2nd March 2021

For the attention:
Phillip Zappala
Senior Planner – Major Assessment
City Development Branch
Council of City of Gold Coast

Dear **Phillip Zappala,**

Objection submission COM/2019/81 - Groundwater Errors and Inconsistencies in DA and analysis of the long term environmental and ecological effect

Please find below further information that I think should be considered re this development Application and its effect on the groundwater and the environment surrounding the proposed quarry pit.

The submitted information on Groundwater Impact, I believe, minimises, trivialises and misleads readers to the true effect of subterranean quarrying at up to 95 metres (or 110 metres depending on where you read it) as proposed by this development application, below the immediately adjacent Coomera River.

How does the development application mislead?

In the main application it is very interesting to compare the 'Summary' section 4.9 of Specialist reports section (reproduced in Attachment B1) with the Groundwater Impact Assessment by AGE Consultants.

The man application summary states: *"A localised deepening of the existing quarry pit from approximately 5 m AHD to -95 m AHD, which will extend the excavation below the regional groundwater table. This will result in groundwater seepage into the quarry pit and drawdown within the surrounding water bearing Neranleigh-Fernvale Beds rock mass".* It is has neglected to say lowering the water table significantly and maybe with catastrophic effects on the local environment for a significant radius of up to 1.45km from the quarry pit (as shown in Attachment A1).

It then states: "*Groundwater inflows of 4 L/s or 130 ML/yr are predicted and are considered more likely to be representative of the magnitude of inflows to be observed during operations"*. To this casual observer this can be taken as a reasonable statement. However, this includes a lot of assumptions and is by no means a worst case scenario (as you might expect and require), it is in fact a best case scenario. From the Groundwater Impact Assessment document, prepared by AGE Consultants a very different picture is observed (Attachment B2). This clearly shows the worst case is 432 ML/yr (172 Olympic swimming pools worth) which is vastly different from the best case quoted of 130 ML/yr (52 Olympic Swimming pools).

It is expected that the 'radius of influence' could be in the region of 1.4km (that's an area in excess of 6 km²) surrounding the quarry that will be potentially affected by the lowering of the water table (Attachment B3). The extent of this can be seen on the map in Attachment A1.

The Groundwater Impact Assessment claims: *"the Coomera River will act as a flow boundary limiting the western extent of the radius of influence"* (Attachment B3). However, this is incorrect and highly misleading. The average depth of the Coomera River is believed to be on average between two and four metres (which equates to two metres above sea level to two meters below sea level given it is sitting at approximately 2m above sea level opposite the quarry). With a quarry pit of -95 metres below it *"the Coomera River will **CERTAINLY NOT** act as a flow boundary limiting the western extent of the radius of influence"*.

In summary, approximately 172 Olympic swimming pools worth of water can be leeched into the quarry pit (DA figures), having been potentially exposed to acid sulfates on the way. This contaminated water will then have to be disposed of pretty rapidly to avoid swamping the quarry.

Disposal of Groundwater

It is interesting to consider how this potentially contaminated water will be disposed of. The Groundwater Impact Assessment, Section 4.9, of the DA (Section 7.2 Conceptual model during and after construction) merely says: "*The quarry will require dewatering to remain dry. Any water that flows to the quarry would be available for use on site and any excess likely discharged"* (Attachment B4).

So approximately three olympic swimming pools of water may be entering the quarry on a weekly basis and the only consideration of this is *"any excess likely discharged"*. This highly important aspect of the proposed quarry expansion is, I believe, culpably neglected.

There are references to hydraulic connection to the Coomera River, such as*: "If there is hydraulic connectivity between the Coomera River"* (Attachment B3) which could be the proposed method for discharge. However no details have been furnished and I expect are missing due to the environmental considerations of such action would be considerable.

There are certainly no details provided for the highly important decontamination of the now contaminated groundwater as would be the case with the processing or rock and the exposure of acid sulfates reacting with oxygen and turning to sulphuric acid (Attachment B5) and also pyrite releasing toxic metals and metalloids such as arsenic (Attachment B6).

