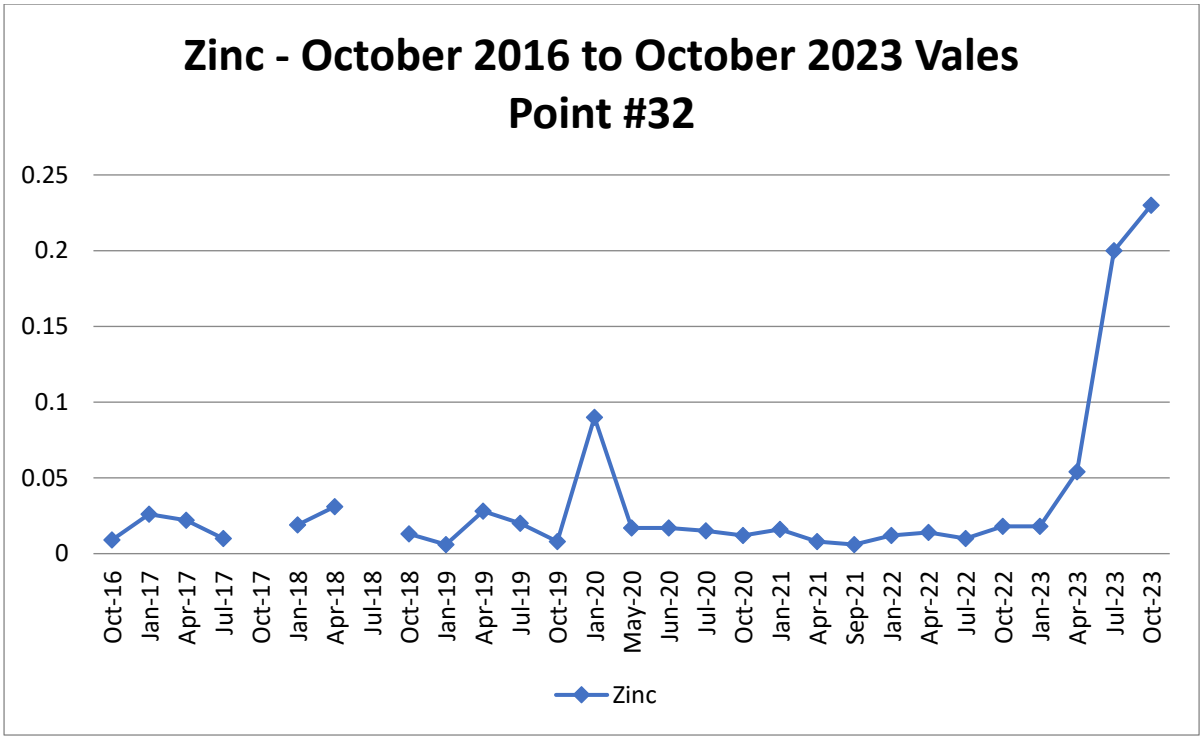

Chart 17a: Groundwater sodium concentrations April 2021 to October 2023 at EPL Monitoring Point 31. Units in mg/L (1 mg/L = 1000 µg/L). (Source: Appendix - The case for reducing water in the Vales Point Ash Dam, HCEC)

Chart 17a shows that at point #32 a peak concentration of zinc was reported in October 2023, almost 0.23 mg/L (230 µg/L). This concentration is 28 times the ANZECC & ARMCANZ (2000) very high reliability marine draft guideline value of 8 µg/L, and almost 70 times the 3.3 µg/L 99% species protection level for protection of sensitive species such as bivalves, molluscs and cnidarians.

These results reflect that fact that Vales Points ash dam holds far too much water, which mobilises toxins within the ash. Elsewhere in Australia and the world, coal ash is transported to storage facilities using far less water than used by Delta to manage Vales Point. The installation of new dense phase ash transport infrastructure designed to reduce the water collecting in the ash dam is essential in reducing groundwater contamination, and the continual contamination of Lake Macquarie.

Recommendation 1: After appropriate trials and engineering design, to minimise toxic trace elements contained within Vales Point coal ash from mobilising and entering groundwater and Lake Macquarie, EPL 761 be varied to incorporate a clause that directs Delta Electricity to install new plant and machinery for dense phase ash transport to the Vales Point Ash Dam.

Recommendation 2: Current NSW power station EPL concentration limits on water pollutants be reviewed against those limits specified in the ANZECC & ARMCANZ 2000[12] water quality guidelines and EPL variations to introduce the strictest possible water concentration limits set out in these frameworks take place within a reasonable timeframe.

[12] Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 2000. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra

Seagrass and thermal pollution – inlet & outlet impacts

Similarly, the temperature limits on NSW coal power stations outlets for thermal pollution are out of step with what is suggested by the global scientific community as required to avoid or reduce impacts.

The water temperature limit at the Eraring outlet for example is 35°C however, accounting for the *Special Condition 8. E1. Discharge of cooling waters into Lake Macquarie* in EPL1429 it can reach up to 37.5°C for total of 307 hours, which is 18.5°C degrees above that of the average ambient water temperature of 18°C for the last 6 months recorded at the inlet[13].

Cooling water discharged by Delta Electricity into Wyee Bay reaches up to 11.3°C above average ambient Lake temperatures in Winter (maximum of 32°C14), and 15.7°C above ambient temperatures in Summer (maximum of 38.1°C.15). Delta also benefit from the Special Condition on discharge of cooling waters. L3.9 permitting "… during normal electricity supply conditions, cooling waters may be discharged over 35°C and up to, but not exceeding, a maximum temperature of 37.5°C for up to a total of 131 hours during the reporting period" as well as "an additional 69 hours are available to allow compliance during periods of high electricity demand to avoid potential shortfall of electricity supply as per conditions E1.1 to E1.4 of this licence where cooling waters may be discharged over 35°C and up to, but not exceeding, a maximum temperature of 37.5°C over a reporting period…"[16]

The temperature differentials allowed by the present limits imposed in EPL 761 and 1429 are well above the less than 5°C initial rise in temperature recommended to avoid impact on aquatic ecosystems[17] which international scientific consensus has settled on.

Accordingly, cooling water discharges from the Vales Point and Eraring power stations are described in the 2023 Lake Macquarie Coastal Management Program, certified by the NSW Environment Minister in September, as "...a defining feature of the estuary."

Between the steady and significant loss of both *Halophila ovalis* and *Zostera capricorn*i seagrass extent in Wyee Bay, coinciding with repeated relaxation of temperature limits by the NSW EPA between 2005 and 2016 at Delta Electricity's request, and the mass fish kills of August and September of 2023, the adverse impacts of cooling water canal discharges particularly that of Vales Point power station, have regrettably become a defining feature of local communities' experience of the estuary too.

The Program also notes that there is "...approximately 12.4km2 of seagrass coverage in Lake Macquarie", making it the "third largest area of seagrass in NSW" and a "main source of primary production for the food web within the lake… used by invertebrate species to recycle organic matter and nutrients."

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[13] Origin Energy. (May-October 2023). Environmental Monitoring Data. EPA Identification no. 27 - The waters of Lake Macquarie located midway between cooling water inlet and Hungary Point. https://www.originenergy.com.au/about/who-we-are/what-we-do/generation/eraring-documents-resources/

[14] Delta Electricity (Jun 2016). Environmental Licences and Monitoring. Vales Point Power Station Monthly Environmental Data Summary; Point 22. Discharge of cooling water from the cooling water outlet canal to Wyee Bay. https://www.de.com.au/environment/environmental-licences-and-monitoring?retain=true&PagingModule=877&Pg=1

[15] Delta Electricity (Feb, 2017; Sep 2018;Jan 2020; Feb 2020. Environmental Licences and Monitoring. Vales Point Power Station Monthly Environmental Data Summary; Point 22. Discharge of cooling water from the cooling water outlet canal to Wyee Bay. https://www.de.com.au/environment/ environmental-licences-and-monitoring?retain=true&PagingModule=877&Pg=1

[16] EPL 761

[17] Laws, E.A. 2000. Aquatic Pollution: An Introductory Text; John Wiley and Sons: New York, NY, USA, 2000

The extent of seagrass loss in Lake Macquarie over the decades since coal power began operating cannot be overstated, nor can the important role of seagrass in the overall health of the Lake estuary, especially considering rising global sea temperatures and associated acidification, to which seagrass provides a foil with a 2021 study showing that seagrasses healthy photosynthetic process can elevate pH levels in the aquatic ecosystem, counteracting the acidifying effect of increased CO2.18

DPI Fisheries seagrass mapping identifies that between 2008 and 2012 southern Lake Macquarie lost 34 percent of its seagrass, compared to a 4 percent increase in seagrass cover in northern Lake Macquarie.

Losses attributable to Vales Point and Eraring thermal discharges are primarily of Zostera seagrass, and estimated by HCEC to be just shy of 60 hectares in Wyee Bay and approximately 10 hectares in Myuna Bay. Based on DPI Fisheries calculations and data, we estimate Delta's thermal pollution has been responsible for an estimated $12.6M a year in lost commercial fishery production, and over the period 2005 to 2023 commercial fisheries of south eastern Australia suffered an estimated combined loss of about $226.8M.

The question of how an ecosystem which has no doubt adapted to the conditions of near continuous thermal pollution will respond when the temperature returns to more consistent natural baseline has been raised by HCEC with the NSW EPA, Delta Electricity and Origin Energy staff.

What other than decades of artificially tropical water temperatures, regularly exceeding 20°C in Wyee and Myuna Bays' could account for the presence of green sea turtles and at least two species of rays including Whitespotted eagle rays, many specimens of which succumbed to the impacts of poisoning after both mass fish kills of 2022.

The potential ill- effect of suddenly altered thermal conditions within these receiving bays, upon the retirement of Vales Point and Eraring necessitates investigation and we proposed a phased reduction in thermal inputs to allow for readjustment. Seagrass restoration and replanting including an assessment of rhizome health and distribution should follow.

Whilst more just attention is being afforded to impacts associated with the cooling water outlet, impingement and entrainment of marine species at the inlet canal are immense and in the absence of more regular and publicly accessible reporting, we can only cite likely outdated figures from Eraring's 2008 capacity grade Major Projects portal documentation, citing an annual figure of 100,000 entrained with fatalities of 7000 and injuries (many of which likely result in fatality) of 26, 000 fish, crustacea and other marine species.

Recommendation 3: To offset seagrass loss in Myuna and Wyee Bays, a Lake Macquarie Seagrass Trust be established with funding of $12M a year from Delta Electricity and $8M a year from Origin Energy to enhance seagrass meadows within Lake Macquarie and replace seagrass damaged and killed by the operations of Vales Point and Eraring power stations.

Recommendation 4: To encourage the rejuvenation of Zostera seagrass within Wyee Bay, a study be undertaken that determines ambient water quality, appropriate seasonal temperature differentials, seagrass sensitivity, and the assimilative capacity of Wyee Bay, and EPL 761 be varied accordingly to incorporate a scientifically established thermal mixing zone south of Wyee Marina.

Recommendation 5: Monitoring and reporting of inlet impacts including figures of species entrained, injured and killed should be disclosed in monthly monitoring data.

[18] https://onlinelibrary.wiley.com/doi/10.1111/gcb.15594

Coal-ash waste: production, emplacement, reuse and rehabilitation

Ultimately, the removal, safe and beneficial reuse of the approximately 200 million tonnes of coal ash waste material presently stored in unlined dumps on key waterways across NSW is the only means of substantially reversing the unfortunate land use and contamination implications of decades of unfettered ash, along with other toxic waste dumping on-site by power station operators.

We note again here that the EPA has introduced a Coal Ash Monitoring Condition and that the "regulatory framework encourages beneficial reuse of coal ash in appropriate circumstances where the reuse is genuine, beneficial or fit for purpose and will not cause harm to human health or the environment."

Whilst there has certainly been some progress towards an increase in ash waste recycling made on behalf of operators and the NSW Government, an overarching market failure is still diverting the bulk of the coal-ash waste produced in NSW into unlined landfills situated on Lake Macquarie, Central Hunter river and Upper Cox's catchment, where Energy Australia's decommissioned Wallerawang power station ash dump, Kerosene Vale ash repository was declared contaminated by the NSW EPA in 2022.[19]

At Mt Piper, a 100% reuse rate was achieved in 2019-20 for the Lamberts North ash emplacement area. 672,002 tonnes was produced, 150,677 tonnes of which not required for brine management, was reused. Overall, brine management present an impediment to ash reuse on behalf of Energy Australia.[20]

No information is provided by Energy Australia via its website on Mt Pipers ash generation, dumping or reuse for the last three years however the Ash Management Strategy of articulates a series of actions to be undertaken "over the next two years" to continue to incentivise and refine ash management strategies.

At Eraring, although Origin again failed to meet its 80% reuse target outlined in the Long Term Ash Management Strategy (LTAMS), it did achieve a 72.8% reuse rate in the 2022 Financial Year. Factoring in Origins ash dam capacity constraints and connections with the construction and concrete sector, it may be apparent why they are faring better than competitors.

In the LTAMS, Origin points to current incompatibility with some Transport for NSW standards, the limits to the quantity of ash permitted to be added to road base and uncertainty on behalf of operators about the "application of resource recovery legislation to coal ash reuse, regarding resource recovery" as the key factors prohibiting coal-ash from being beneficially reused in greater quantities.[21]

The strategy notes that "To reduce uncertainty… Origin applied to the Environment Protection Authority (EPA) to support an amendment and renewal of the RRO and RRE for the land application of coal ash excavated from EPS. On the 29 April 2022, the EPA approved the Eraring ash dam coal ash order 2022 and the Eraring ash dam coal ash exemption 2022. The approval of this recourse recovery legislation during the reporting period will promote the ability for Origin to assess other ash recycling projects in a timelier manner.[22]"

Unfortunately, recycling rates still appear stagnant at Vales Point and less fortunate still, this ash dam along with Bayswater appear to have chronic groundwater leachate issues which we substantiate for Vales Point in this submission and Appendix.

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[19] https://www.newcastleherald.com.au/story/7883467/health-impacts-of-coal-ash-dams-in-the-spotlight/

[20] ENERGY AUSTRALIA NSW Lamberts North Ash Repository LONG TERM ASH MANAGEMENT STRATEGY November 2020, https://www.energyaustralia.com.au/document/ash-management-strategy-3

[21] Eraring Long Term Ash Management Strategy, EPS-AMS-STR-001 Released 07 November 2022 – Version 3.0

[22] Eraring Long Term Ash Management Strategy, EPS-AMS-STR-001 Released 07 November 2022 – Version 3.0 Page 10 of 26

Bayswater has the poorest performance history when it comes to ash reuse rates. To our knowledge, although we note the MoU signed between AGL and NuRock in 2021 to undertake a feasibility study "…to determine whether we can implement this technology at Bayswater"[23], nothing has been publicly announced about the outcome of the study.

In 2019, AGL was fined for the sale of coal-ash with unsafe heavy metal levels in excess of limits set out in the Coal Ash Order 2014 [24] including chromium, cadmium and copper from Baywater and Lidell, potentially from as far back as 2015. In January 2020, the EPA forced AGL to award $100, 000 to local community projects. [25]

The 2022 Bayswater Power Station Upgrade - SSD 9697 had a stated objective of "upgrades to increase ash recycling" which were at the conclusion of the assessment subject to "Partial consent … excluding the approval of the ash dam augmentation and seepage collection infrastructure upgrades at this time."[26] and a condition was imposed by the Planning Secretary requiring the preparation of an "…updated Surface and Groundwater Assessment to the satisfaction of the Secretary, in consultation with the EPA."[27]

In our submission to the Bayswater Power Station Upgrade SSD 9697 HCEC pointed out what we deemed deceptive information provided by AGL in the EIS which overstated projected ash production rates and that detail of the actual projects or proposed reuses are absent from the EIS.

Again, the inclusion of the Coal Ash Monitoring condition to EPL779 may assist with the transparency and attention placed on coal ash waste, both its toxicity and its beneficial reuse potential.

It seems that AGL's Liddell ash dump, and likely its leachate will slip through the cracks too at least for now. The EPBC Act Referral for the Liddell Future Land Use and Enabling Works Project project[28] cites the "…staged extraction of up to 12 million m3 of capping material and construction of a containment area for hazardous materials."[29] which will be used to cover up the Liddell Ash Dam totalling 390 hectares.30 A one page factsheet from AGL insinuates that it may unearth the ash when it becomes a more commercially viable feedstock for construction materials.

Progressive and ultimate capping with a layer of topsoil is put forward as a solution to limit water from percolating the dam, however pollutants contained in NSW coal ash waste dumps will migrate into groundwater and surface water eventually, and present a massive impediment and liability to the estuarine and terrestrial environments in which they are situated. On the whole,

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[23] https://www.agl.com.au/about-agl/media-centre/asx-and-media-releases/2022/april/agl-and-nu-rock-sign-mou-to-investigate-feasibility-of-repurposi

[24]https://www.smh.com.au/business/companies/pretty-disturbing-agl-pulls-toxic-waste-product-off-the-market-20190117-p50s1u.html

25 NSW EPA. Media Releases. AGL Macquarie ordered to give $100,000 to community projects after breach. 10 January 2020, https://www.epa.nsw.gov.au/news/media-releases/2020/epamedia200110-agl-macquarie-ordered-to-give-$100000-to-community-projects-after-breach

[26] Development Consent. Bayswater Power Station Upgrade Project Department of Planning and Environment (SSD 9697)

[27] Ibid

[28]

[29] Liddell Future Land Use and Enabling Works Project Application Number: 01252, 3. Existing environment 3.1.2 Describe any existing or proposed uses for the project area.

[30] chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.agl.com.au/content/dam/digital/agl/documents/about-agl/how-we-source-energy/agl-macquarie/221209-liddell_flyer_ash_dam.pdf

the public still have little to no assurance of when or how AGL might rid the Hunter river of the tens of million tonnes of toxic waste it has left behind at Liddell.

Although we can acknowledge and welcome the evident increase in reuse and progress which has been made, legacy waste dumps spanning hundreds of hectares remain clogging our waterways with toxicants, necessitating constant management.

The need to actively reduce water from entering coal ash dams is perennial however, prior to the full flourishing of an economically viable coal ash recycling sector, all efforts on behalf of regulators and operators aside from sustainable and beneficial growth of a circular economy must be focused on reducing excess water from entering coal ash dams to limit harmful leachate from entering groundwater.

We note that a Long-Term Ash Management Strategy is available publicly for Eraring and Mt Piper and a Rehabilitation Management Plan for the Ravensworth Ash Disposal Area for Bayswater has been published. No such documents are known to exist for the other NSW power station EPL holders as they are not publicly available.

Recommendation 6: NSW coal power EPL 1429, 761, 779 and 13007 be varied to incorporate a clause specifying best practice ash handling and targets for improved performance including reduced water use and the production and publication of hydrological maps and diagrams showing areas of high leachate risk presented by geological faults.

Recommendation 7: Where Long-Term Ash Management Plans/Strategies exist, they should be made public via the EPA and/or the operators website. The NSW EPA should vary EPL's to require operators to undertake and publish short-, mid- and long-term ash management strategies.

Air pollution

HCEC shares the view of many members of the community and environment organizations that the air pollution limits which NSW power stations are subject to are inadequate, and note that they too fall short of the limits comparable facilities in US, EU, South Korea, China, Japan are subject to where conditions limiting particle matter, nitrogen oxides, sulphur dioxide and mercury are sophisticating.

Here in NSW we are again behind the game when it comes to the use of best practice emissions reductions technology, and much to the frustration of many in the Central Coast and Lake Macquarie, on the NSW EPA's watch Vales Point power station benefitted from seven years of exemption from the NSW Clean Air Regulation.[31]

The recent release of a health study from the George Mason University, The University of Texas at Austin, and Harvard T.H. Chan School of Public Health[32] has revealed shocking new findings that the "mortality burden" of PM2.5 from coal sources has been seriously underestimated and is associated with double the mortality risk compared to other sources of PM2.5.[33]

[31] https://www.nature.org.au/vales_point_submission_guide

[32] 'Mortality risk from United States coal electricity generation', LUCAS HENNEMAN et al, SCIENCE, 23 Nov 2023, Vol 382, Issue 6673 pp. 941-946 DOI: 10.1126/science.adf4915

[33] https://www.hsph.harvard.edu/news/press-releases/particulate-pollution-from-coal-associated-with-double-the-risk-of-mortality-than-pm2-5-from-other-sources/

The study author states that "… death toll declined drastically as plants closed or scrubbers – a type of sulfur filter – were installed to comply with new environmental rules. By 2020, the coal PM2.5 death toll had dropped 95%, to 1,600 people."

An assessment undertaken by Jacob's for Delta Electricity shows that NOx emissions could be halved by installing low-NOx burners for a total cost of approximately $88m.[34] meaning that, as the Nature Conservation Council of NSW has pointed out, Delta could halved NOx emissions from Vales Point for a fraction of its annual profit.[35]

The following excerpt from Abigail Boyd's First Reading Of the Protection of the Environment Operations Amendment (Clean Air) Bill 202136 aptly summarises this regrattable situation:

"Post-combustion technologies can dramatically reduce the pollution that comes out of combustion stacks. The use of sulphur oxide [SOx] or wet scrubbers, properly known as flue gas desulphurisation, would remove 99 per cent of sulphur pollution. Selective catalytic reduction would significantly reduce oxides of nitrogen and activated carbon injection would remove mercury.

At this point none of the five power stations in New South Wales uses any of these methods because we simply do not require them to regulate their toxic pollution to this extent. New South Wales power stations do use fabric filters to reduce particulate pollution but this is clearly not working as well as it should, given the high particulate levels still affecting New South Wales residents. According to the industry's own figures, during the 2020 financial year coal-fired power stations at Lithgow, on the Central Coast and in the Hunter Valley released more than 268,000 tonnes of toxic air pollution, including 102,000 tonnes of nitrogen oxides; 153,000 tonnes of sulphur dioxide; 1,312 tonnes of coarse particles, or PM10; and 358 tonnes of fine particles, or PM2.5.

Again, pollution reduction technologies that have been available for many years and that are frequently used overseas could significantly reduce power station emissions in New South Wales but they are not being used. These pollution control measures could save lives and safeguard the health of affected communities, yet the Government and the Environment Protection Authority [EPA] have not made New South Wales coal-fired power stations install them. Environmental Justice Australia's Director of Advocacy and Research Nicola Rivers publicly stated in 2018 that the EPA had effectively given coal-fired power stations a licence to harm our communities. The International Energy Agency recently noted that in those countries where air pollution is being controlled, strong government regulation is the primary reason."

We note that NSW EPA tightened limits on NOx in 202137 for Vales Point and that the Particulate Matter Continuous Emissions Monitoring Systems implementation and ongoing trials are a positive step towards real-time continuous pollution monitoring across the board so that where emissions reduction technology is not feasible, there is at least accessible data.

Recommendation 8: Delta be required to investigate, assess and install plant equipment and enhanced processes to reduce air emissions, particularly in the event the continued operational life of the Vales Point power station beyond 2029 is formalised.

Recommendation 9: Under either life span scenario for Vales Point, in October 2024 at the conclusion of the present two-year exemption period from NOx emissions limits, this long

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[34] Jacobs Group (Australia) Pty Limited (2017), *Vales Point Power Station Delta Electricity NOX Pollution Reduction Study (PRS),* pp.10. Available at: https://drive.google.com/file/d/1nEnWDuWZXDIZ5GtU8xDUIb-VZfxOH90I/view?usp=sharing

[35] https://www.nature.org.au/vales_point_submission_guide

[36] https://www.parliament.nsw.gov.au/Hansard/Pages/HansardResult.aspx#/docid/'HANSARD-1820781676-85345'

[37] https://www.epa.nsw.gov.au/news/media-releases/2021/epamedia211215-strict-new-operating-limits-for-vales-point-power-station-from-1-january

running evasion of NSW Clean Air Laws[38] must reach its conclusion and an extension refused by the NSW EPA.

Climate change

This submission is being written as the World Meteorological Organization records" the first day that average global temperature exceeded 2°C above pre-industrial levels ", as Greater Sydney and regional NSW receive predictions of a drinking water shortage within the next two years and as Glencore and Yancoal's Hunter Valley Operations mine expansion threatens to add see annual carbon emissions continue until rise until 2045, even with the Safeguard Mechanism in effect.

The Warragamba Dam catchment supplies 80% of Sydney's drinking water and is a receiver of water from the Upper Cox's Catchment where Mt Piper power station ash dam and Centennial's associated mining operations are licenced to discharge polluted water. Beneath the nearby Newnes Plateau is another contested mine expansion proposal site, that of Angus Place West which threatens not only the Greater Blue Mountains World Heritage Area and areas of the Gardens of Stone State Conservation Area, but will add yet further burden to the hydrology and the vital water resources which are being polluted by coal mining and power operations, and are on a trajectory towards urgent scarcity.

For the NSW chief, independent environmental regulator in NSW to omit climate emissions reporting and limits, indeed a comprehensive framework on carbon from its regulatory regime is an regrettably situation which has received legal scrutiny since 2009 and most recently been subject of a successful challenge led by the Environmental Defenders Office on behalf of the Bushfire Survivors.

We are in strong support of provisions to be added to the EPL's of NSW largest domestic CO2 emitters which give immediate effect to climate change mitigation and adaptation plans and swift reductions, as part of the EPA's Climate Change Policy and Climate Change Action Plan 2023-2026 rollout

Climate Analytics cites the Australian Government when it wrote in 2019 that the domestic consumption of coal is "… not projected to drop below 50% until well after 2025." and that "Australia's share of global CO2 emissions from domestic use of fossil fuels was about 1.4% of global fossil fuel combustion emissions in 2017. It goes on to "...estimate that in 2017 Australia's coal emissions (both domestic and exported) contributed to about 3.5% of global CO2 emissions from fossil fuels…)."

These may sound like measly contributions in the broader scheme but our combined domestic and exported emissions put us on par with the world's fifth largest polluter, Russia and on a per capita basis our carbon footprint would be the largest among top emitters, surpassing China by a factor of 9, the US by a factor of 4 and India by a factor of 37.[39]

As we continue to strive to meet emissions targets, the demand for coal power will continue to decline as renewable sources come online, and ideally any power station operating beyond its limits should be drawn upon only in times of need to fulfil energy security demand when renewable supply is not readily available.

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[38] https://www.theguardian.com/environment/2021/dec/16/nsw-grants-vales-point-coal-plant-further-five-year-exemption-from-emissions-limit

[39] 'Evaluating the significance of Australia's global fossil fuel carbon footprint', Climate Analytics for the Australian Conservation Foundation (ACF). Paola Yanguas Parra, Bill Hare, Ursula Fuentes Hutfilter, Niklas Roming, July 2019, page 21

It appears an achievable undertaking for the NSW EPA and licence holders to collaborate to expand the reporting requirements to encompass CO2 swiftly, whilst the details of a proposed cut-off date for CO2 are reconciled with electricity demand and the delivery timeline of the Hunter Valley Transmission Project (HTP).

Recommendation 10: NSW EPA introduce climate change mitigation and adaptation plans to the EPL regime for NSW power stations, our largest domestic emitters which include provisions for progressive reporting and set a CO2 limit in line with the NSW EPA's Climate Change Policy and Climate Change Action Plan 2023-2026.

Data access and transparency

The HCEC support any actions resulting from this review to increase public access to information and enhance transparency about the operational performance and practices of owners of electricity assets.

The 2022 September fish kill, which the NSW EPA have alleged to be the result of Delta Electricity failing to maintain its plant equipment, lends immediate urgency to the need for more scrutiny by the regulator and for the concerns and feedback of the public - often highly-local observations and accounts of an ecosystem and/or former workplace understood intimately - to be utilized in order to avoid impacts from the outset.

Local community members have a real stake in the health of the waterway they reside on, recreate on, one with a rich history and abundant ecology. Access to information about the nature and severity of threats posed it, as well as the mitigating measures being undertaken by regulators and operators and Government, should be immediately available to them in an accessible, comprehensible format.

Expert opinions sought on a pollution or regulatory matter should be accessible to the public

The GIPA Act provides is an important mechanism for public access to information which affirms a right to access to information which is in the public interest.

Since 2018, the HCEC has lodged in excess of ten Government Access Public Information (GIPA) requests in pursuit of basic information about NSW coal power stations pollution which is not publicly accessible.

Of particular interest to our organization has been the findings and advice of independent experts or ecological consultants engaged by electricity companies to provide reports or undertake their own investigations to aid with the delivery of and compliance with monitoring, pollution reduction or other special condition programs.

We do not believe it is common practice for the NSW EPA to fail to account for the advice of credible scientific results sought from experts and consultants to aid in its regulatory endeavour, therefore there seems to be no reason not make these documents or at least the results, which could be reported on by the NSW EPA to protect the privacy of third parties, publicly accessible via the Public Register.

The Public Register is of the most comprehensive receptacles of information on NSW coal fired power stations and their regulation but it is legalistic and broadly inaccessible to the average resident of the Hunter.

Whilst it does contain ample information, the format provides only a limited picture of the regulation of power stations or the particularities of an operation and its environmental and social

compliance, maintenance and planning history. Indeed, it is difficult for the layman who has the time to interpret and contextualize much of the good information available via the register, as it relates to the actual physical facility and its interaction with its environs.

We note the NSW EPA's recent addition of webpages dedicated to explaining and illustrating, for example coal-ash waste, its pollution impacts as well as the regulatory adjustments and scientific work being done to address these issues. These are excellent additions, nevertheless the Public Register should contain more readily accessible information and documents pertaining to power stations operation, environmental and social standards, impacts, compliance, planning and maintenance history.

Recommendation 11: An archive of planning, assessment, modification and consultants documents pertaining to NSW coal power stations be made accessible via the Public Register or public archive on the NSW EPA website. In addition, reports required by licence conditions including all Special Conditions, should also be made to be published on operator's websites.

Audits of EPL data

The requirement for NSW power station EPL holders to collect and publish monthly monitoring data is an important feature of the limited transparency there is between the public and power station operators about pollution impacts.

Community members who maintain an up to data summary of NSW power station monthly monitoring data have pointed out instances of repeatedly identical concentration readings month to month for some pollutants, seeding some doubt in the integrity of the data.

Explaining and animating, even demonstrating in-person the sampling methodologies and processes which operators are required to undertake, in accessible terms and formats would increase the understanding of community members engaging with the data available, who are either left to speculate in the absence of sensible information or explanations, or alternatively can find themselves overwhelmed with data difficult to contextualize in relation to the actual facility and its interaction with the surrounding environment.

Recommendation 11: To increase transparency and assure the public of the integrity of monthly EPL monitoring data, it is recommended that documentation and publication on the NSW EPA website of the sampling methodology and processes occur.

Recommendation 12: NSW EPA seek independent auditors to assess monthly monitoring data provided by NSW power station licence holders. Auditor reports should be made public.

Presentation and format of monthly monitoring results and other data

Copious volunteer hours have been injected into converting data presented in pdfs by EPL holder, into spreadsheets in order to create graphs and charts which can reveal potential trends and give a better overall picture of contaminant volumes.

Those presented in the Liddell and Bayswater Emissions Graphs showing emissions data from the January to March 2020 quarter, recorded in real time by Continuous Emissions Monitors are an example of an informative and comprehensible layout. Although legibility is average and the charts relatively basic, they at least enable the data to be put in context over time and contain a hefty amount of information in one snapshot.

Data collected at LDP's to water presented in graph and chart formats would be an ideal, rendering data being provided by EPL holders more accessible, engaging, and useful to the general public.

The installation of the Smart Buoy and the continuous live data feed is an excellent addition and we hope the NSW EPA continue expanding, upgrading and making more accessible data on contamination arising from coal power stations.

In the interest of greater transparency and readily accessible information of interest to the public, a visual and ideally interactive dashboard containing information on ash quantities, projected production and reuse could be a useful visual tool to aid with keeping the NSW public and local audiences informed about how the waste stream is being managed. Other information and notices regularly issued to the public, of planned dust suppressant works for example could also be displayed via the dashboard.

Recommendation 14: Monthly EPL monitoring data should be provided in excel spreadsheet format as well as pdf and consider legibility and presentation from the perspective of the general public.

Recommendation 15: A dashboard for visual presentation of data tracking ash production, impoundment and reuse as well as pollution pathways via LDP's be developed by the NSW EPA to make visible and accessible to the public information which is already public not readily accessible.

Community participation

When it comes to community transparency more generally, the need for robust and functional Community Consultative Committees (CCC's) to be introduced via EPL variations is painfully clear. Particularly at Vales Point where the procedure of the Delta Care Forum is considered to deviate from the standards set out in the NSW Department of Planning and Environment's *Community Consultative Committee Guidelines*, the establishment of a CCC is urgent due to its proximity to local communities and documented adverse impacts on Lake Macquarie's environment.

Recommendation 16: Immediate variation of EPL conditions to require a CCC in accordance with the NSW Department of Planning and Environment's *Community Consultative Committee Guidelines*

Scope of the EPL's

In addition to climate change, an environmental regulatory framework cannot truly claim to be comprehensive and robust if it neglects two key areas pertaining to ecological and community health including rehabilitation and cumulative impacts.

The HCEC propose the current scope of Environmental Protection Licences for NSW coal power stations be varied to accommodate:

Rehabilitation requirements

Ready public access to information about the final landform of coal power sites is not afforded by the NSW EPA either via its public register nor website. The NSW EPA is well placed but perhaps not well-enough resourced to form a view on the best outcome pertaining to rehabilitation at the sites it regulates, with access to an immense body of knowledge and experience of the operational, environmental and social history of EPL holders.

The retirement timeline of NSW coal power stations is determined with a degree of certainty sufficient to commence planning for the future land use and restoration of the site.

Rehabilitation assessment frameworks which articulate best practice processes pertaining to final land form, water quality, ecological health, revegetation of corridors and other requirements appropriate to a particular site, including of course coal-ash waste management strategies which are aligned with other local council, NSW Government and EPA environmental enhancement initiatives, could be introduced within 5 years of anticipated facility closure.

This could be used to aid community understanding of future plans for sites of interest and could also give rise to more efficient community grant-making on behalf of operators, EPA and Government which targets sites and ecosystems most affected by industry pollution or fragmentation.

Recommendation 17: Rehabilitation assessment frameworks be investigated by the NSW EPA for NSW power stations EPLs be varied to make public the plans and processes underway at coal power stations towards rehabilitation, within 5 years of an anticipated closure date.

Cumulative impact assessment

In the case of Lake Macquarie, there is no shortage of pathways for cumulative impacts with coal -ash waste dumps operating directly above in the case of Vales Point, areas of exploited underground mine workings which Delta Coal recently renewed interest in exploiting to secure future supply for Vales Point to operate far beyond its tenable span under a range of scenarios and criteria.

At least an investigation and public disclosure of what risks are present or possible when considering potential or likely cumulative impacts should be a requirement of EPL's for coal power stations, invariably co-located with coal mining operations which supply them.

At a glance its evident subsidence risk is high, and could arise from further underground mining in Lake Macquarie, placing stress on seagrass from increased turbidity or root disturbance and presenting a cumulative impact risk worth exploring.

Compounding the effects of thermal pollution on Lake Macquarie is contamination by nutrients, metals, metalloids, and turbidity from the Vales Point ash dam and coal mines.

Numerous reports have shown that Vales Point ash dam is a significant source of phosphate, and Delta Electricity and Delta Coal have breached EPL limits for Total Suspended Solids (TSS) almost 50 times since taking ownership.

The cumulative impacts of these additional inputs together with the elevated temperatures have never been assessed. However, these inputs are likely to significantly magnify impacts.

In our most recent report,[40] we refer to consults documents obtained via GIPA which reveal what we deem to be a "regulatory disconnect" over the potential impacts of the combination of elevated temperature, chlorine, turbidity, salinity, nutrients as well as metals and metalloids stemming from both coal power and mining operations.

Delta Electricity's EPL allows 1200kg of chlorine to be added to the cooling water system each day[41] and limits the concentration of free chlorine at the hot water discharge point at 0.2 mg/L, which is over 200 times the "No Observed Effect Criteria for 95% of species tested in a study undertaken by HLA Envirosciences in 2007.

[40] 'Delta's dirty deeds done dirt cheap: The impacts of Vales Point Power Station on Lake Macquarie', HCEC, 2022.

[41] *HLA Envirosciences, 2007. Conceptual Model of Vales Point Power Station Cooling Water System for: Delta Electricity Vales Point Power Station. Page 23. Accessed under GIPA Act, EPA860*

Submission: NSW Coal Fired power station Environmental Protection Licence review 2023, Hunter Community Environment Centre

Recommendation 18: A cumulative impact study be undertaken under a variation to EPL 761, EPL 191 (Mannering Colliery), and EPL 1170 (Chain Valley Colliery) to establish a Pollution Reduction Program for Total Suspended Solids (TSS), faecal coliforms, oil and grease, and metals and metalloids, and to determine the interaction of mine subsidence, the undermining of Vales Point ash dam, and their impacts on marine life in Wyee and Chain Valley Bays.

Recommendation 19: EPL's for NSW coal power stations should be varied to require cumulative impact assessments to be undertaken and made publicly accessible.

Summary of Recommendations

Concentration limits

Recommendation 1: After appropriate trials and engineering design, to minimise toxic trace elements contained within Vales Point coal ash from mobilising and entering groundwater and Lake Macquarie, EPL 761 be varied to incorporate a clause that directs Delta Electricity to install new plant and machinery for dense phase ash transport to the Vales Point Ash Dam.

Recommendation 2: Current NSW power station EPL concentration limits on water pollutants be reviewed against those limits specified in the ANZECC & ARMCANZ 2000[42] water quality guidelines and EPL variations to introduce the strictest possible water concentration limits set out in these frameworks take place within a reasonable timeframe.

Seagrass and thermal pollution – inlet & outlet impacts

Recommendation 3: To offset seagrass loss in Myuna and Wyee Bays, a Lake Macquarie Seagrass Trust be established with funding of $12M a year from Delta Electricity and $8M a year from Origin Energy to enhance seagrass meadows within Lake Macquarie and replace seagrass damaged and killed by the operations of Vales Point and Eraring power stations.

Recommendation 4: To encourage the rejuvenation of Zostera seagrass within Wyee Bay, a study be undertaken that determines ambient water quality, appropriate seasonal temperature differentials, seagrass sensitivity, and the assimilative capacity of Wyee Bay, and EPL 761 be varied accordingly to incorporate a scientifically established thermal mixing zone south of Wyee Marina.

Recommendation 5: Monitoring and reporting of inlet impacts including figures of species entrained, injured and killed should be disclosed in monthly monitoring data.

Coal-ash waste: production, emplacement, reuse and rehabilitation

Recommendation 6: NSW coal power EPL 1429, 761, 779 and 13007 be varied to incorporate a clause specifying best practice ash handling and targets for improved performance including reduced water use and the production and publication of hydrological maps and diagrams showing areas of high leachate risk presented by geological faults.

Recommendation 7: Where Long-Term Ash Management Plans/Strategies exist, they should be made public via the EPA or the operators website. The NSW EPA should vary EPL's to require operators to undertake and publish short-, mid- and long-term ash management strategies.

Air pollution

Recommendation 8: Delta be required to investigate, assess and install plant equipment and enhanced processes to reduce air emissions, particularly in the event the continued operational life of the Vales Point power station beyond 2029 is formalised.

[42] Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 2000. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra

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Recommendation 9: Under either life span scenario for Vales Point, in October 2024 at the conclusion of the present two-year exemption period from NOx emissions limits, this long running evasion of NSW Clean Air Laws[43] must reach its conclusion and an extension refused by the NSW EPA.

Climate change

Recommendation 10: NSW EPA introduce climate change mitigation and adaptation plans to the EPL regime for NSW power stations, our largest domestic emitters which include provisions for progressive reporting and set a CO2 limit in line with the NSW EPA's Climate Change Policy and Climate Change Action Plan 2023-2026.

Data access and transparency

a) Expert opinions sought on a pollution or regulatory matter should be accessible to the public

Recommendation 11: An archive of planning, assessment, modification and consultants documents pertaining to NSW coal power stations be made accessible via the Public Register or public archive on the NSW EPA website. In addition, reports required by licence conditions including all Special Conditions, should also be made to be published on operator's websites.

b) *Audits of EPL data*

Recommendation 12: To increase transparency and assure the public of the integrity of monthly EPL monitoring data, it is recommended that documentation and publication on the NSW EPA website of the sampling methodology and processes occur.

Recommendation 13: NSW EPA seek independent auditors to assess monthly monitoring data provided by NSW power station licence holders. Auditor reports should be made public.

c) Presentation and format of monthly monitoring data

Recommendation 14: Monthly EPL monitoring data should be provided in excel spreadsheet format as well as pdf and consider legibility and presentation from the perspective of the general public.

Recommendation 15: A dashboard for visual presentation of data tracking ash production, impoundment and reuse as well as pollution pathways via LDP's be developed by the NSW EPA to make visible and accessible to the public information which is already public not readily accessible.

d) Community participation

Recommendation 16: Immediate variation of EPL conditions to require a CCC in accordance with the NSW Department of Planning and Environment's *Community Consultative Committee Guidelines*

[43] https://www.theguardian.com/environment/2021/dec/16/nsw-grants-vales-point-coal-plant-further-five-year-exemption-from-emissions-limit

Scope of the EPL's

a) Rehabilitation requirements

Recommendation 17: Rehabilitation assessment frameworks be investigated by the NSW EPA for NSW power stations EPLs be varied to make public the plans and processes underway at coal power stations towards rehabilitation, within 5 years of an anticipated closure date.

b) Cumulative impact assessment

Recommendation 18: A cumulative impact study be undertaken under a variation to EPL 761, EPL 191 (Mannering Colliery), and EPL 1170 (Chain Valley Colliery) to establish a Pollution Reduction Program for Total Suspended Solids (TSS), faecal coliforms, oil and grease, and metals and metalloids, and to determine the interaction of mine subsidence, the undermining of Vales Point ash dam, and their impacts on marine life in Wyee and Chain Valley Bays.

Recommendation 19: EPL's for NSW coal power stations should be varied to require cumulative impact assessments to be undertaken and made publicly accessible.

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Appendix: The case for reducing water in the Vales Point Ash Dam

Contents

Introduction

HCEC maintain an up-to-date summary of EPL monitoring results from data uploaded to their website by Delta Electricity.[44] Recent groundwater monitoring results show a significant increase in concentrations of ammonia, arsenic, copper, manganese, nickel, potassium, sodium, and zinc.

The groundwater monitoring bores from which water samples are taken by Delta help identify contaminates that may leach into groundwater from the ash dam as the groundwater flows from the ash dam towards Lake Macquarie. See Figure 1 below for groundwater monitoring bore location in relation to the ash dam and Mannering Bay and Wyee Bay.

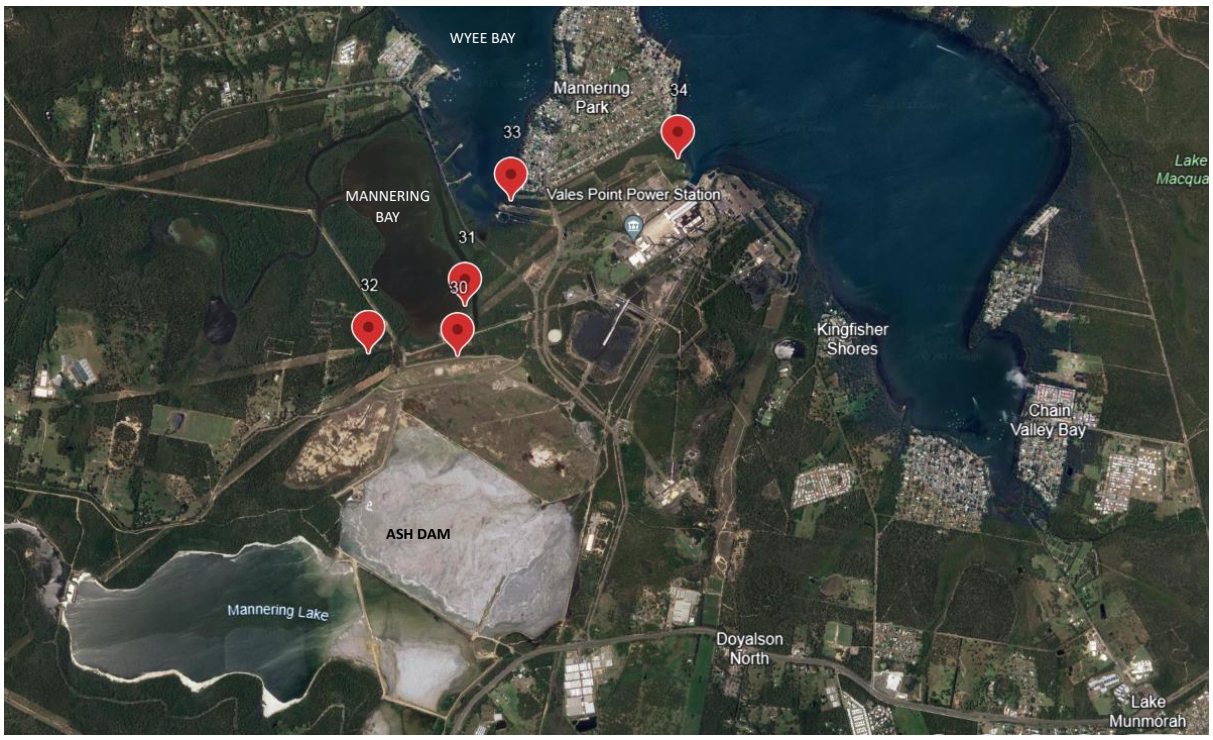

Figure 1:EPL groundwater monitoring bores (purple/red) and surface water monitoring points (white/yellow), also showing substantial volume of water sitting in the ash dam.

As toxins and contaminants within the ash can be mobilised in the presence of water the HCEC has been warning the EPA that the ash dam holds far too much water and has recommended ways of reducing this volume.

The Vales Point Ash Dam has been an operational ash repository for over 60 years, and during this time ash has used wet-sluiced using saline water pumped from Lake Macquarie to convey the ash along pipelines to the Ash Dam.[45] Over the same period sediments in Mannering Bay have become contaminated with a number of toxicants, particularly, arsenic, cadmium, copper, manganese, nickel, and zinc. Edible crabs have also been contaminated with Blue Swimmer and Mud Crabs being found with elevated concentrations of arsenic and cadmium.

Power Station via ash return water pumps.

[44] See https://www.de.com.au/environment/environmental-licences-and-monitoring

[45] Bunn T. F. and Chambers A. J., (1991), "Characterisation of Fly Ash Slurries", International Mechanical Engineering Congress, Sydney, NSW, Australia, 8 - 12 July, pp. 50 - 61.

A 2021 consultant's report[46] prepared for Delta Electricity in response to a complaint of contaminated groundwater seepage at a nearby nursery business, found elevated metal concentrations (particularly aluminium, copper, lead, and zinc) at all wells closest to the groundwater seepage. Similar elevated total dissolved metal concentrations were reported at other groundwater seepage discharge points and the Ash Dam Pipe, suggesting groundwater impact at these locations through the dissolution of metals from ash caused by acidic groundwater conditions.