This could have dire consequences for our local ecosystem (attachment B7)

There are no containment pits or decontamination pits in the proposed quarry layout. How will excess water be decontaminated, and adjusted to the right PH level etc. if there is nowhere to store it? 'Quarry Development Plan Stage 8' for instance shows there is absolutely no area to store any water for settlement or decontamination.

Dewatering and drainage

This toxic groundwater will need thorough decontamination before any discharge is possible. The Queensland acid Sulfate management guideline identifies the problems faced and notes dewatering ASS in urbanised areas is unacceptable without appropriate management strategies to limit sediment oxidation (Attachment B8). It also notes that *"extractive industry sites should be hydrologically isolated using bunding and diversion drains"* and *"Management techniques should make sure that there is no discharge from the settlement pools until the sulfidic fines have settled on the bottom and water quality within the ponds meets licence conditions".* Also*, "the location and dimensions of all settlement ponds should also be documented and reported to assessing authorities".* Further, *"All processing areas should be graded to make sure that all runoff is captured, and treated if necessary.*

*All runoff and leachate escaping the stockpiled areas should be collected and fully treated on site, **especially if it to be reused for purposes such as dust suppression**"*.

There are no diversion drains, settlement ponds, etc. as is required as can be clearly seen in the 'Quarry Development Plan Stage 8'. There is absolutely no area to store any water for settlement or decontamination.

Contamination

The problems associated with 'Extractive industries' and containment is thoroughly discussed in the Queensland Acid Sulfate Technical Management guideline (Attachment B9). It highlights aspects such as the need to be hydrologically isolated using bunding and diversion drains. And, the requirements to capture all runoff and treat as necessary, especially if it is to be used for dust suppression of stockpiles for instance. This, I believe, emphasises the requirement to contain all groundwater and neutralise before any form of reuse or redistribution can be permitted.

In summary, I believe, this clearly highlights the need to carefully collect and process the significant amounts of groundwater, that will be ever present on a 24/7 basis, 365 days a year for the next 100 plus years basis, prior to any subsequent reuse or redistribution this groundwater.

To trivialise this highly important and significant matter with a one line sentence of: *"The quarry will require dewatering to remain dry. Any water that flows to the quarry would be available for use on site and any excess likely discharged"* (as stated in Attachment B4) is, I believe, culpably negligent.

An in-depth analysis and solution incorporating settlement pits, bunding, etc. is obviously required.

<u>Changes in water table knock on effects?</u>

The map produced in Attachment A1 shows how the groundwater 'radius of influence' will engulf the Coomera freshwater lake (opposite the quarry) and the Gold Coast Wake Park and Aqua Park (be it the best or worst case scenario).

Currently this freshwater lake is sitting at two metres above sea level. This level being determined by the height of the wier where the freshwater part of the Coomera river feeds into the tidal seawater section of the Coomera river.

Attachment C1 shows a cross section of the quarry area at the juncture with the John Muntz bridge (as identified in Attachment C2).

This clearly shows how close the water table is reliant upon the depth of the Coomera River. Once the quarry pit goes below this level the corresponding water table around it will drop also (In fact it will drop a staggering 95 metres).

What will happen if the lowering of the water table so drastically creates a new level for the Coomera lake opposite? Will the Coomera river be able to maintain its present level given the underlying water table has been lowered substantially? How will this affect the local environment? Will the Coomera

River actually be drained by this much lowering of the water table throughout the area. The map in Attachment A1 clearly show the influence on the water table will be extensive.

Also, what about the wake park and the aqua park, slightly upstream but sitting at a current water level of 7m above sea level. Any change in the level of the water table could drastically alter the lake depth and could possibly have a disastrous effect on these businesses in the area.