The consultant's report suggests:

> "it is likely that over this time the ash in the Dam have experienced anaerobic conditions resulting in sulfate-reducing bacteria in the ash converting dissolved sulfate present in the pore water to react with metals, particularly iron, resulting in the formation of metal sulphides (principally pyrite). It is likely that wet-sluicing of the ash for disposal has resulted in RIS oxidation, and the resultant lowering of groundwater pH and the dissolution of trace metals and metalloids. Groundwaters and surface water affected by RIS oxidation can be characterised as highly saline, low pH and have elevated metal concentrations."

The report recommended ceasing wet-sluicing of ash as soon as possible and the investigation of preferential groundwater migration pathways noting that it is likely that one exists through fractures, joints and/or bedding planes in the weathered Munmorah Conglomerate rock.

The ash transport process known as wet-sluicing used at Vales Point has been abandoned elsewhere in Australia and the world due to the higher volumes of toxic ash leachate it produces compared to transport processes known as "dense phase" ash transport.

We reiterate our recommendation that to minimise toxic trace elements contained within Vales Point coal ash from mobilising and entering groundwater and Lake Macquarie, EPL 761 must be varied to incorporate a clause to significantly reduce the volume of water in the ash dam. This would require Delta Electricity to install new plant and machinery for dense phase ash transport to the Vales Point Ash Dam.

Vales Point Ash Dam

The 18 meter deep Vales Point Ash Dam was constructed in the natural valley of Mannering Creek, from a ridge to the south towards the north east and Mannering Bay. Up until 1995, the dam discharged directly into Mannering Bay which adjoins Wyee Bay. Originally built in 1962 to accept coal ash from Vales Point and Munmorah Power Stations, the ash dam was expanded in 1982 to increase its capacity sufficient to accept ash from both Munmorah and Vales Point power stations to about 2000. The 1982 augmentation also included the construction of the Wyee channel to divert the flow of Mannering Creek to the newly constructed Wyee Dam wall. The ash dam now discharges into Wyee Creek. The Dam was built to ameliorate flooding of Wyee caused by the raising of the ash dam 8m to 25m using natural clay fill and coal washery refuse.: the original ash dam overflowed into Mannering Bay. In 1995 the ash dam capacity was again increased and recycling of ash dam waters introduced. Before this time, coal ash was mixed with lake water and pumped to the ash dam, which drained directly into Wyee Bay via Mannering Bay. Since 1995, water has been removed from the ash dam and recycled back to the power station, where it is mixed with cooling water before being discharged into Wyee Bay. The new procedures were expected to raise selenium concentrations within the ash dam but reduce the amount of suspended and dissolved trace metals reaching the lake.

[46] Douglas Partners, 2021. Report on Groundwater Assessment In the Vicinity of Lot 421 in DP 578194, Doyalson North for Delta Electricity, Accessed under NSW Parliamentary Standing Orders 52

The Vales Point Ash Dam comprises a series of settling ponds. The northern portions of the ash dam (Ponds 1, 2, 3 and 4A) have been filled to capacity and rehabilitated (capped with imported soils). Ponds 4B, 5A and 5B are located in the south-east portion of the ash dam site and were actively receiving wet-sluiced ash until December 2020 and are currently being progressively rehabilitated (i.e. capped with imported soils). The south-west portion of the dam (Ponds 6 and 7) is currently being ash filled. Ash settles in these upper reaches of the dam and the water is pumped back to the Power Station via ash return water pumps.

HCEC water and sediment sample analyses

HCEC surface water testing

On 23 April 2020. HCEC staff took two water samples from a brackish creek running along the northern ash dam wall that drains into the southern end of Mannering Bay (Point 3 in Figure 2 below) and closest to Monitoring Point 32 in Figure 1.[47]

The results of laboratory analysis of the water samples provided to Envirolab P/L are set out in Table 1 below. They identify concentrations of;

- Iron 5 times the EPL 761 concentration limit for discharge to Wyee Bay from LDP22.
- Cobalt, manganese, nickel, and zinc above ANZECC Marine Trigger Values,
- Aluminium, boron, iron, manganese, above ANZECC (2000) Recreational Use guidelines, and
- Arsenic, manganese, and nickel, above NHMRC Drinking Water Guidelines.

[47] HCEC, 2020. Out of the ashes II. NSW water pollution and our aging coal-fired power stations. https://static1.squarespace.com/static/5e22ffdfa732e601799afba2/t/5f962ea21d206d227a96ba32/1603678044609/Out+of+the+ashes+II_final-min.pdf

Sample location					
Sample ID					
Field Prep.					
Type of sample				Water	Water
Date Sampled				23/5/20	23/5/20
pH.				4.5	
EC		uS/CM			
Metal/metaloiid		**Units**	**PQL**		
Aluminium	Al	µg/L	10	81000	75000
Arsenic	As	µg/L	1	43	43
Boron	Bo	µg/L	20	100	100
Barium	Ba	µg/L	1	230	200
Cadmium	Cd	µg/L	0.1	0.1	0.2
Cobalt	Co	µg/L	1	59	60
Chromium	Cr	µg/L	1		
Copper	Cu	µg/L	1		
Iron	Fe	µg/L	10	1700	1700
Lead	Pb	µg/L	1	2	2
Manganese	Mn	µg/L	5	8600	8600
Molybdenum	Mo	µg/L	1		
Mercury	Hg	µg/L	0.05		
Nickel	Ni	µg/L	1	36	36
Selenium	Se	µg/L	1		
Thallium	Th	µg/L	1		
Vanadium	V	µg/L	1		
Zinc	Zn	µg/L	1	130	130

Table 1: Laboratory results of HCEC water samples taken at point 3 in Figure 2.

Figure 2: HCEC water samples and sediment core sample locations.

The water samples HCEC took in 2020 were found to exceed ANZECC & ARMCANZ 2000[48] trigger values for:

- Cobalt - 60 times the marine high reliability trigger value of 1 µg/L at 95% protection. [49]
- Manganese - over 100 times the marine low reliability trigger value of 80 µg/L at 95% protection.[50]
- Nickel – over 5 times the marine **high reliability** guideline value of 7 µg/L for 99% protection level recommended for slightly to moderately disturbed marine systems.
- Zinc -15 times the very high reliability DGVs of 8 µg/L[51] for 95% species protection[52]

HCEC Bio sampling of edible crabs

Documents obtained by the HCEC in 2020 from the then-NSW Office of Environment and Heritage (OEH) under freedom of information law suggest these concentrations have not changed markedly over the intervening 24 years.63 Mud crabs, however, were found to have concentrations above levels that could cause human exposure to cadmium toxicity if consumed more than once a week.

- Mean concentrations of cadmium in Mud Crabs was found to be 2.5 mg/kg, and Blue Swimmer Crabs was 0.75 mg/kg.
- The maximum arsenic concentration was 70 mg/kg from a Blue Swimmer Crab from the very southern end of Lake Macquarie.
- Maximum selenium was 3 mg/kg from a bream caught in central Lake Macquarie. The maximum selenium in a crustacean was found in a Mud Crab (2 mg/kg) from the very northern part of the Lake.

HCEC collected flesh, organs and shell from two male Blue Swimmer Crabs and one male Mud Crab caught in a dilly trap from the southern end of Wyee Bay in late 2020, and sent them for metal analyses.[53]

• The flesh and organs of the Mud Crab were found to contain significant concentrations of Selenium - 4 mg/kg and 3 mg/kg respectively.
• Cadmium was found in the shell and organs, but not the flesh, of all three crabs. The organs contained significantly higher concentrations of cadmium; the Blue Swimmer Crabs 5.3 mg/kg and 5.7 mg/kg, and the Mud Crab 9.1 mg/kg.
• Significant concentrations of arsenic was found in the flesh and organs of all three crabs;
  ° Blue Swimmer- 9 mg/kg: 9 mg/kg,- 8 mg/kg; 6 mg/kg,
  ° Mud Crab - 8 mg/kg; 6 mg/kg.

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[48] Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 2000. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra

[49] See https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/toxicants/cobalt-2000

[50] See https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/toxicants/manganese-2000

[51] Although the 95% species protection DGV of 8.0 µg/L is still recommended for adoption in the assessment of slightly-to-moderately disturbed ecosystems, the 99% species protection DGV of 3.3 µg/L could be adopted if there are concerns about the protection of key sensitive species

[52] ANZG 2021, Toxicant default guideline values for aquatic ecosystem protection: Zinc in marine water. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. CC BY 4.0. Australian and New Zealand Governments and Australian state and territory governments, Canberra, ACT, Australiahttps://www.waterquality.gov.au/sites/default/files/documents/zinc_marine_dgv_technical-brief.pdf

[53] HCEC, 2022. TOXIC HABITAT Heavy metal impacts on water birds near NSW coal fired power stations https://static1.squarespace.com/static/5e22ffdfa732e601799afba2/t/62bbf4ad5a599362c42e38d4/1656485083192/Toxic+Habitat+Heavy+metal+impacts+on+NSW+water+bir%E2%80%A6oal+fired+power+stations_FULLREPORT_HCEC_July_2022.pdf

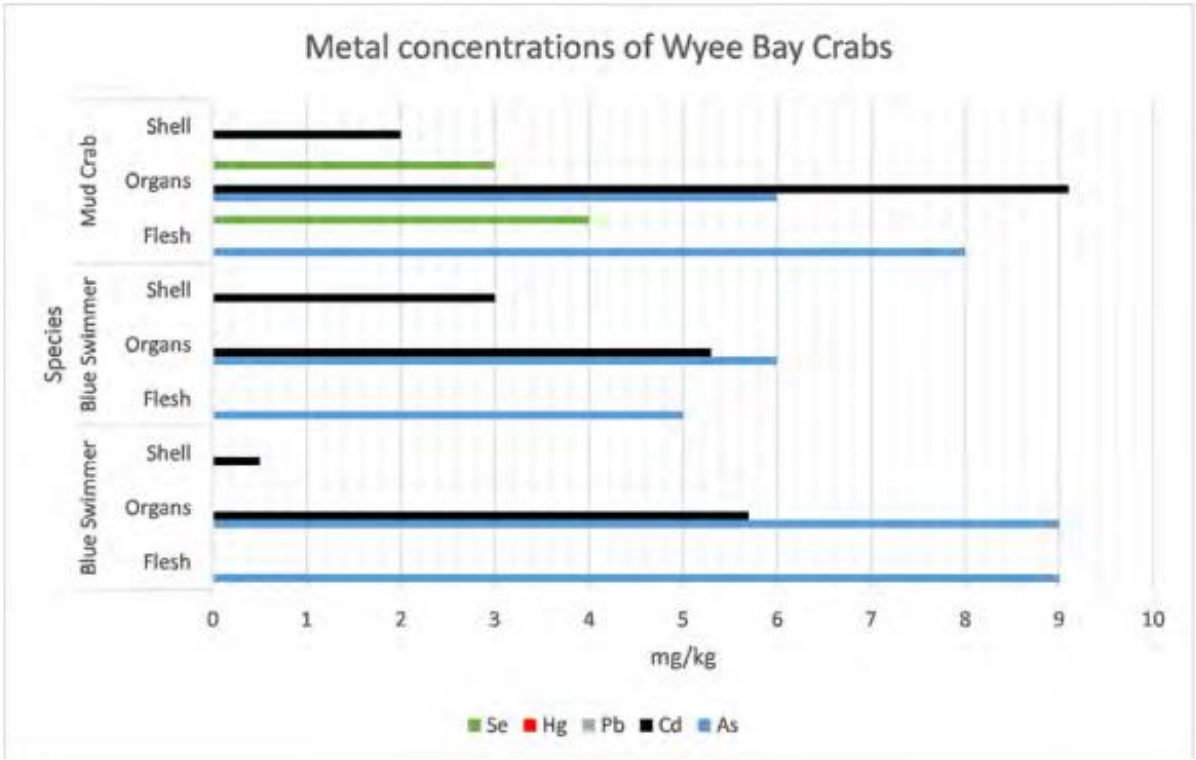

Chart 1: Metal concentrations found in edible crabs from southern Lake Macquarie (Wyee Bay)

Acid Extractable metals in crab						
Our Reference		257951-1	257951-2	257951-3	257951-4	257951-5
Your Reference	UNITS	1a	1b	1c	2a	2b
Date Sampled		24/11/2020	24/11/2020	24/11/2020	24/11/2020	24/11/2020
Type of sample		crab flesh	crab organs	crab shell	crab flesh	crab organs
Date prepared	-	11/12/2020	11/12/2020	11/12/2020	11/12/2020	11/12/2020
Date analysed	-	14/12/2020	14/12/2020	14/12/2020	14/12/2020	14/12/2020
Aluminium	mg/kg	<10	<10	20	<10	<10
Arsenic	mg/kg	9	9	<4	5	6
Boron	mg/kg	<3	<3	4	<3	<3
Cadmium	mg/kg	<0.4	5.7	0.5	<0.4	5.3
Chromium	mg/kg	<1	<1	<1	<1	<1
Copper	mg/kg	16	140	15	15	69
Iron	mg/kg	<10	20	20	<10	30
Lead	mg/kg	<1	<1	<1	<1	<1
Manganese	mg/kg	<1	2	36	<1	2
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	<1	<1	<1	<1	<1
Selenium	mg/kg	<2	<2	<2	<2	<2
Thallium	mg/kg	<2	<2	<2	<2	<2
Vanadium	mg/kg	<1	<1	<1	<1	<1
Zinc	mg/kg	43	19	10	35	24

Table 2: Laboratory results of HCEC crab samples taken from the southeastern shore of Wyee Bay

Elevated concentrations of copper, iron, manganese, and zinc were also found in the crabs (See Table 2 above).

HCEC Mannering Bay sediment core sample

In 2019, HCEC staff took a 30cm sediment core from Mannering Bay for which ANSTO provided a lead 210 isotopic dating analysis. ANSTO identified 15 dates from 1930 to 2019. Laboratory analysis of the sediment samples taken from these time stamps, shows a substantial increase in metal concentrations

between 1960 and 1970; Coal ash waste was first dumped in Vales Point ash dam in 1962. The time series also shows that from 1930 to 1960 little increase in metal concentrations was apparent. However, the next time stamp (1970), a substantial increase in metal concentrations in the sediment of Mannering Bay;

1. Cadmium concentrations had increased by a factor of 15,
2. copper by 12,
3. zinc by 10,
4. selenium by 8 to 10,
5. lead by 4,
6. manganese by 3,
7. arsenic by 2 to 3, and
8. iron by 2.

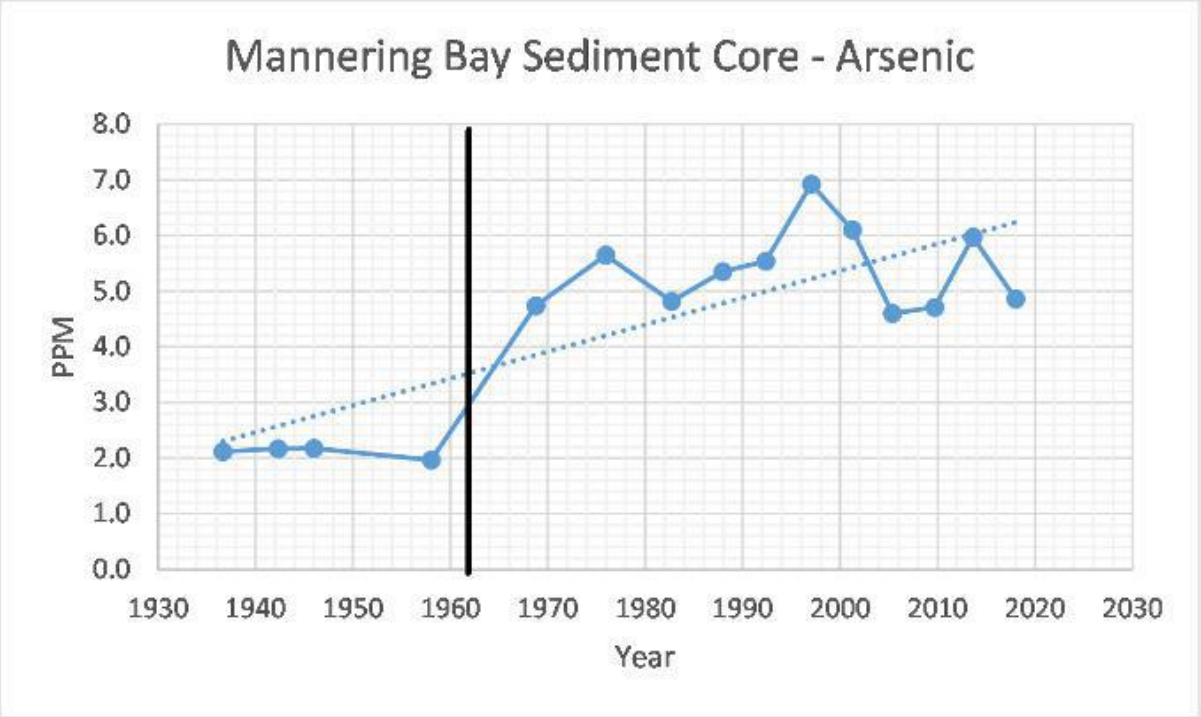

Chart 2: Mannering Bay sediment arsenic concentrations 1930 to 2019. Black line indicates commissioning of Vales Point A.

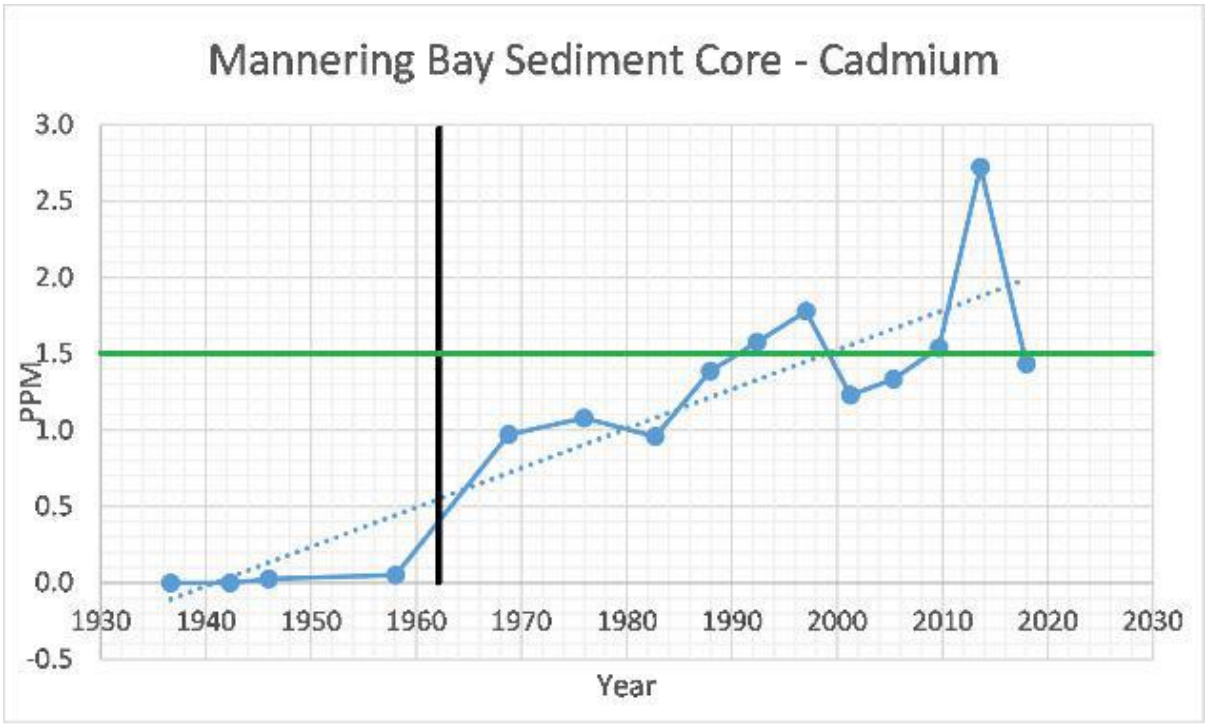

Chart 3: Mannering Bay sediment cadmium concentrations 1930 to 2019. Black line indicates commissioning of Vales Point A.

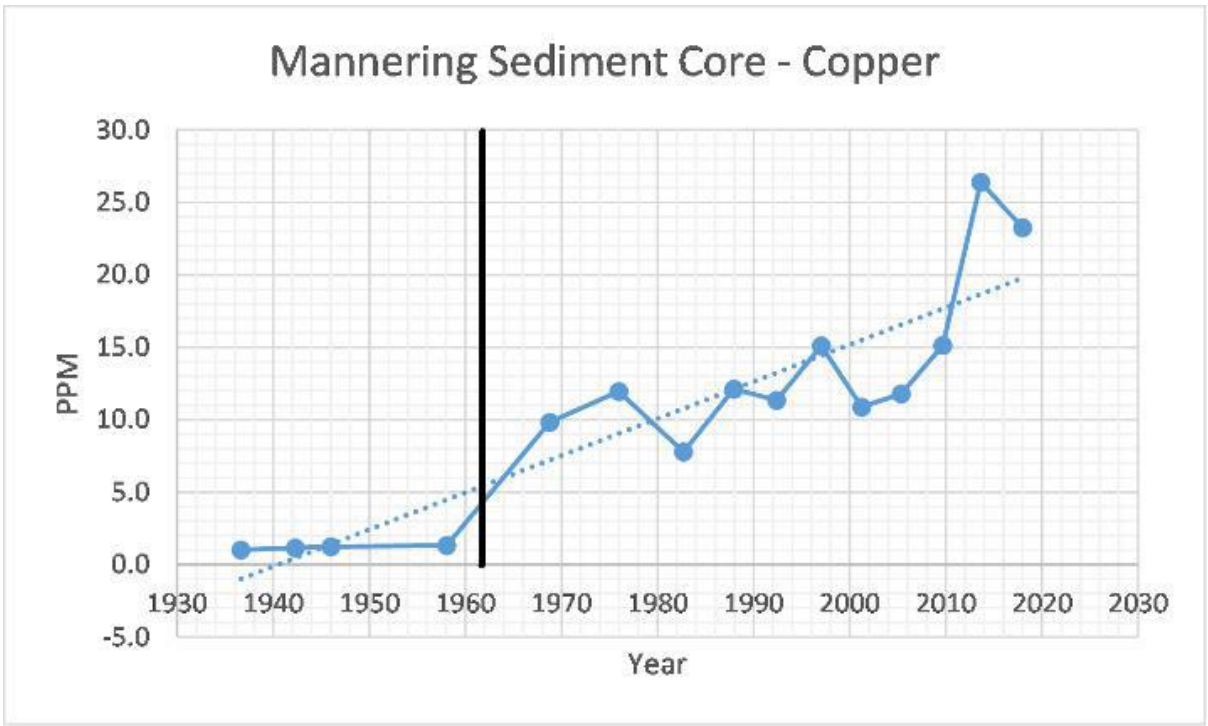

Chart 4: Mannering Bay sediment copper concentrations 1930 to 2019. Black line indicates commissioning of Vales Point A.

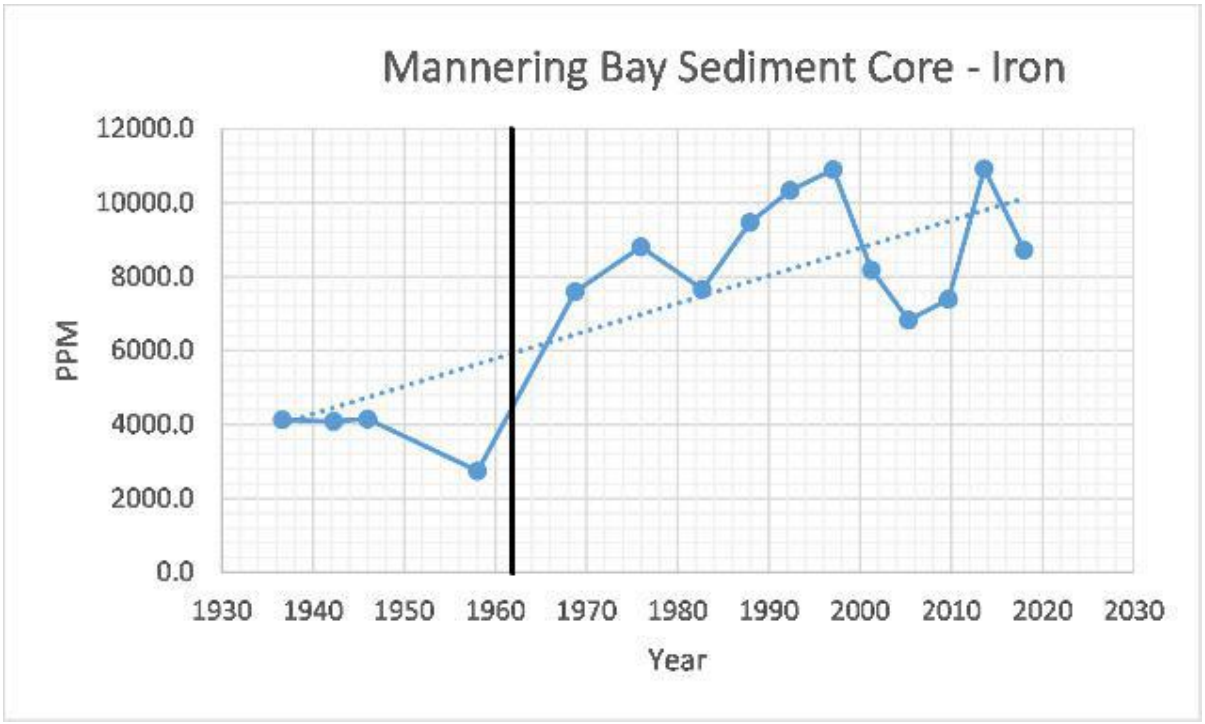

Chart 5: Mannering Bay sediment iron concentrations 1930 to 2019. Black line indicates commissioning of Vales Point A.

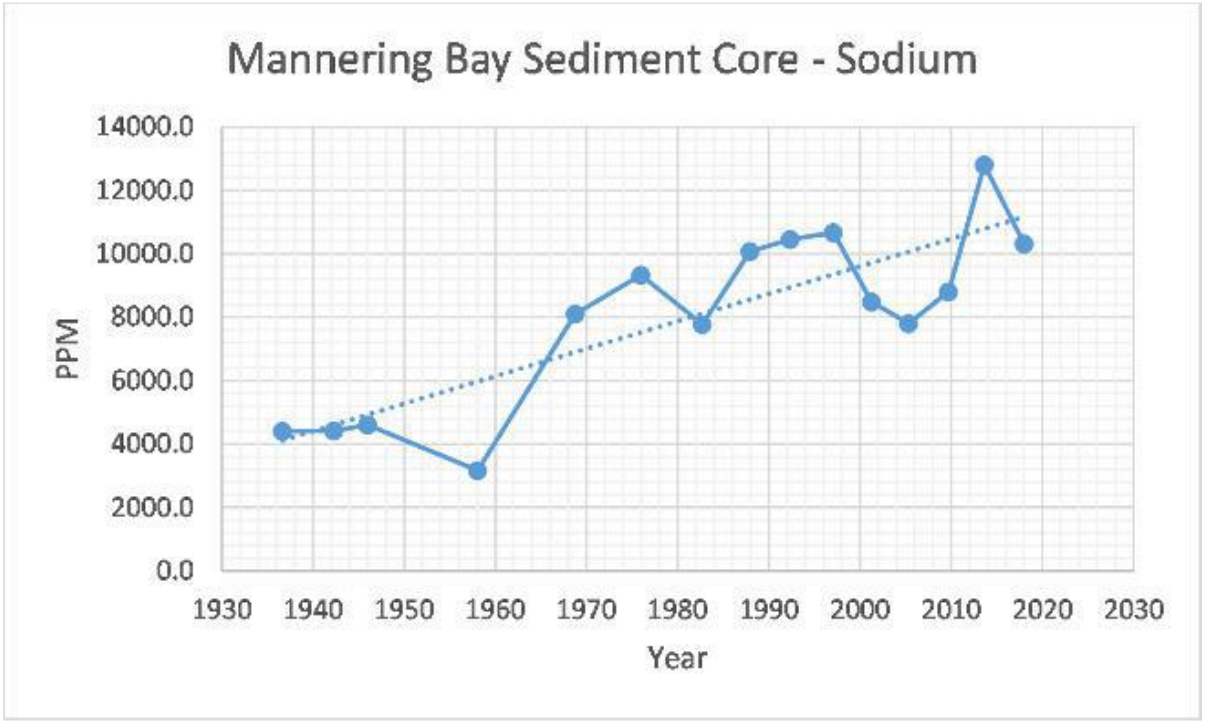

Chart 6: Mannering Bay sediment sodium concentrations 1930 to 2019. Black line indicates commissioning of Vales Point A.

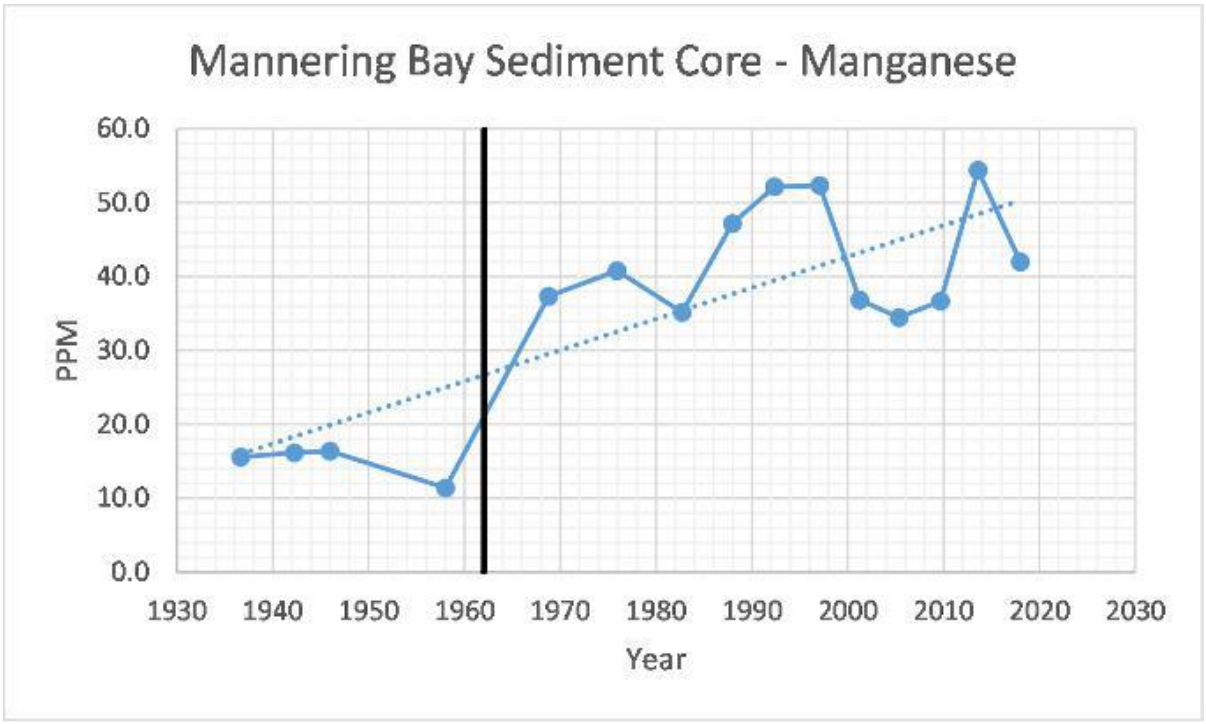

Chart 7: Mannering Bay sediment manganese concentrations 1930 to 2019. Black line indicates commissioning of Vales Point A.

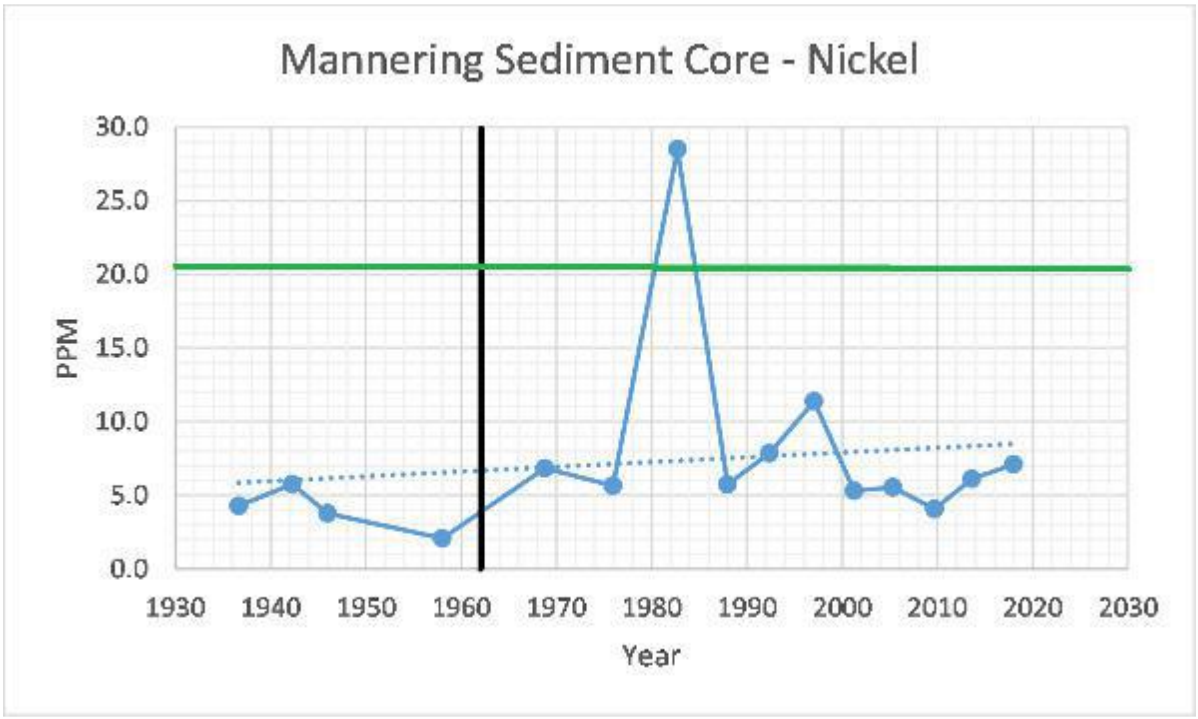

Chart 8: Mannering Bay sediment nickel concentrations 1930 to 2019. Black line indicates commissioning of Vales Point A.

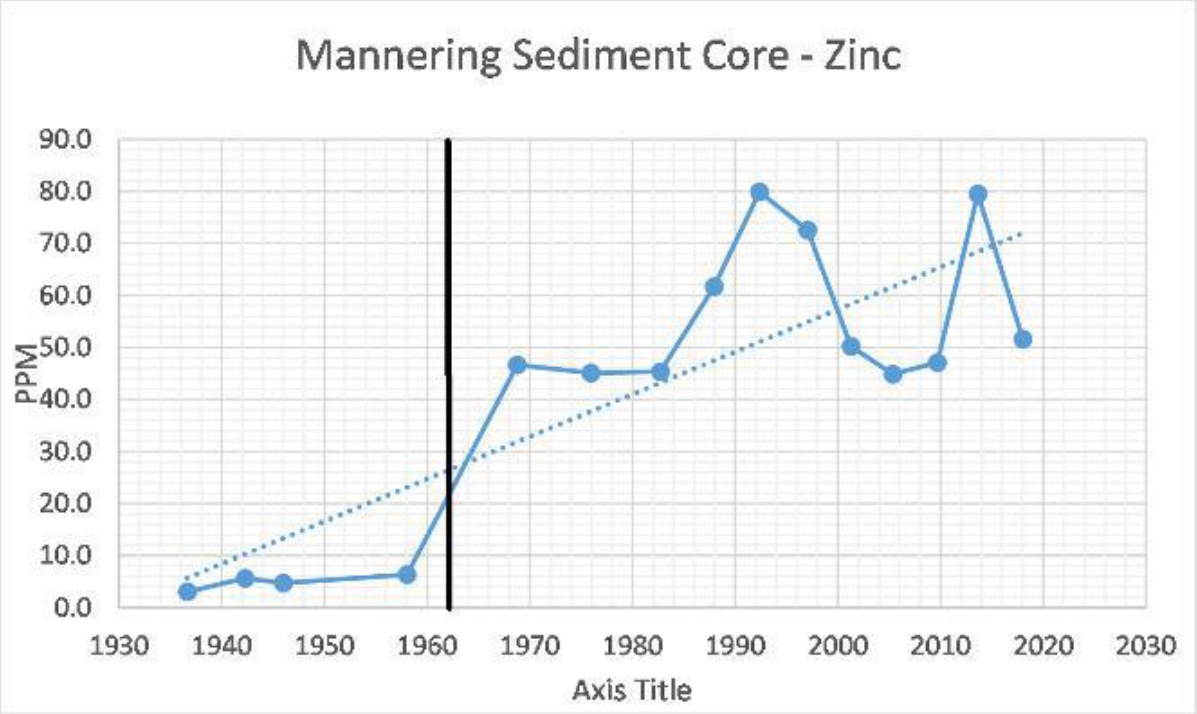

Chart 9: Mannering Bay sediment zinc concentrations 1930 to 2019. Black line indicates commissioning of Vales Point A.

Environmental Protection Licence 761

Up until July 2020, Vales Point's EPL did not prescribe any metal concentration limits for any of its five discharge points. The 2020 EPL variation[54] prescribes free residual chlorine (200ppb) copper (5ppb), iron (300ppb), selenium (5ppb), and temperature (37.7C) limits at LDP 22 (Discharge of cooling water from the cooling water outlet canal to Wyee Bay).

The following subsections set out the groundwater monitoring results uploaded to Delta Electricity's website under its monitoring requirements set out in EPL 761.[55]

Groundwater monitoring results 2016 to 2023

Ammonia

Delta Electricity's quarterly monitoring results for October 2023 identifies a spike in ammonia at three of the five groundwater monitoring points. Samples from a further monitoring bore identifies a spike in concentrations of ammonia in July 2023. These are the highest ammonia concentrations identified in groundwater since July 2020, when EPL groundwater ammonia monitoring began.

[54]https://apps.epa.nsw.gov.au/prpoeoapp/ViewPOEONotice.aspx?DOCID=-1&SYSUID=1&LICID=761
[55]https://apps.epa.nsw.gov.au/prpoeoapp/Detail.aspx?instid=761&id=761&option=licence&searchrange=licence&range=POEOlicence&prp=no&status=Issued

ANZECC (2000) recommends a marine **moderate reliability** trigger value of 910 µg/L (0.9mg/L) total ammonia- calculated at pH 8.0 with 95% protection.[56] At pH 6, this increases to 5900 µg/L (5.9 mg/L).

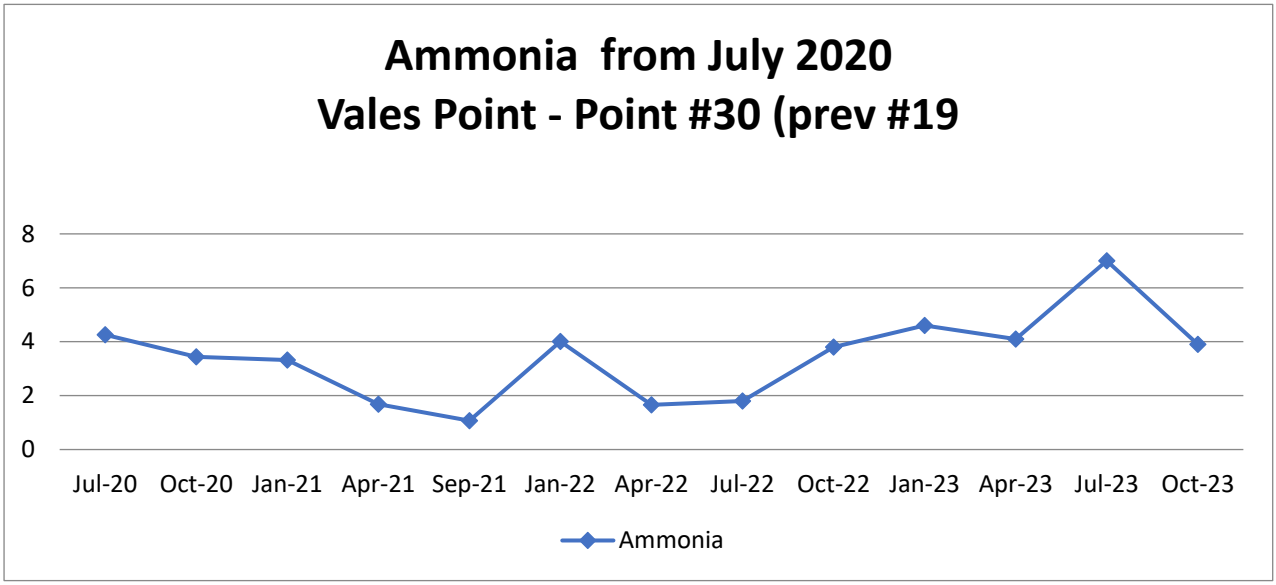

Chart 10a: Groundwater ammonia concentrations July 2020 to October 2023 at EPL Monitoring Point 30 Units in mg/L (1 mg/L = 1000 µg/L)

Chart 10a above shows EPL 761 quarterly groundwater ammonia monitoring results at point 30, which is at the base of the ash dam wall (See Figure 1).

In July 2023, at a measured pH of 6.2, ammonia concentrations reached 7 mg/L (7000 µg/L), up from a previous high of 4 mg/L (4000 µg/L) in January 2022 and January 2023.

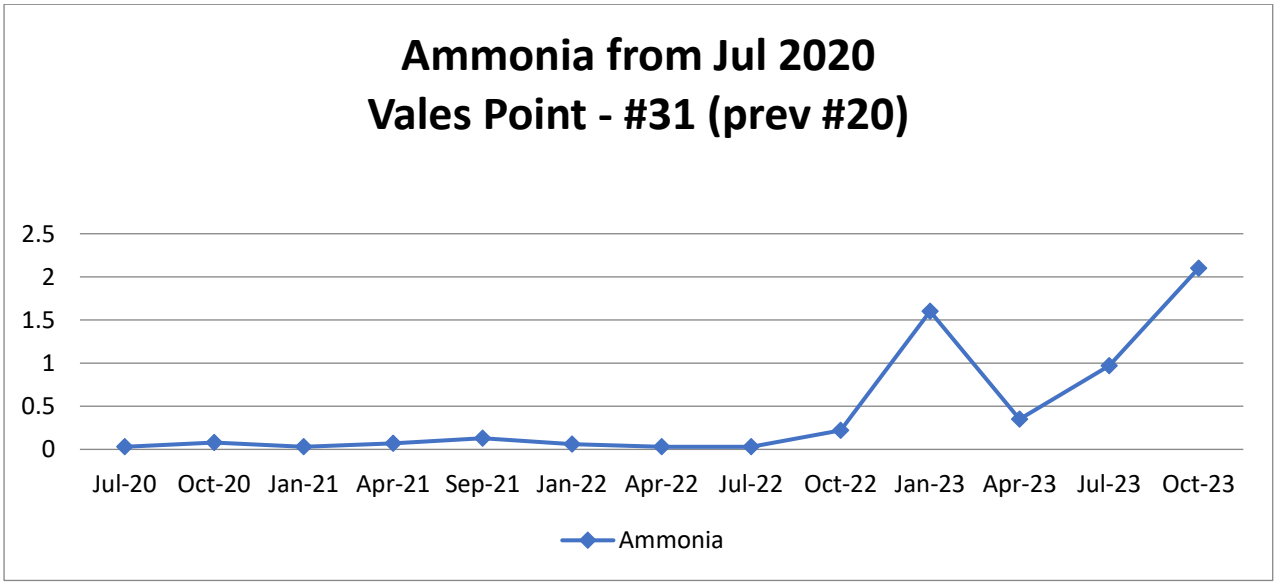

Chart 10b: Groundwater ammonia concentrations July 2020 to October 2023 at EPL Monitoring Point 31. Units in mg/L (1 mg/L = 1000 µg/L)

Chart 10b above shows groundwater ammonia monitoring at point 31, 300m downgradient of the ash dam wall on the shoreline of Mannering Bay (See Figure 1).

[56] See https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/toxicants/ammonia-2000

In October 2023, ammonia concentrations spiked to over 2 mg/L (2000 µg/L), up from a previous high of 1 mg/L (1000 µg/L) In January 2023.

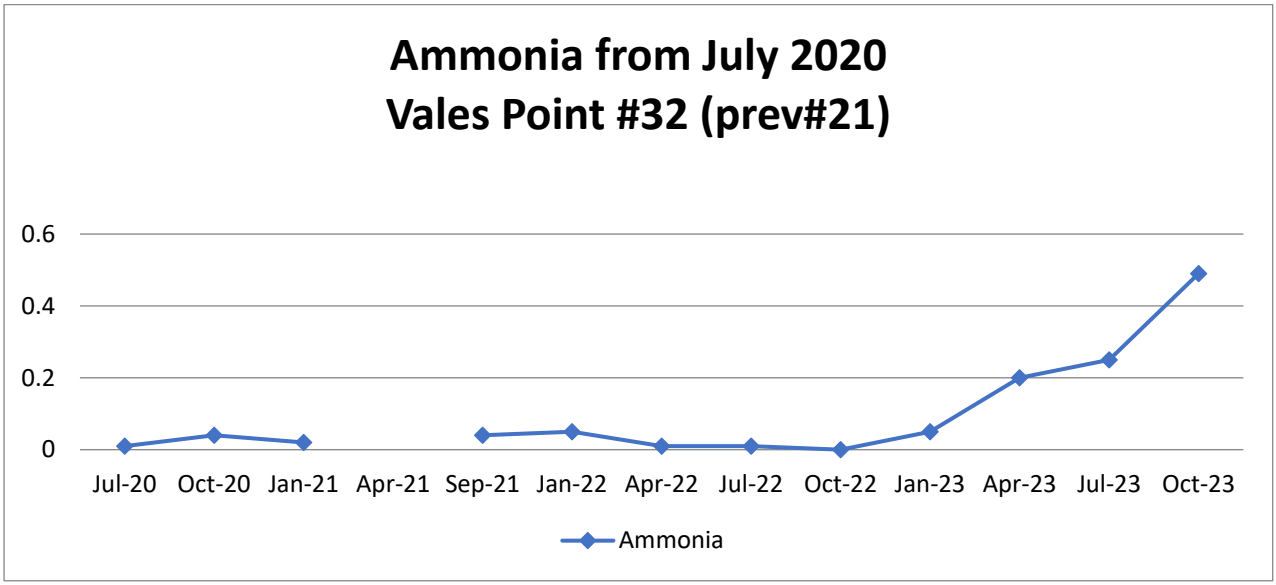

Chart 10c: Groundwater ammonia concentrations July 2020 to October 2023 at EPL Monitoring Point 32 . Units in mg/L (1 mg/L = 1000 µg/L)

Chart 10c above shows groundwater ammonia monitoring at Point 32, 200mdowngradient of the ash dam wall on the drainage line that HCEC took water samples from in April 2020 (See Figure 1 and 2)

In October 2023, ammonia concentrations spiked to over 2 mg/L (2000 µg/L), up from a previous high of 1 mg/L (1000 µg/L) In January 2023.