The significant lowering of the water table in the area, and the envisaged hydraulic pumping back into the Coomera river opposite the quarry (but downstream of the Wake Park and Aqua Park) will inevitably see these parks struggle to maintain their current water level of 7m above sea level once the water table below has dropped significantly. I would hazard to guess that these parks will have immense trouble maintaining their equilibrium and will far more susceptible to weather and suspect they will constantly run dry during the dry season as they will have lost their natural equilibrium with the surrounding water table they once had.

This could be a financial disaster for the park operators and an environmental and ecological disaster unfolding for the whole area for the foreseeable future.

And the quarries response to this ecological and environmental disaster waiting to happen: "The post-quarrying conceptual model shows that the water level in the quarry void will **likely** stabilize to approximately the same elevation as the current Coomera River (that is -0m AHD*"* (Attachment B1). So it will be ok after 100 plus years!

Groundwater Bores

As mentioned in an earlier submission (Groundwater Impact, dated 29th July, 2020) there will be up to eighteen legally owned and run bores within the radius of influence (Attachment D1). It is assumed these will run dry. Is this fair?

Dangers to the Environment

Quarries change their environment. They displace huge amounts of material and force animals out of the area. Abandoned quarries rarely leave enough material to allow life to return to the area (National Geographic - Quarries and the Environment Attachment E1).

"Quarries are prone to flooding because they are sometimes dug below the water table. Environmentalists fear the toxic materials could seep into groundwater if an abandoned quarry's water reaches an areas water table" (Quarries and the Environment Attachment E1). As this proposed development has admitted to lowering the water table throughout the area there would appear a very real risk of toxic materials affecting the groundwater and/or the Coomera River if it is pumped into the adjacent River. What safeguards are proposed to stop this happening?

"To avoid contamination, miners must sometimes pump water out of quarries. Quarries are sealed from the surrounding water table" (Quarries and the Environment Attachment E1). It would seem impossible give the gargantuan proposed extractive footprint to seal from the surrounding water table. Does this quarry need to be sealed from the surrounding water table? What are the implications of not being sealed from the surrounding water table?

Conclusion

With so many quarries in the North Darlington range that are in rural (not urban) locations and are not subterranean (e.g. Cedar Creek currently at 170m AHD, Luscombe 142m AHD, Ormeau and Yatala 60m AHD and Kingsholme 60m AHD) it would seem ridiculous to risk unknown consequences of altering the water table so drastically within a residential area, within 100 metres of the Coomera River and within two water parks reliant on the water level, whilst there are clearly more viable and more cost effective alternatives without the risks associated with a subterranean venture such as this that has been fully engulfed within a suburban environment. This will undoubtedly have a disastrous effect on the water table in the area with untold ecological and environmental effects for all our foreseeable futures.

The potential contamination of the Coomera River by "discharging" large amounts of excess groundwater, that has been artificially leached from the surrounding area, and will have been contaminated by quarrying activity could have a disastrous effect on our local environment and ecosystem. Not to mention maybe financial disaster for the Gold Coast Wake Park and Aqua Park upstream of this proposed subterranean development.

I believe, the risks of subterranean quarrying in this location are potentially devastating for our local environment and our fragile ecosystem.

It is also, I believe, unnecessary as there is no "Need" for this product as there is ample supply from other local quarries within the Gold Coast and therefore of no actual benefit to the Gold Coast (as proven in the Planning and Environment Court dismissed appeal case of Boral Resources v Gold Coast Council [2017] QPEC 23).