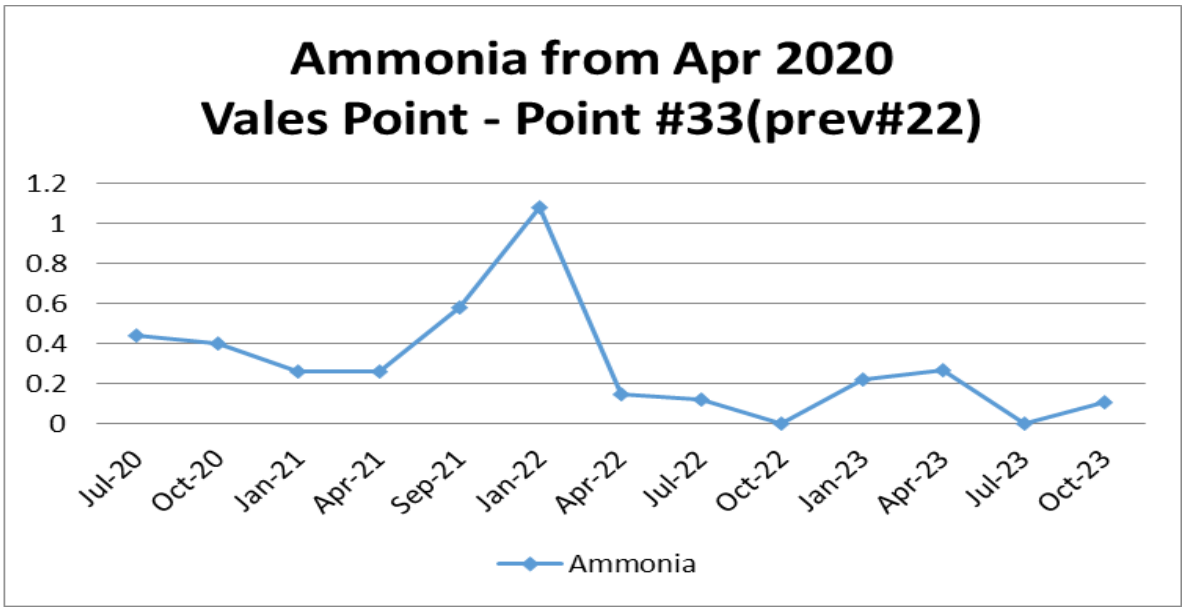

Chart 10d: Groundwater ammonia concentrations July 2020 to October 2023 at EPL Monitoring Point 33 Units in mg/L (1 mg/L = 1000 µg/L).

Chart 10d above sets out the available time series of ammonia concentrations in groundwater samples taken from EPL monitoring point 33. This Monitoring Point 1 km down gradient from the Ash Dam wall monitors groundwater chemistry at the point where the cooling water canal enters Wyee Bay (See Figure 1)

Recent results of monitoring point 33 identifies a pH readings just above 6, and ammonia concentrations well below ANZECC (2000) recommended marine **moderate reliability** trigger value. Of 5.9 mg/L .

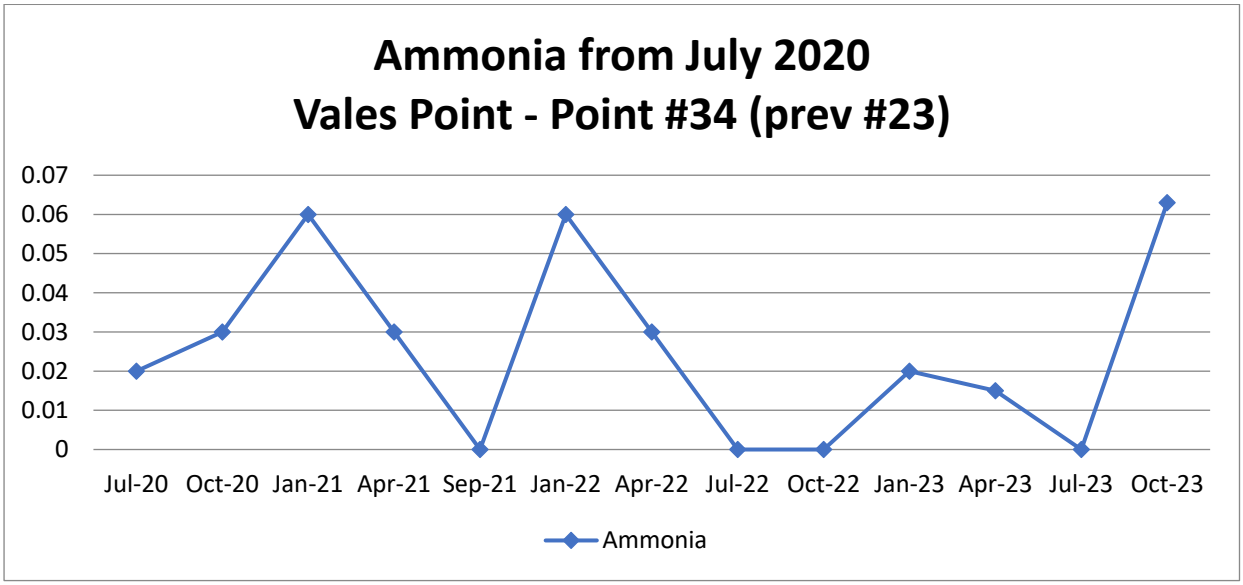

Chart 10e: Groundwater ammonia concentrations July 2020 to October 2023 at EPL Monitoring Point 33 (formerly 22). Units in mg/L (1 mg/L = 1000 µg/L).

Arsenic

A significant spike in groundwater arsenic concentrations was identified between July 2019 and January 2020. In July 2020, Delta began publishing quarterly monitoring results for the two oxidation states of arsenic - arsenic (III) and arsenic (V)[57]

Arsenic III is highly soluble in water and can easily dissolve in groundwater. Inorganic arsenic III compounds are highly toxic and have been linked to various health problems such as skin lesions, cardiovascular disease, and some types of cancer. While arsenate (arsenic V) is not as toxic as arsenite (arsenic III), it can still pose a risk to human health through long-term exposure.

ANZECC & ARMCANZ (2000) does not provide a marine trigger value for total dissolved arsenic. However Section 8.3.4.5 of the ANZECC & ARMCANZ (2000) provides an Environmental Concern Level (ECL) of 2.3 µg/L (0.0023 mg/L) for As (III) in marine waters, suggesting it could be adopted as a marine low reliability trigger value. A l**ow reliability** marine guideline trigger value of 4.5 µg/L (0.0045 mg/L) for As (V) is also recommended, as an indicative interim working level.[58]

Arsenic III and arsenic V are the most commonly found oxidation states of arsenic, total dissolved arsenic can thus be found by adding the two oxidative state concentrations. This would result in a combined trigger value of 6.8 µg/L (0.0068 mg/L)

[57]). In water, arsenic normally occurs in the oxidation states III and V. Therefore, a total arsenic measurement is a combination of the concentration of arsenic III and arsenic V.

[58] See https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/toxicants/arsenic-2000

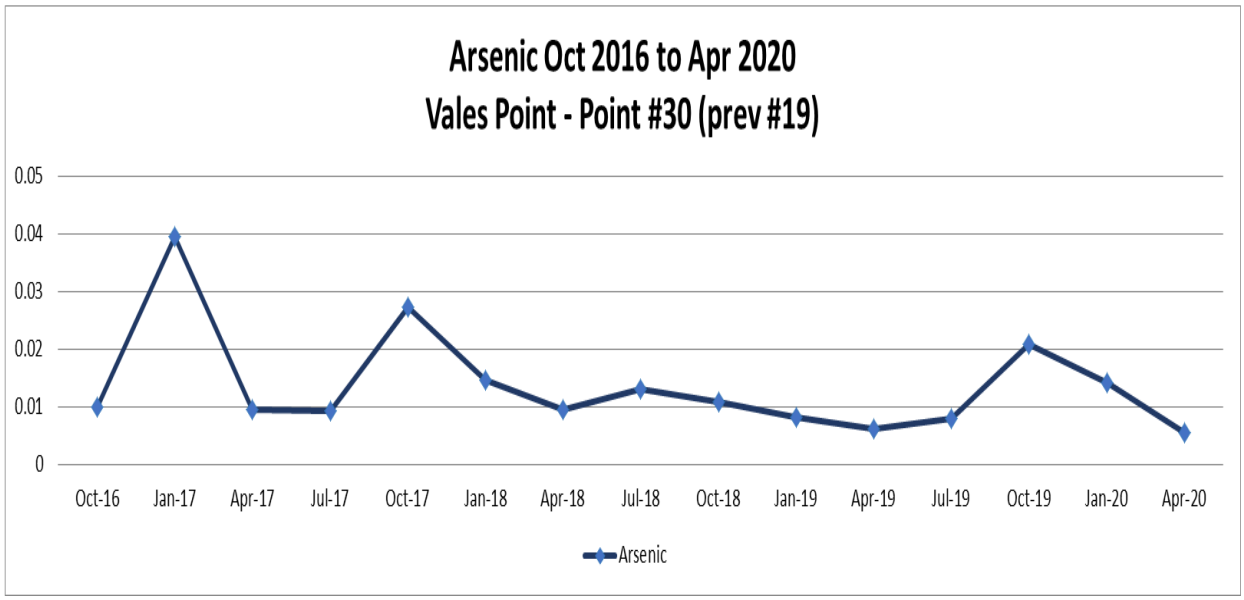

Chart 11a: Groundwater arsenic concentrations October 2016 to April 2020 at EPL Monitoring Point 30. Units in mg/L (1 mg/L = 1000 µg/L).

Chart 11a above sets out the published results of total dissolved arsenic concentrations in groundwater monitoring by Delta Electricity under its EPL between October 2016 and April 2020. This point is directly below the ash dam wall. It shows total dissolve arsenic concentrations falling over time from a peak of 0.04mg/L (40 µg/L) in January 2017.

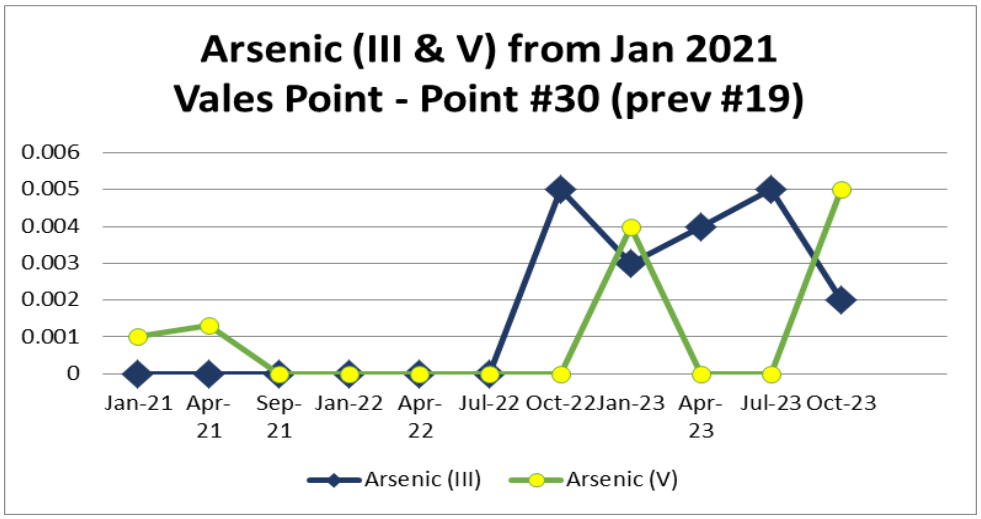

Chart 11b: Groundwater arsenic concentrations October 2016 to April 2020 at EPL Monitoring Point 30. Units in mg/L (1 mg/L = 1000 µg/L).

Chart 11b above is a time series of groundwater monitoring results for arsenic III and arsenic V between January 2021 and October 2023 at point 30 below the ash dam wall.

Concentrations of arsenic III spiked to 0.005 mg/L (5 µg/L) in July 2022 and again in July 2023, double the ANZECC (2000) ECL. This is an indicative interim working level, further study into the impacts this concentration may have on aquatic species in Mannering Bay and Wyee Bay is warranted.

A combined Total dissolved arsenic of 0.007 mg/L (7 µg/L) in January and October 2023 is slightly higher than the concentration of 0.005 mg/L (5 µg/L) reported in April 2020.

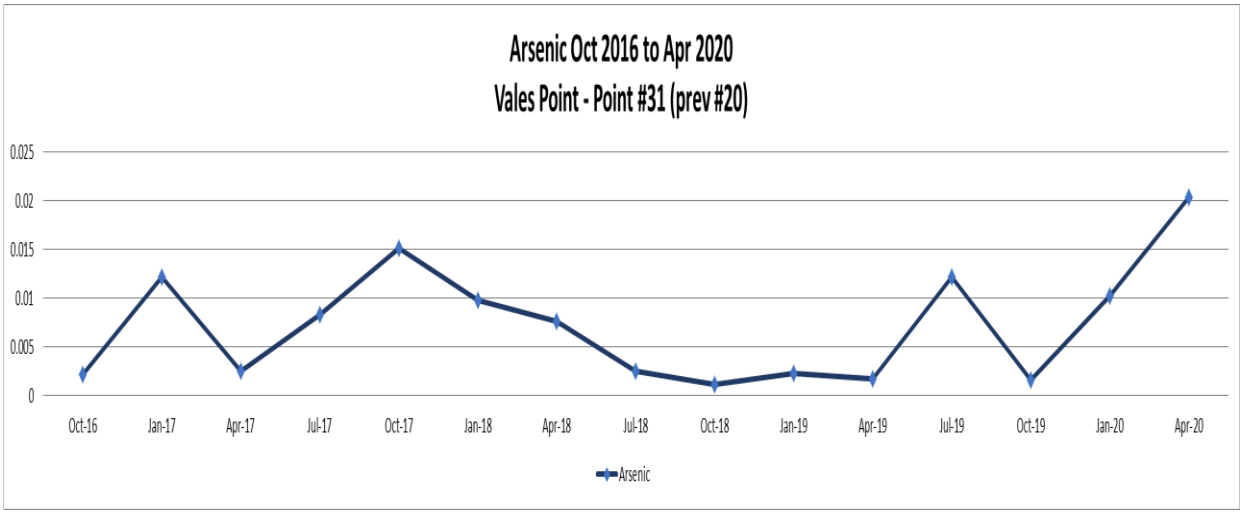

Chart 11c: Groundwater arsenic concentrations October 2016 to April 2020 at EPL Monitoring Point 31. Units in mg/L (1 mg/L = 1000 µg/L).

Chart 11c above sets out groundwater monitoring results from October 2016 to April 2020. This site is upstream from the drainage line HCEC took surface water samples (See Table 1 and Figures 1 and 2).

A spike in total dissolved arsenic concentrations is evident in the April 2020 groundwater monitoring results, when it reached 0.02 mg/L (20 µg/L).

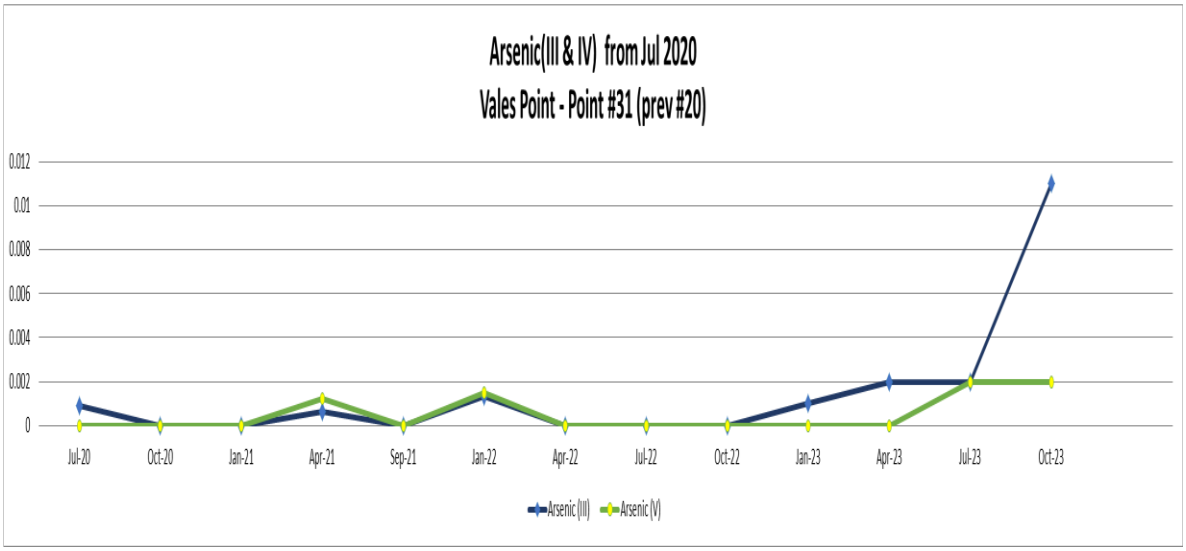

Chart 11d: Groundwater arsenic III and arsenic V concentrations July 2020 to October 2023 at EPL Monitoring Point 31 (formerly 20). Units in mg/L (1 mg/L = 1000 µg/L).

Chard 11d above sets out concentrations of arsenic III and arsenic V between July 2020 and October 2023 at groundwater monitoring point 31.

A spike in arsenic III is evident in Delta's most recent groundwater monitoring results for October 2023. The concentration of 0.011 mg/L (11 µg/L) is 4 times the ANZECC & ARMCANZ (2000) ECL of 2.3 µg/L. This is an indicative interim working level and further study into the impacts that this concentration may have on aquatic species in Mannering Bay and Wyee Bay is warranted.

The combined total arsenic concentration for October 2023 is 0.013 mg/L (13 µg/L) represents a reduction from the peak of 0.02mg/L (20 µg/L) found at this monitoring bore in April 2020.

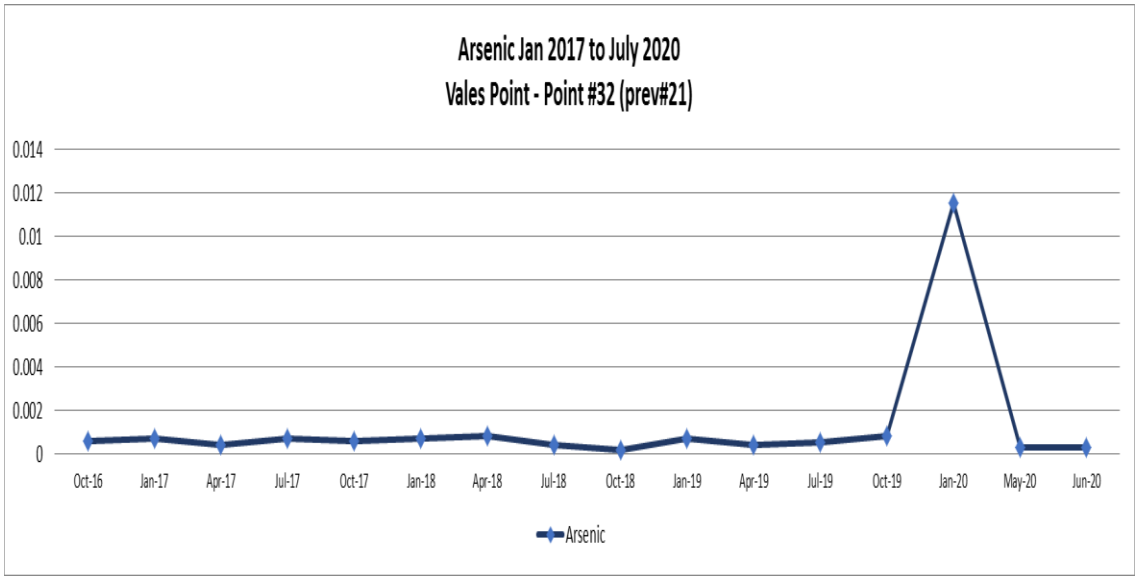

Chart 11e: Groundwater Total dissolved arsenic concentrations October 2016 to June 2020 at EPL Monitoring Point 32 (formerly 21). Units in mg/L (1 mg/L = 1000 µg/L).

Chard 11e above sets out concentrations of arsenic between October 2016 and April 2020 at groundwater monitoring point 32. This bore is on a drainage line below the ash dam wall to the west of Point 30. See Figure 1.

A peak in total dissolved arsenic is evident in Delta's groundwater monitoring results for January 2020.

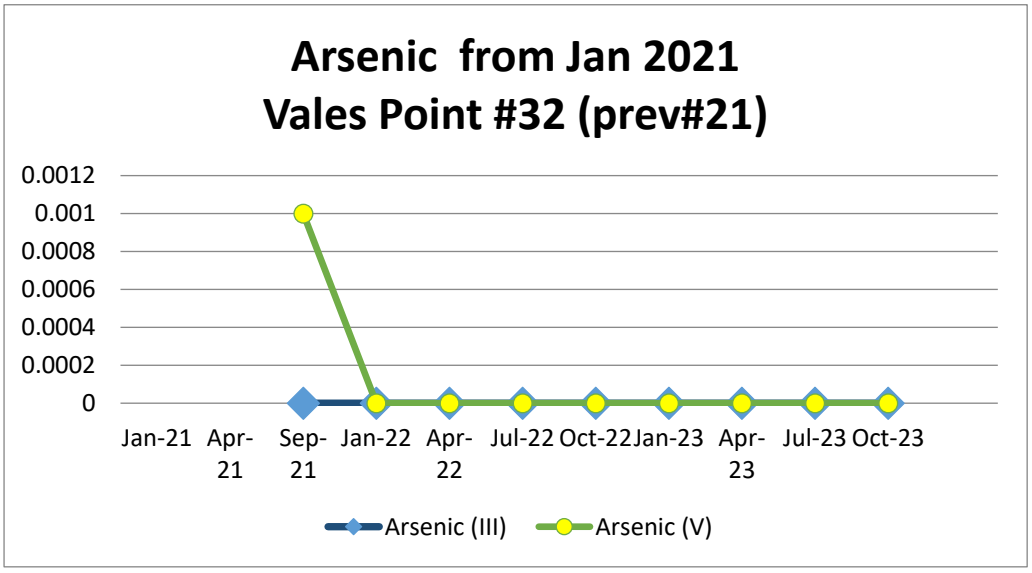

Chart 11f: Groundwater arsenic III and arsenic V concentrations January 2021 to October 2023 at EPL Monitoring Point 32 . Units in mg/L (1 mg/L = 1000 µg/L).

Chart 11f above sets out monitoring results from point 32 from January 2021 to October 2023. Arsenic III has not been recorded for this bore. However, arsenic V spiked to 0.001 mg/L (1 µg/L) in September 2021.

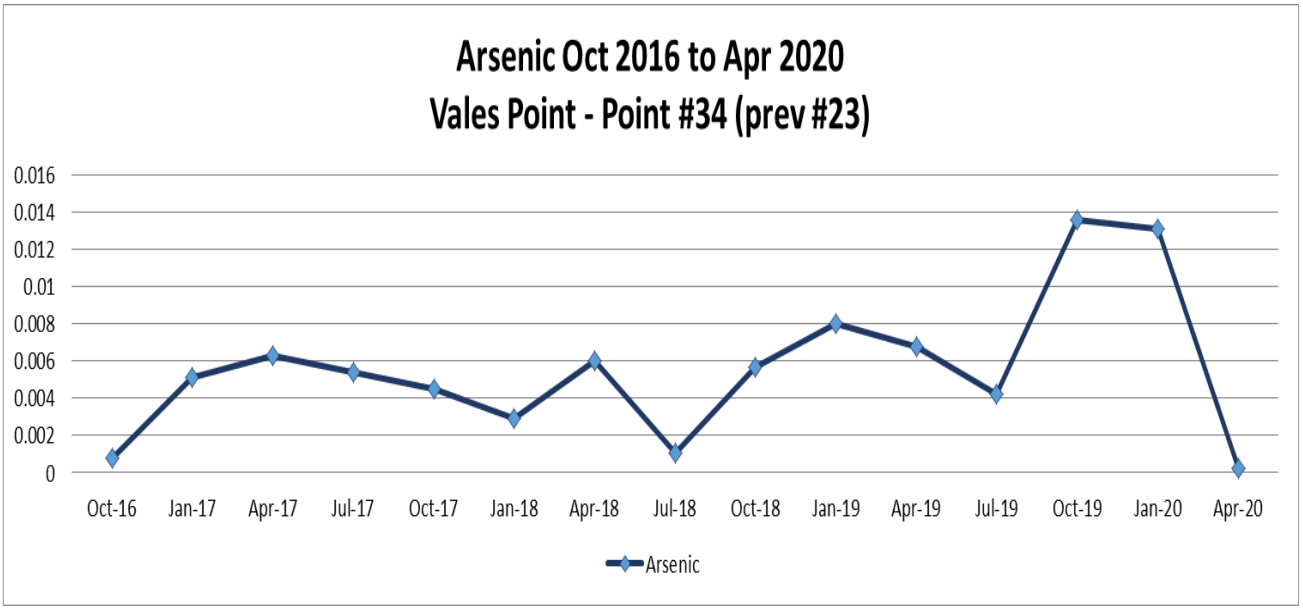

Chart 11g: Groundwater Total dissolved arsenic concentrations October 2016 to April 2020 at EPL Monitoring Point 34 (formerly 23). Units in mg/L (1 mg/L = 1000 µg/L).

The above Chart 11g sets out the monitoring results from October 2016 to April 2020. Total dissolved arsenic spiked in October 2019 to 0.014 mg/L (14 µg/L).

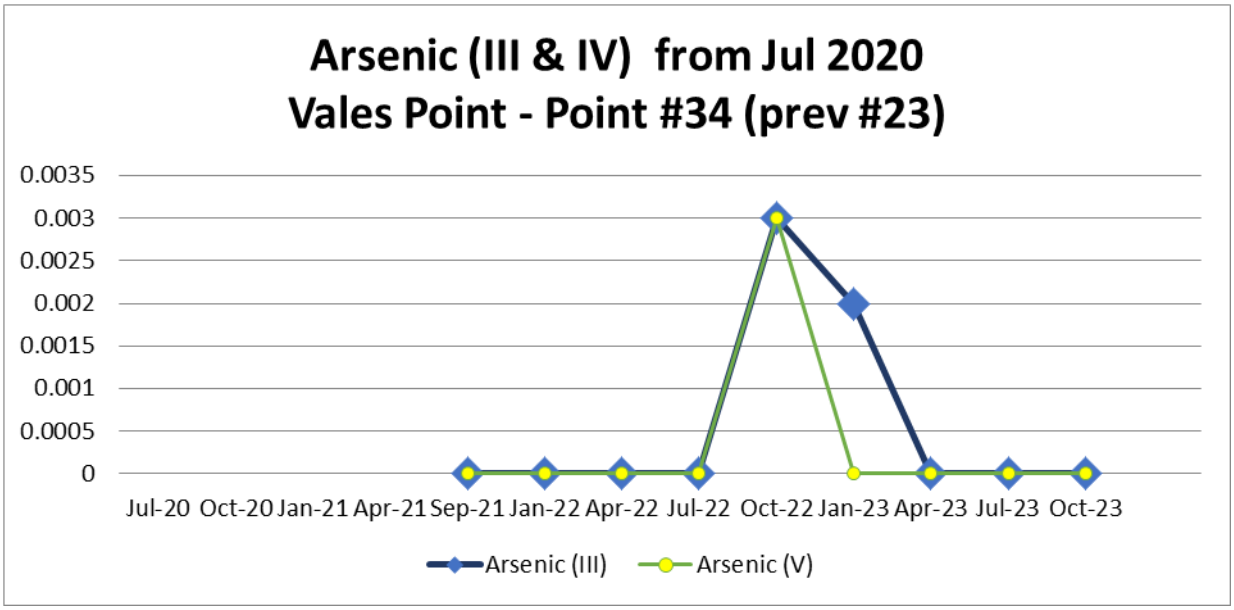

Chart 2h: Groundwater arsenic III and arsenic V concentrations January 2021 to October 2023 at EPL Monitoring Point 32 . Units in mg/L (1 mg/L = 1000 µg/L).

Cadmium

ANZECC & ARMCANZ (2000) recommend a high reliability marine guideline value for cadmium of 5.5 µg/L for 95% protection. However, to protect against chronic toxicity and bioaccumulation of cadmium to related species, the 99% protection level of 0.7 µg/L is recommended for slightly to moderately disturbed ecosystems. If in an area where shellfish are likely to be used for human consumption, the trigger value should be reduced to 0.2 µg/L. [59]

[59] See https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/toxicants/cadmium-2000

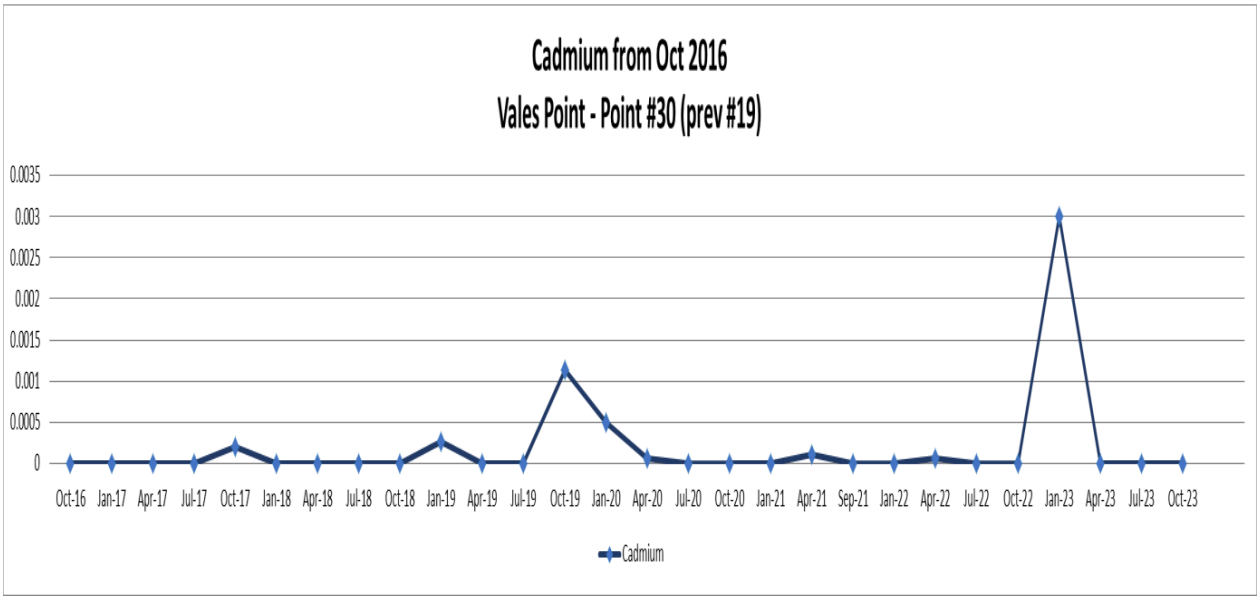

Chart 12a: Groundwater cadmium concentrations October 2016 to October 2023 at EPL Monitoring Point 30 (formerly 19). Units in mg/L (1 mg/L = 1000 µg/L).

Chart 12a above sets out a time series of Delta Electricity's groundwater monitoring results for cadmium from October 2020 to October 2023, at point 30 (previously 19), adjacent to the toe drain just below the ash dam wall up gradient of Mannering Bay.

A spike in cadmium concentrations to 0.003 mg/L (3 µg/L) is identified in the monitoring results for January 2023, the highest concentrations of cadmium since October 2016. This is 4 times the ANZECC & ARMCANZ (2000) recommended high reliability marine guideline value for cadmium of of 0.7 µg/L, which is to protect against chronic toxicity and bioaccumulation of cadmium, particularly bivalves and crustaceans.

As this monitoring point is near to an area where shellfish are likely to be used for human consumption, a case could be made for the trigger value to be reduced to 0.2 µg/L. The January 2023 monitoring results for this bore is 15 times this human consumption trigger value.

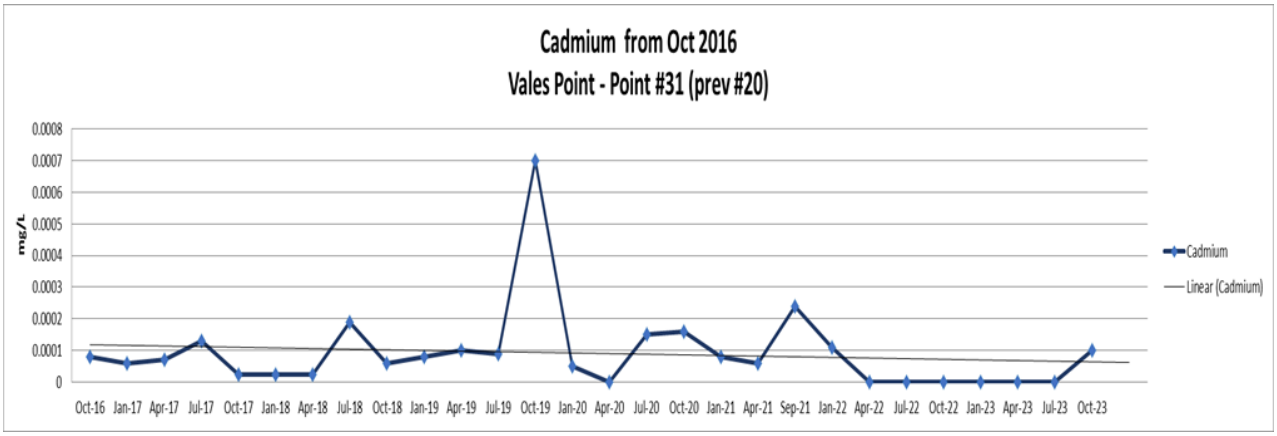

Chart 12b. Groundwater cadmium concentrations October 2016 to October 2023 at EPL Monitoring Point 31. Units in mg/L (1 mg/L = 1000 µg/L).

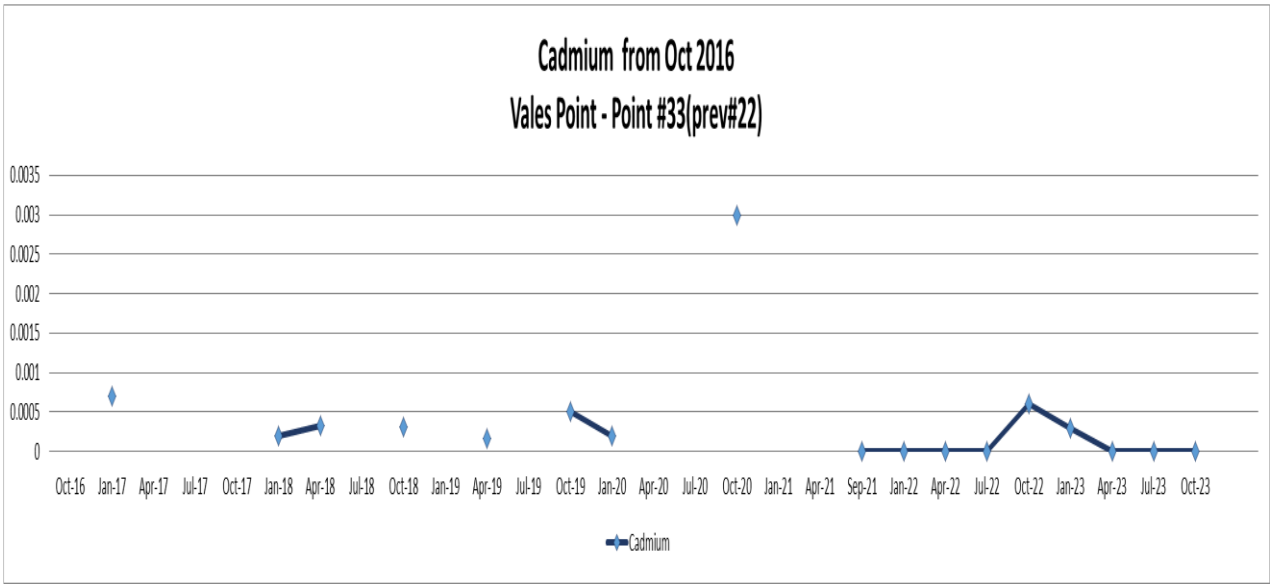

Chart 12c. Groundwater cadmium concentrations October 2016 to October 2023 at EPL Monitoring Point 33 (formerly 22). Units in mg/L (1 mg/L = 1000 µg/L).

Chart 12c above sets out results for groundwater monitoring point 33 (previously 22). A spike in cadmium concentrations is evident in the results from October 2020 reaching 0.003 mg/L (3 µg/L). This is 3 times ANZECC & ARMCANZ (2000) recommended a high reliability marine guideline value for cadmium of of 0.7 µg/L for slightly to moderately disturbed ecosystems, and 15 times the reduced marine guideline value of 0.2 µg/L recommended for areas where shellfish are likely to be used for human consumption.

Copper

Delta Electricity's quarterly monitoring results for October 2023 identifies a spike in copper at two of the five groundwater monitoring points. Samples from a further monitoring bore identifies a spike in concentrations of ammonia in July 2023. These are the highest copper concentrations identified in groundwater since October 2016, when EPL 761 groundwater copper monitoring began.

ANZECC & ARMCANZ (2000) recommend a marine **high reliability** trigger value for copper of 1.3 µg/L (0.0013 mg/L) for 95% species protection in slightly-moderately disturbed systems.[60]

[60] See https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/toxicants/copper-2000

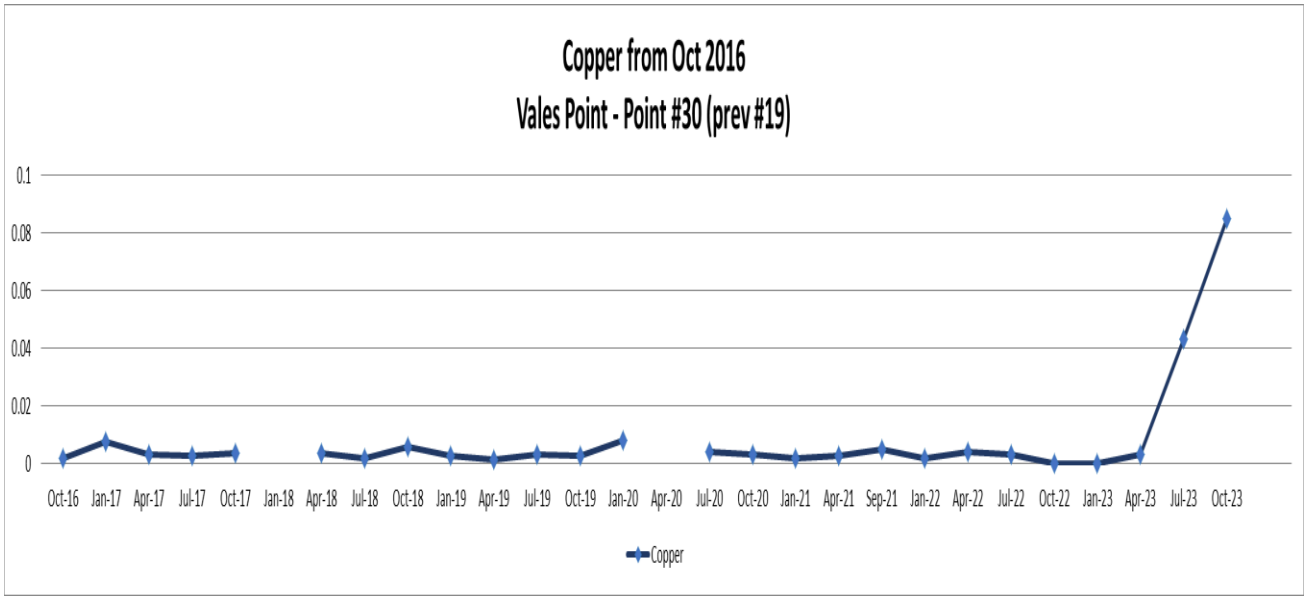

Chart 13a:. Groundwater copper concentrations October 2016 to October 2023 at EPL Monitoring Point 30 (formerly 19). Units in mg/L (1 mg/L = 1000 µg/L).

A substantial spike in copper concentrations is evident for this bore reported in the 0ctober 2023 quarterly groundwater monitoring by Delta. The October 2023 monitoring result for copper at this bore was 0.085 mg/L (85 µg/L), almost 70 times the ANZECC & ARMCANZ (2000) recommended trigger value of 1.3 µg/L (0.0013 mg/L) for slightly-moderately disturbed systems.[61]

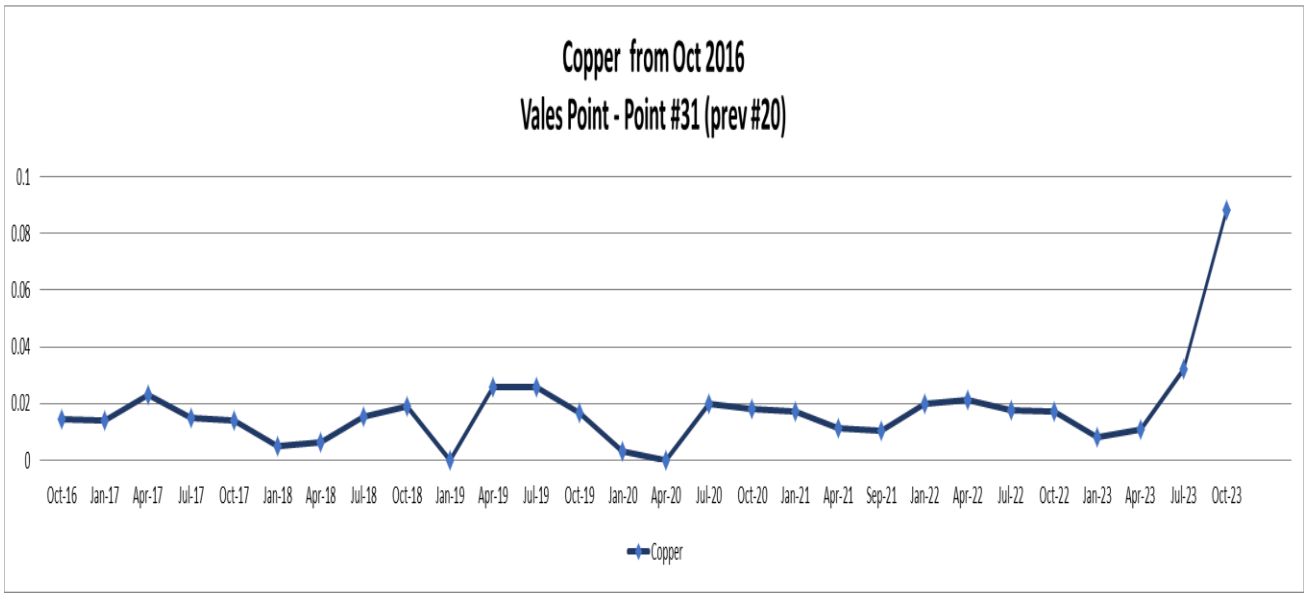

Chart 13b: Groundwater copper concentrations October 2016 to October 2023 at EPL Monitoring Point 31. Units in mg/L (1 mg/L = 1000 µg/L).

A substantial spike in copper concentrations is evident for this bore reported in the 0ctober 2023 quarterly groundwater monitoring by Delta. The October 2023 monitoring result for copper at this bore was 0.09 mg/L (90 µg/L), almost 70 times the ANZECC & ARMCANZ (2000) recommended trigger value of 1.3 µg/L (0.0013 mg/L) for slightly-moderately disturbed systems.[62]

[61] See https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/toxicants/copper-2000

[62] See https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/toxicants/copper-2000

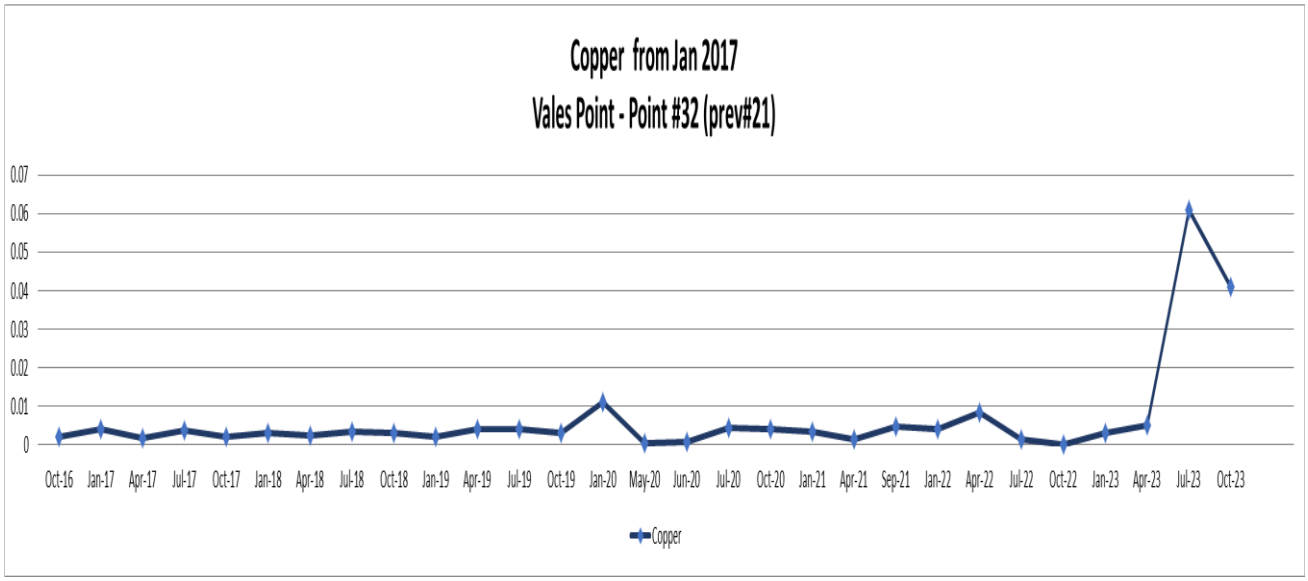

Chart 13c: Groundwater copper concentrations October 2016 to October 2023 at EPL Monitoring Point 32. Units in mg/L (1 mg/L = 1000 µg/L).

A substantial spike in copper concentrations is evident for this bore reported in the 0ctober 2023 quarterly groundwater monitoring by Delta. The October 2023 monitoring result for copper at this bore was 0.06 mg/L (60 µg/L), 45 times the ANZECC & ARMCANZ (2000) recommended trigger value of 1.3 µg/L (0.0013 mg/L) for slightly-moderately disturbed systems.[63]

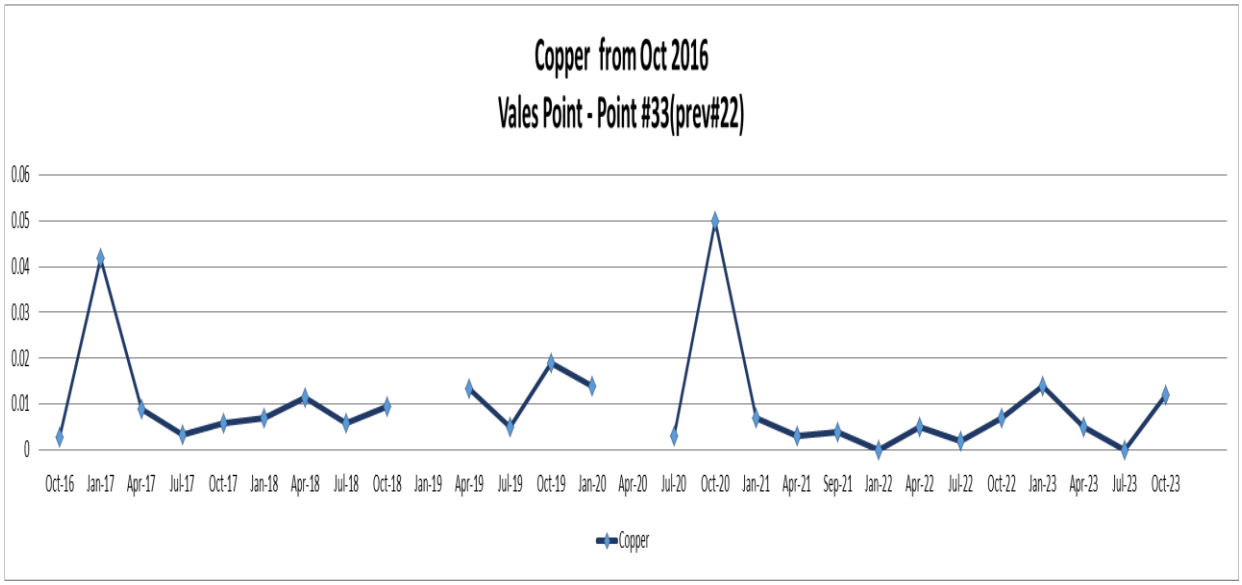

Chart 13d: Groundwater copper concentrations October 2016 to October 2023 at EPL Monitoring Point 33. Units in mg/L (1 mg/L = 1000 µg/L).

Chart 13d above sets out reported groundwater concentrations of copper at Point 33 (previously 22) between October 2016 and October 2023. A substantial spike in groundwater copper concentrations was reported in the 0ctober 2020 quarterly groundwater monitoring by Delta. The monitoring result

[63] See https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/toxicants/copper-2000

for copper at this bore was 0.0 mg/L (50 µg/L), 45 times the ANZECC & ARMCANZ (2000) recommended trigger value of 1.3 µg/L (0.0013 mg/L) for slightly-moderately disturbed systems.[64]

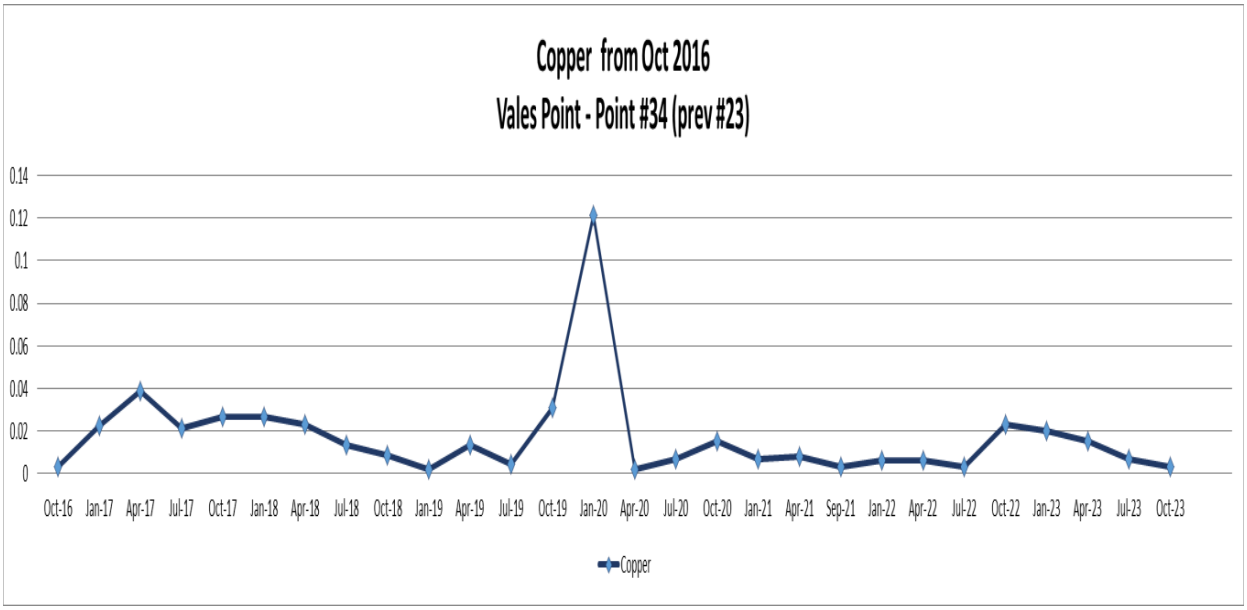

Chart 13e: Groundwater copper concentrations October 2016 to October 2023 at EPL Monitoring Point 34. Units in mg/L (1 mg/L = 1000 µg/L).

Chart 13e above shows the large spike in concentrations of copper in groundwater at monitoring bore 34 (previously 23) for January 2020. The monitoring result for copper at this bore was 0.12 mg/L (120 µg/L), more than 90 times the ANZECC & ARMCANZ (2000) recommended trigger value of 1.3 µg/L (0.0013 mg/L) for slightly-moderately disturbed systems.[65]

Manganese

Delta Electricity's quarterly monitoring results for 2023 identify a spike in manganese concentrations at three of the five groundwater monitoring points. These are the highest manganese concentrations identified in groundwater since October 2016, when EPL 761 groundwater manganese monitoring began.

ANZECC & ARMCANZ (2000) recommends a marine **low reliability** trigger value of 80 µg/L for manganese as an indicative interim working level.[66]

[64] See https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/toxicants/copper-2000
[65] See https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/toxicants/copper-2000
[66] See https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/toxicants/manganese-2000

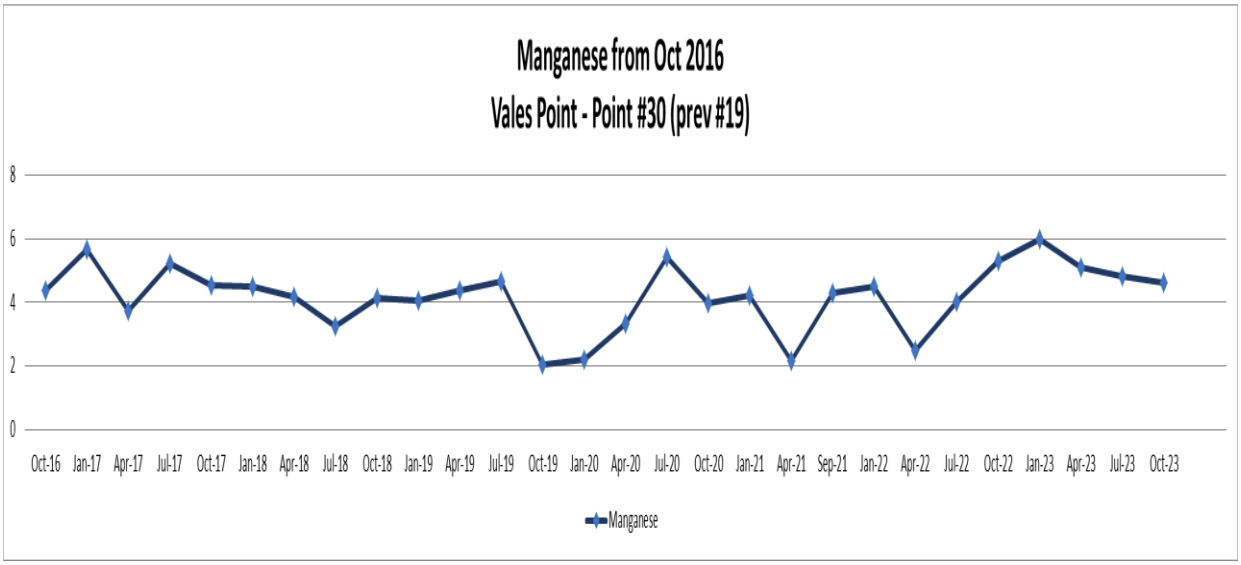

Chart 14a: Groundwater manganese concentrations October 2016 to October 2023 at EPL Monitoring Point 30 (formerly 19). Units in mg/L (1 mg/L = 1000 µg/L).

Chart 14a above sets out a time series of reported groundwater concentrations of manganese at monitoring bore 30 (previously 19) for the past seven years. Manganese concentrations peaked at this bore in January 2023 at 6 mg/L (6000 µg/L). The lowest concentration of 2 mg/L (2000 µg/L) was recorded in October 2019.

The monitoring result for manganese in October 2023 for this bore is 75 times the ANZECC & ARMCANZ (2000) recommended marine **low reliability** trigger value of 80 µg/L (0.08 mg/L). This is an indicative interim working level and further study into the impacts this concentration may have on aquatic species in Mannering Bay and Wyee Bay is warranted.

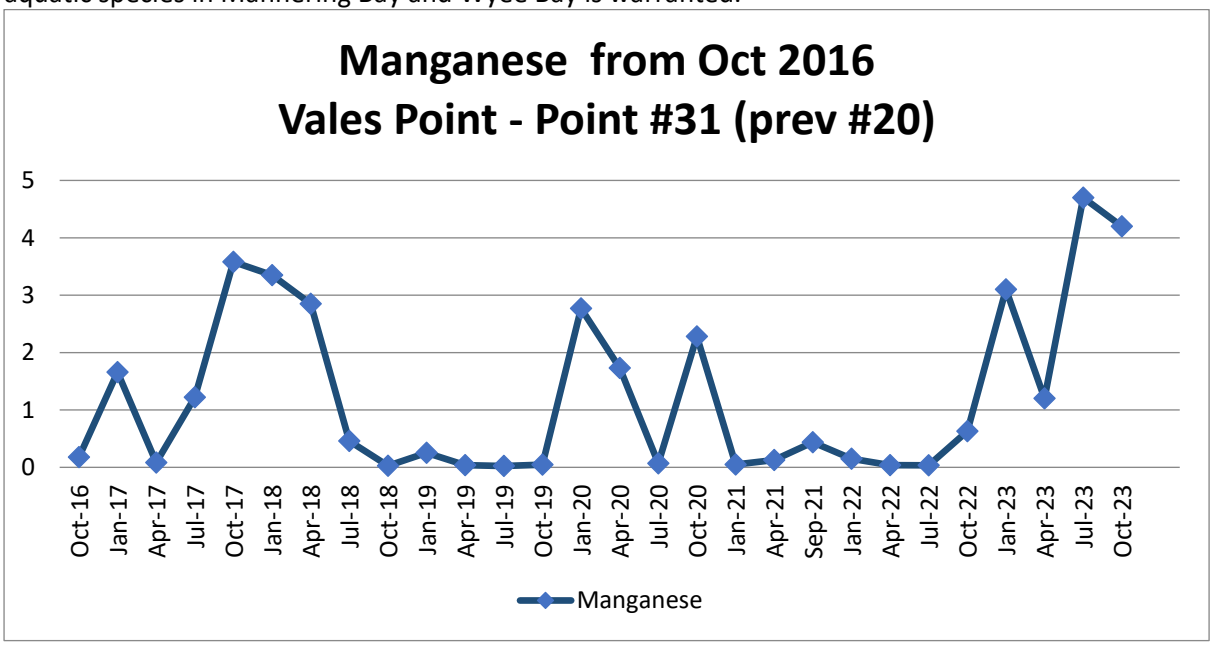

Chart 14b: Groundwater manganese concentrations October 2016 to October 2023 at EPL Monitoring Point 31 (formerly 20). Units in mg/L (1 mg/L = 1000 µg/L).

Chart 14b above sets out results for manganese at groundwater monitoring point 31 (previously 20) over the past seven years. A spike in manganese concentrations is evident in the results from July 2023 reaching 4.7 mg/L (4,700 µg/L). The next highest for the seven year period was 3.6 mg/L in October 2017. The lowest concentration was 0.03 mg/L recorded in July 2019.

The spike in July 2023 manganese concentrations at this bore on the shores of southern Mannering Bay was 58 times ANZECC & ARMCANZ (2000) recommended a high reliability marine guideline value for manganese of 80 µg/L (0.08 mg/L) for slightly to moderately disturbed ecosystems.

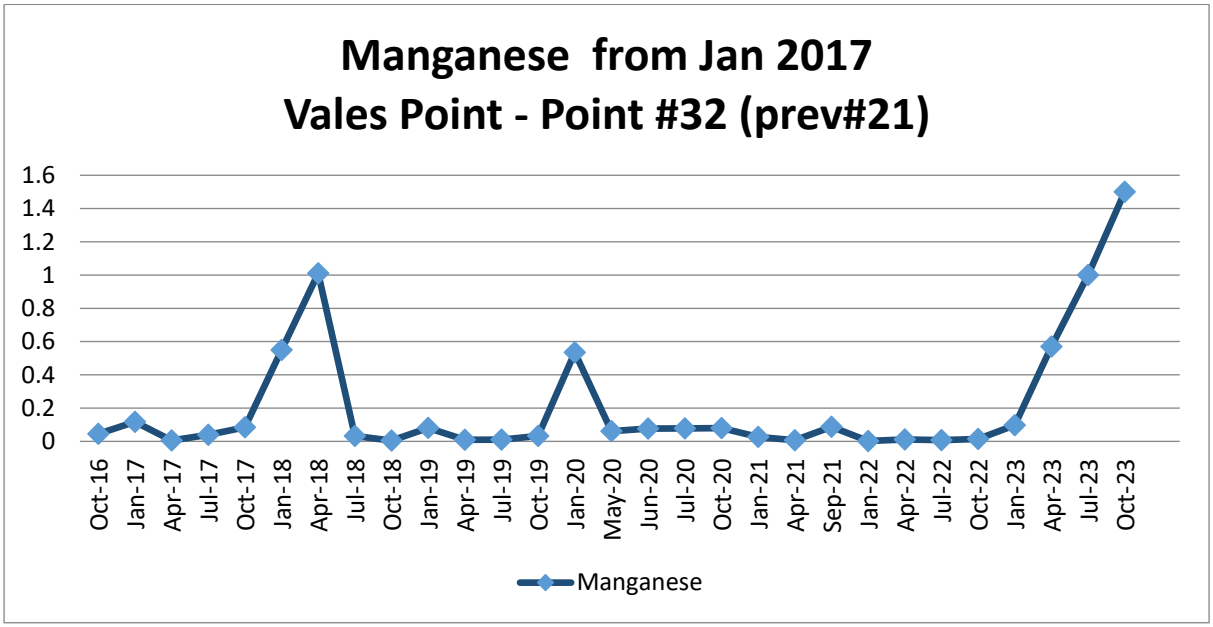

Chart 14c: Groundwater manganese concentrations October 2016 to October 2023 at EPL Monitoring Point 32 (formerly 21). Units in mg/L (1 mg/L = 1000 µg/L).

Chart 14c above sets out results for manganese over the past seven years at groundwater monitoring point 32 (previously 21). A spike in manganese concentrations is evident in the most recent results reported in October 2023 reaching 1.5 mg/L (1500 µg/L). The next highest for the seven year period was 1 mg/L in April 2018 2017.

The spike in October 2023 manganese concentrations at this bore downgradient of the ash dam wall on the drainage line shoreline of Mannering Bay (See Figure 1) is 12 times ANZECC & ARMCANZ (2000) recommended a high reliability marine guideline value for manganese of 80 µg/L (0.08 mg/L) for slightly to moderately disturbed ecosystems.

The concentration of manganese concentrations in surface water samples collected from the drainage line near to this bore in May 2020 by HCEC, was 8.6 mg/L (8600 µg/L).

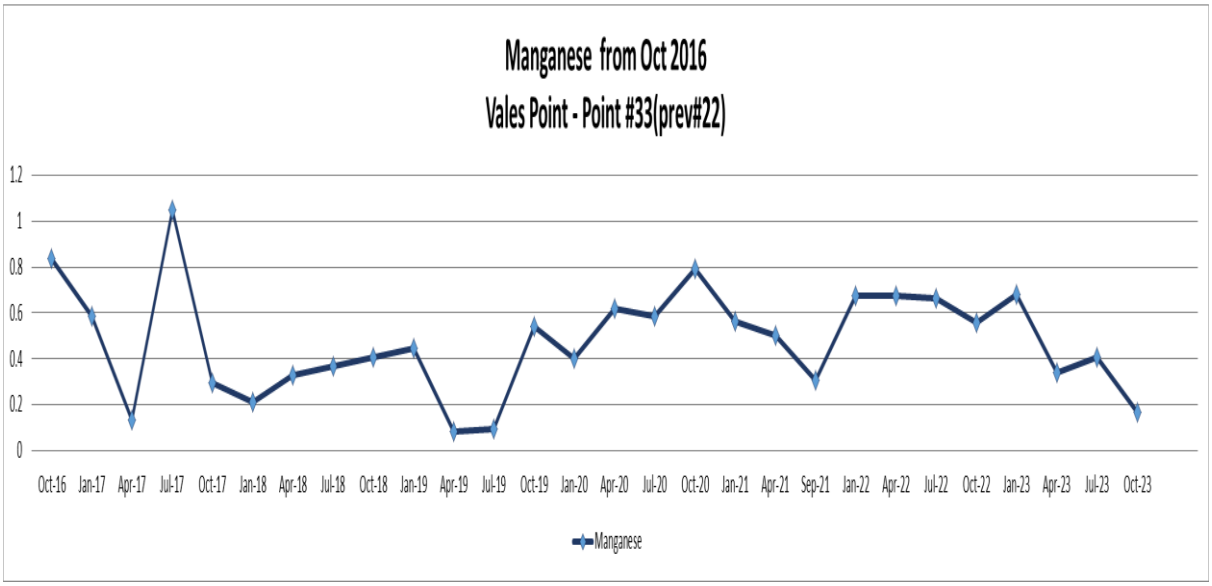

Chart 14d: Groundwater manganese concentrations October 2016 to October 2023 at EPL Monitoring Point 33 (formerly 22). Units in mg/L (1 mg/L = 1000 µg/L).

Chart 14d above sets out results for manganese over the past seven years at groundwater monitoring point 33. A peak in manganese concentrations of 1 mg/L (100 µg/L) occurred in July 2017.

Nickel

Delta Electricity's quarterly monitoring results for October 2023 identifies a spike in nickel at three of the five groundwater monitoring points.. These are the highest nickel concentrations identified in groundwater since October 2016, when EPL 761 groundwater nickel monitoring began

ANZECC & ARMCANZ (2000) derived a marine high reliability guideline value of 70 µg/L for nickel at 95% protection. However, the 95% protection level does not give sufficient margin of safety from acute toxicity for:

- a juvenile mysid (152 µg/L,
- a mollusc (60 µg/L),
- a diatom (50 to 100 µg/L) and
- two dinoflagellates (100 µg/L).

The ANZECC & ARMCANZ (2000), therefore, recommends the 99% protection level of 7 µg/L for slightly to moderately disturbed marine systems. [67]

[67] See https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/toxicants/nickel-2000

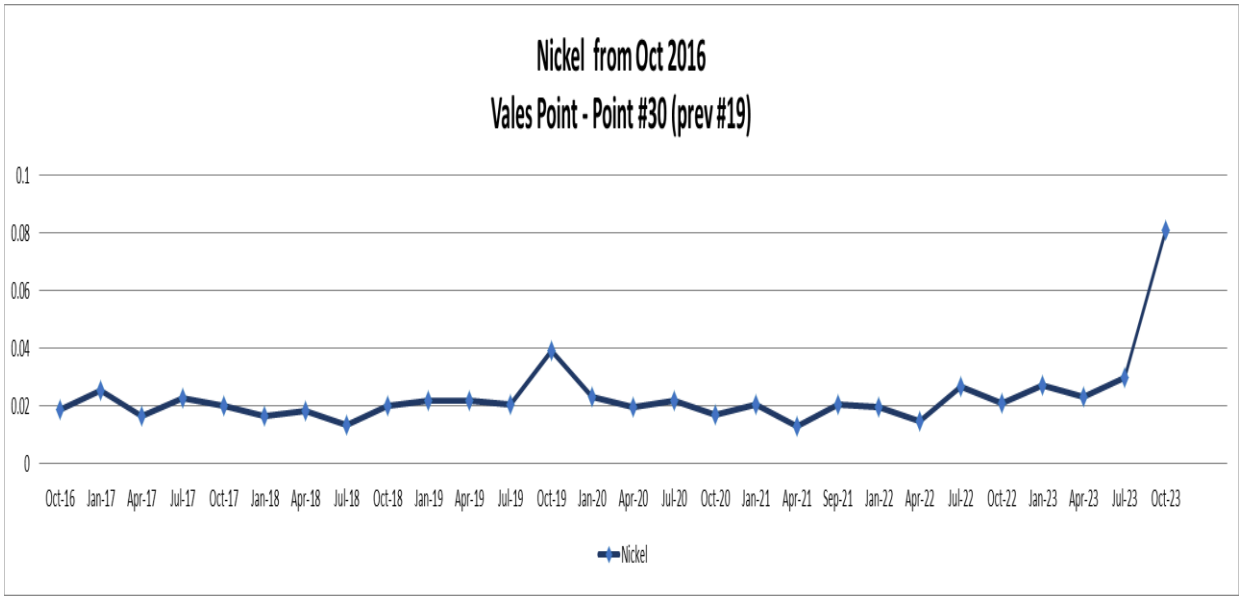

Chart 15a: Groundwater nickel concentrations October 2016 to October 2023 at EPL Monitoring Point 30. Units in mg/L (1 mg/L = 1000 µg/L).

Chart 15a above sets out results for nickel over the past seven years at groundwater monitoring point 30 (previously 19). A recent spike in concentrations of nickel at this bore was reported in the October 2023 monitoring results. The peak of 0.8 mg/L (800 µg/L) is ten times the ANZECC & ARMCANZ (2000) recommended high reliability marine guideline of 70 µg/L at 95% protection, and 100 times the 99% species protection level recommended for slightly-moderately disturbed marine systems, to give sufficient margin of safety from acute toxicity in some species.

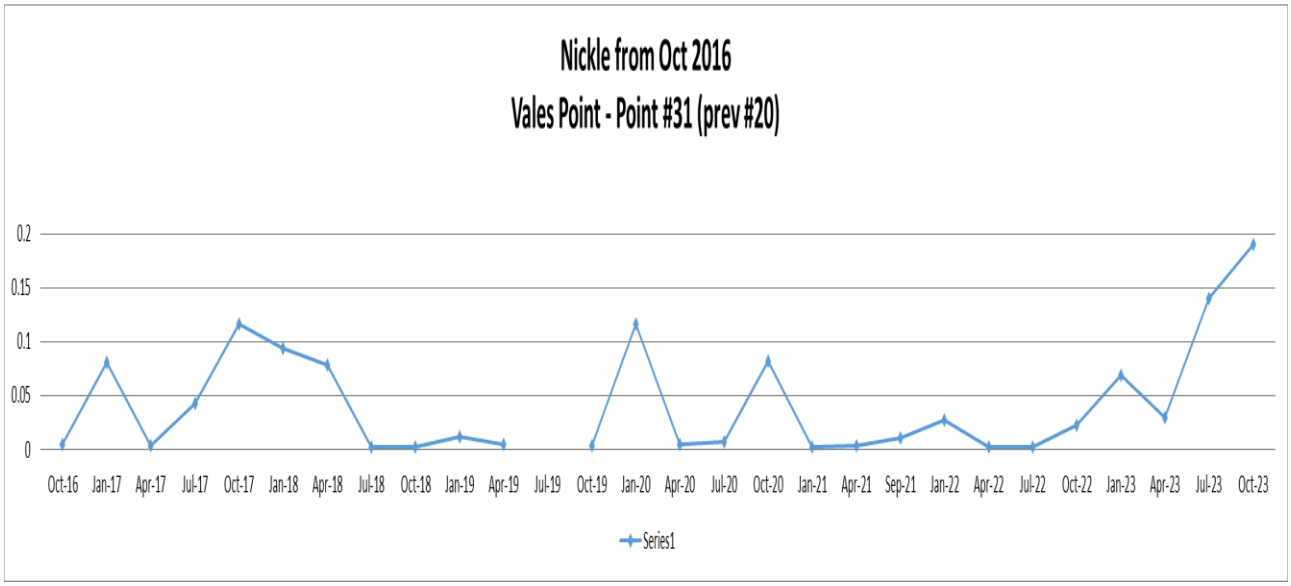

Chart 15b: Groundwater nickel concentrations October 2016 to October 2023 at EPL Monitoring Point 31. Units in mg/L (1 mg/L = 1000 µg/L).

Chart 15b above sets out results for nickel over the past seven years at groundwater monitoring point 31. A recent spike in concentrations of nickel at this bore was reported in the October 2023 monitoring results. The peak of 0.19 mg/L (190 µg/L) is more than double the ANZECC & ARMCANZ (2000) recommended high reliability marine guideline of 70 µg/L at 95% protection,

and 27 times the 99% species protection level recommended for slightly-moderately disturbed marine systems, to give sufficient margin of safety from acute toxicity in some species.

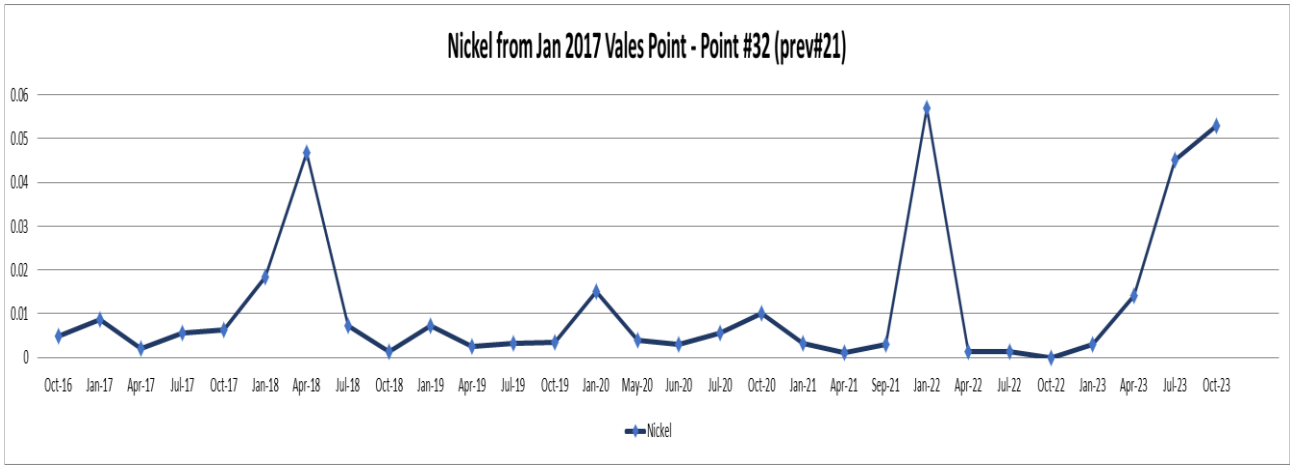

Chart 15c: Groundwater nickel concentrations October 2016 to October 2023 at EPL Monitoring Point 32. Units in mg/L (1 mg/L = 1000 µg/L).

Chart 15c above sets out results for nickel over the past seven years at groundwater monitoring point 32. Two recent spikes in concentrations of nickel at this bore were reported in the January 2022 and October 2023 monitoring results. The peak of 0.057 mg/L (57 µg/L) in January 2022 and 0.053 mg/L (53mg/L) in October 2023 is below the ANZECC & ARMCANZ (2000) recommended high reliability marine guideline of 70 µg/L at 95% protection, but 7 times the 99% species protection level recommended for slightly-moderately disturbed marine systems, to give sufficient margin of safety from acute toxicity in some species.

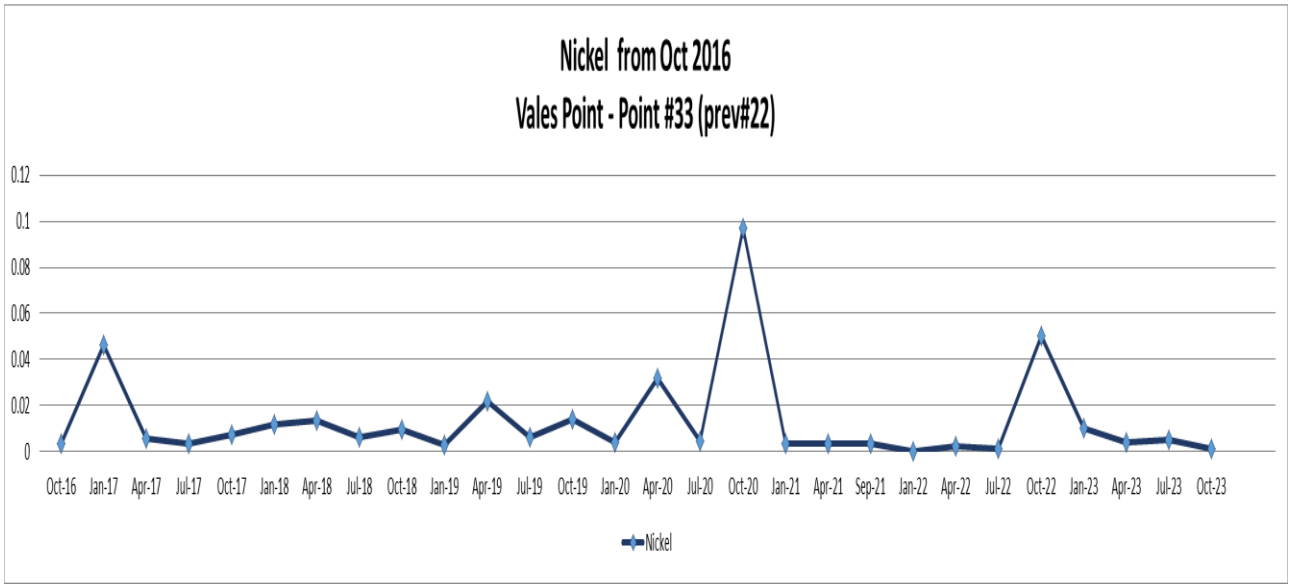

Chart 15d: Groundwater nickel concentrations October 2016 to October 2023 at EPL Monitoring Point 33. Units in mg/L (1 mg/L = 1000 µg/L).

Chart 15d above sets out results for nickel over the past seven years at groundwater monitoring point 33. A peak concentration of nickel was reported in October 2020 with almost 0.1 mg/L (100 µg/L). Another spike was reported for October 2022 of 0.5 mg/L (50 µg/L)

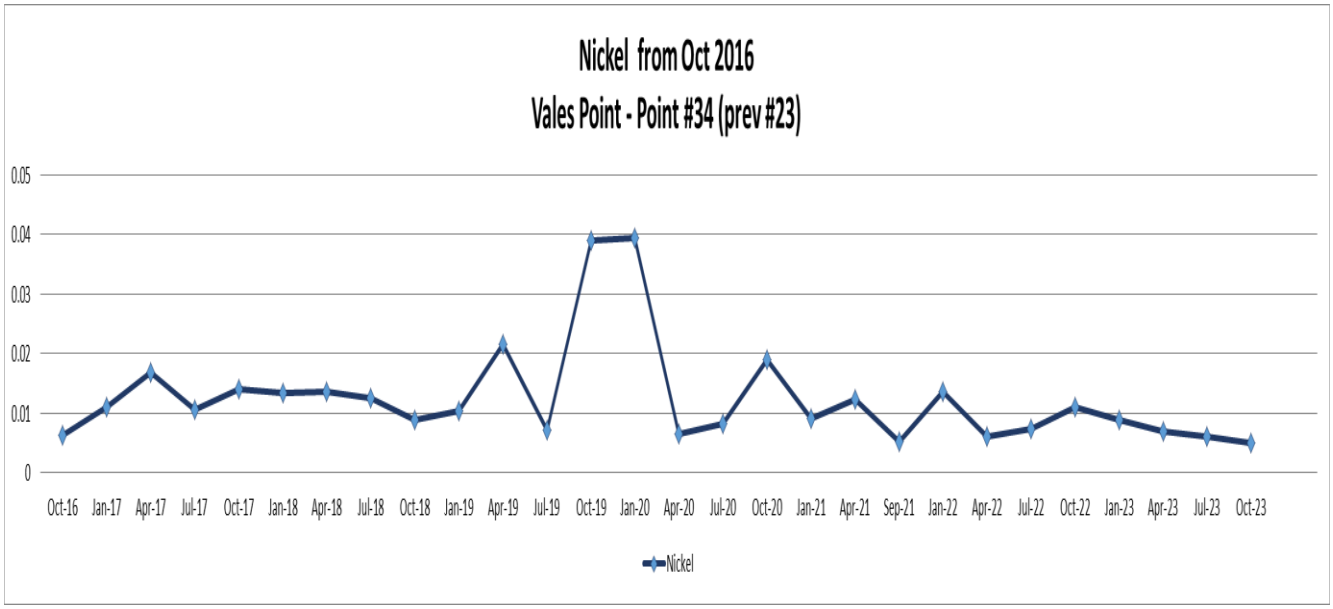

Chart 15e: Groundwater nickel concentrations October 2016 to October 2023 at EPL Monitoring Point 34. Units in mg/L (1 mg/L = 1000 µg/L).

Sodium

Delta Electricity's quarterly monitoring results for 2023 identifies a spike in sodium at two of the five groundwater monitoring points.. These are the highest sodium concentrations identified in groundwater since April 2021, when EPL 761 groundwater sodium monitoring began

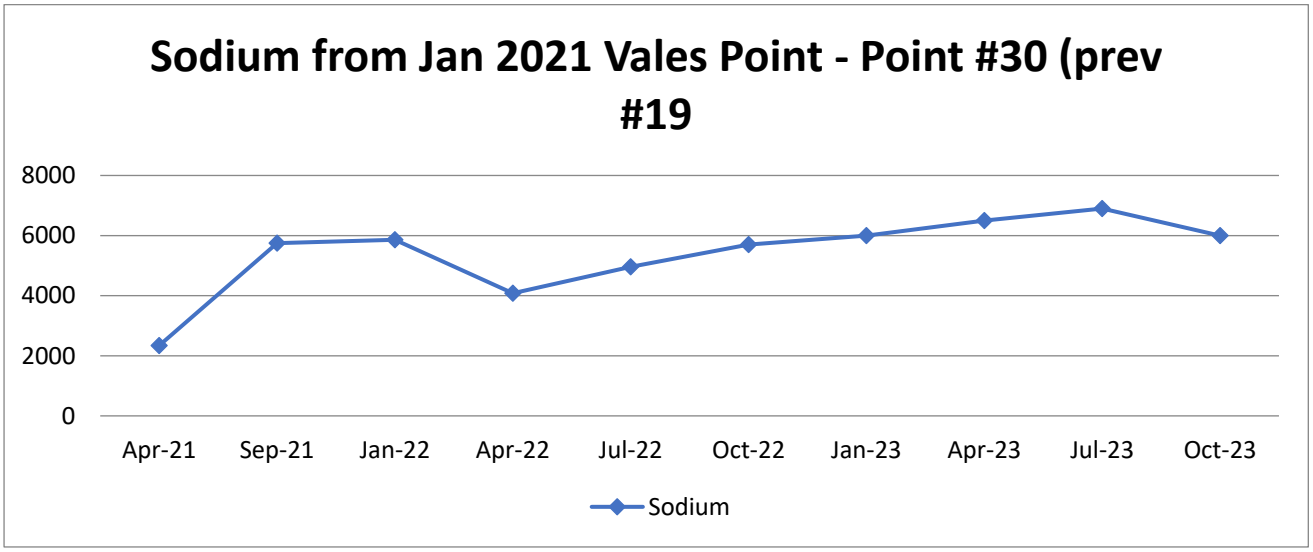

Chart 16a: Groundwater sodium concentrations April 2021 to October 2023 at EPL Monitoring Point 30. Units in mg/L (1 mg/L = 1000 µg/L).

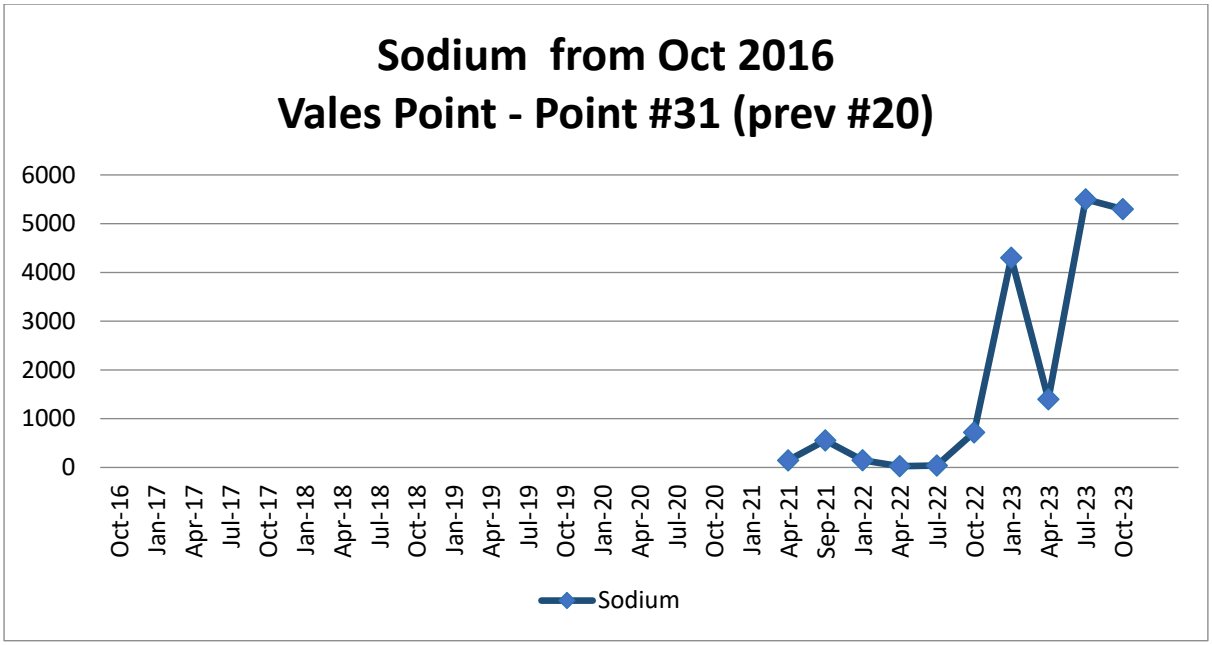

Chart 16b: Groundwater sodium concentrations April 2021 to October 2023 at EPL Monitoring Point 31. Units in mg/L (1 mg/L = 1000 µg/L).

Potassium

Delta Electricity's quarterly monitoring results for October 2023 identifies a spike in potassium er at one of the five groundwater monitoring points.. This is the highest potassium concentration identified in groundwater since April 2021, when EPL 761 groundwater potassium monitoring began

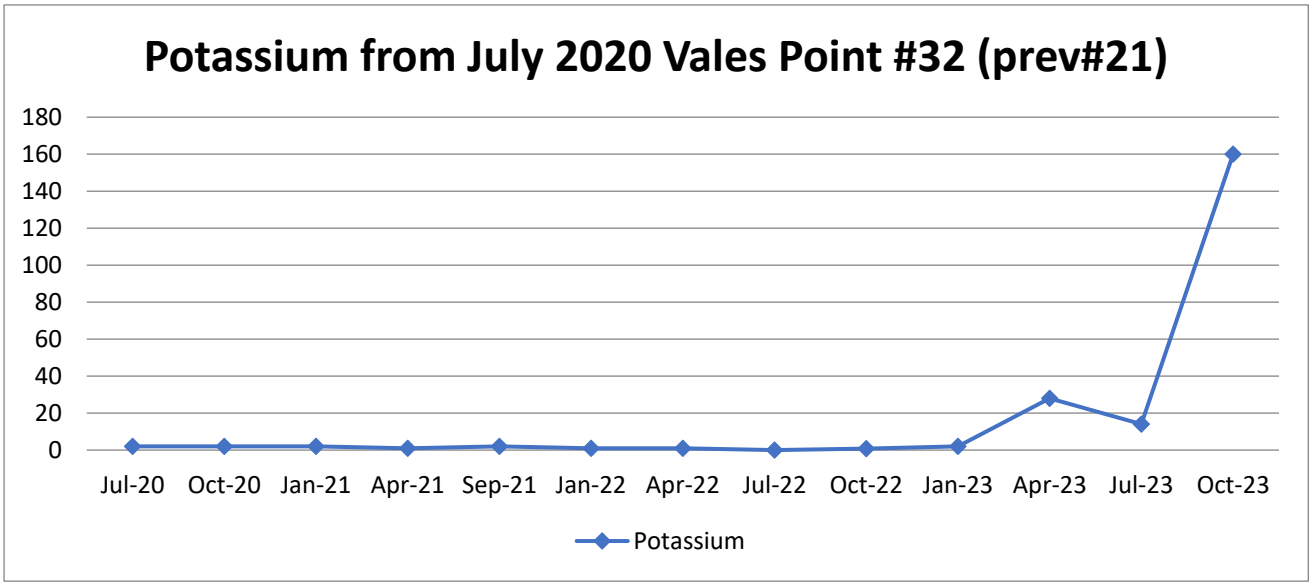

Chart 17a: Groundwater potasium concentrations July 2020 to October 2023 at EPL Monitoring Point 32. Units in mg/L (1 mg/L = 1000 µg/L).

Zinc

Delta Electricity's quarterly monitoring results for October 2023 identifies a spike in zinc one of the five groundwater monitoring points.. This is the highest zinc concentrations identified in groundwater since October 2016, when EPL groundwater zinc monitoring began.

ANZECC & ARMCANZ (2000) derived a very high reliability DGV for zinc in marine wate from chronic (long-term) toxicity data for 16 species. The DGVs for 95% species protection is 8.0 µg/L.. The 95% species protection DGV may be under-protective for key sensitive species (e.g. bivalve molluscs,

cnidarians) and the 99% species protection DGV of3.3 µg/L could be adopted if there are concerns about the protection of key sensitive species. .[68]

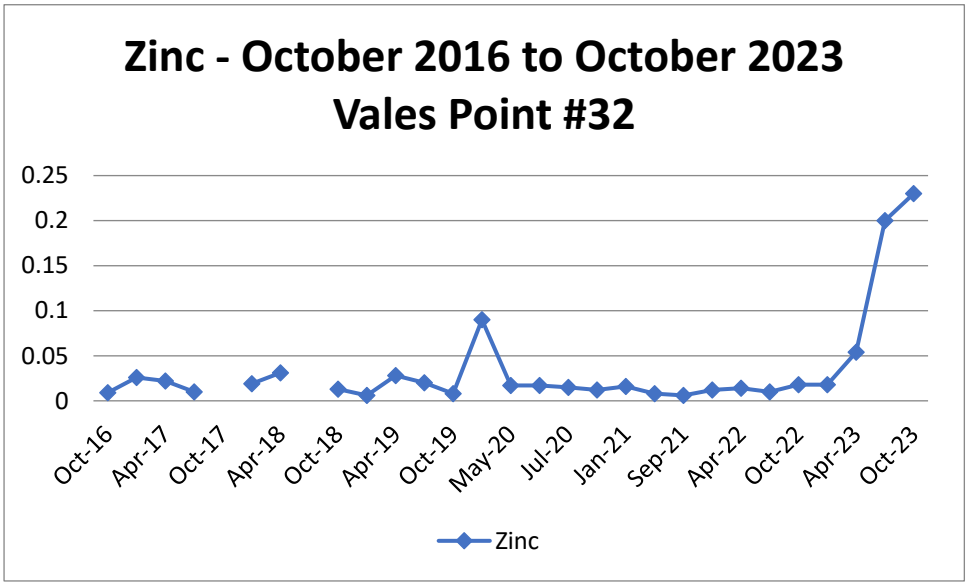

Chart 17a: Groundwater zinc concentrations April 2021 to October 2023 at EPL Monitoring Point 31. Units in mg/L (1 mg/L = 1000 µg/L).

Chart 17a above sets out results for zinc over the past seven years at groundwater monitoring point 32. A peak concentration of zinc was reported in October 2023 with almost 0.23 mg/L (230 µg/L).

This concentration is 28 times the ANZECC & ARMCANZ (2000) very high reliability marine draft guideline value of 8 µg/L, and almost 70 times the 3.3 µg/L 99% species protection level for protection of sensitive species such as bivalves, molluscs and cnidarians.

Conclusion and recommendations

It is almost certain that groundwater contamination is occurring at Vales Point due to the mobilisation of toxicants in the coal ash deposited in the Ash Dam since the 1960s.

Elevated metal concentrations (particularly aluminium, copper, lead, and zinc) have been found by Delta Electricity consultants [69] in groundwater seepage discharge points and the Ash Dam Pipe.

HCEC has found similarly elevated metals in:

- Seepage along the Ash Dam wall (particularly (aluminium, boron, Iron, cobalt, manganese, nickel, and zinc).
- Sediments of Mannering Bay since the Power Station began operations (particularly arsenic , cadmium, copper, iron, lead, manganese, nickel, selenium zinc).
- Edible crabs caught from southern Wyee Bay (particularly arsenic, cadmium, copper, iron, manganese, and zinc).

The latest quarterly groundwater monitoring report for EPL 761 has now identified the highest groundwater concentrations yet found by Delta Electricity for ammonia, copper, manganese, nickel, sodium, potassium, and zinc. The highest cadmium groundwater concentration was found in January 2023.

[68] https://www.waterquality.gov.au/sites/default/files/documents/zinc_marine_dgv_technical-brief.pdf
[69] Douglas Partners, 2021. Report on Groundwater Assessment In the Vicinity of Lot 421 in DP 578194, Doyalson North for Delta Electricity, Accessed under NSW Parliamentary Standing Orders 52

Deltas consultant[70] suggests the groundwater impacts are caused by the dissolution of metals from ash caused by acidic groundwater conditions, and that It is likely that this is due to wet-sluicing of the ash for disposal in the Ash Dam.

The ash dam holds far too much water, which mobilises toxins within the ash. Elsewhere in Australia and the world, coal ash is transported to storage facilities using far less water than used by Vales Point. The installation of new dense phase ash transport infrastructure designed to reduce the water collecting in the ash dam is essential in reducing groundwater contamination, and the continual contamination of Lake Macquarie.

We reiterate our recommendation that to minimise toxic trace elements contained within Vales Point coal ash from mobilising and entering groundwater and Lake Macquarie, EPL 761 must be varied to incorporate a clause to significantly reduce the volume of water in the ash dam. This would require Delta Electricity to install new plant and machinery for dense phase ash transport to the Vales Point Ash Dam.

[70] Douglas Partners, 2021. Report on Groundwater Assessment In the Vicinity of Lot 421 in DP 578194, Doyalson North for Delta Electricity, Accessed under NSW Parliamentary Standing Orders 52