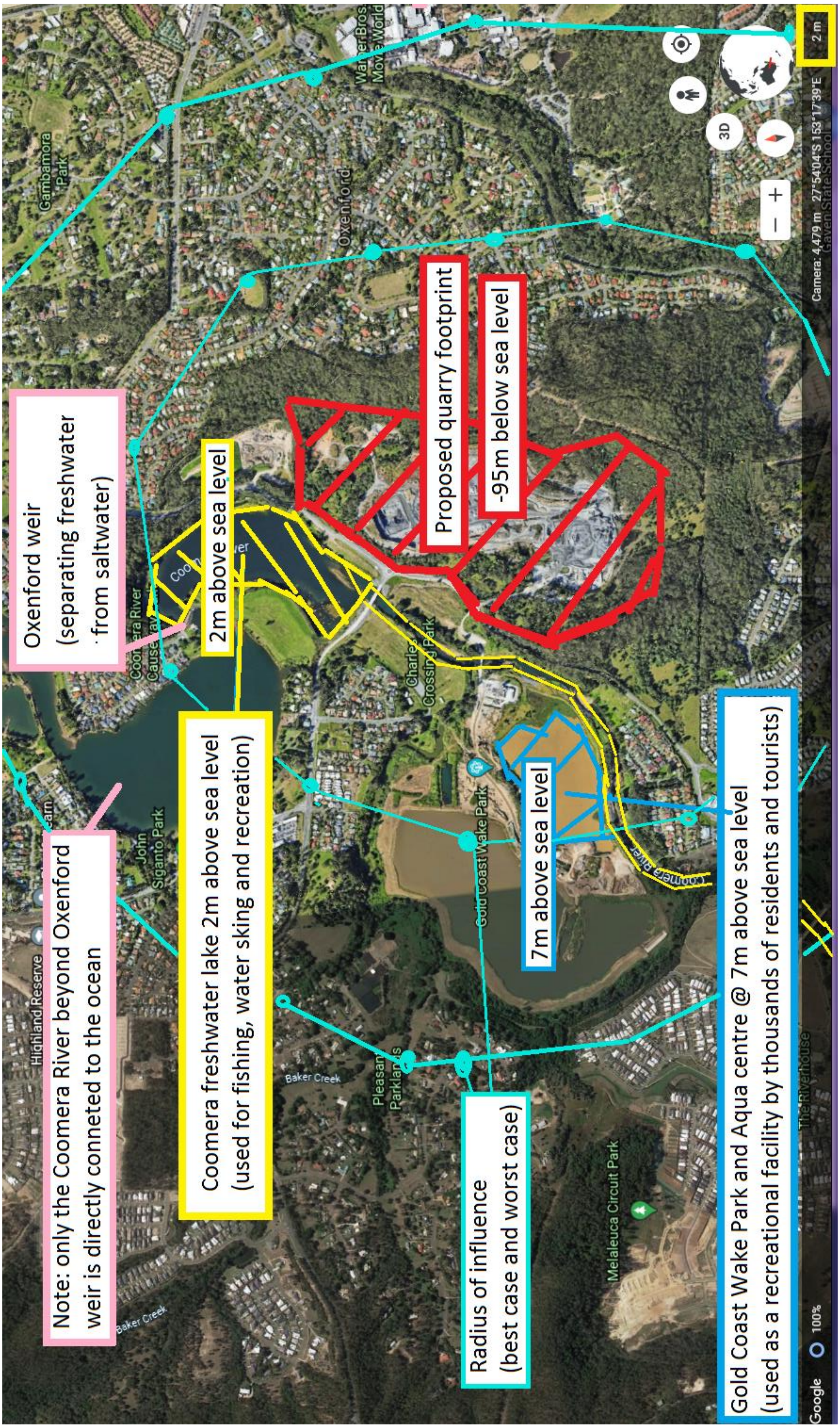
Thank you for considering my objection,

Kind regards

Tony Potter

* Disclaimer. Please note my findings are believed correct and are to the best of my ability. However, there may be errors and assumptions I have made that are incorrect. I do not believe this to be the case, but, realise with the vast amounted of submitted data from the applicant, errors and assumptions on my part may occur. Hopefully this is not the case, but please accept my apologises if this is so. Thank you.

Attachment A1 - Surrounding Water Levels



2019-05-20 Section 2 - The main application.pdf 29 / 354

4.9 Groundwater Impact Assessment – AGE Consultants

Australasian Groundwater and Environmental Consultants Pty Ltd prepared a groundwater impact assessment of the proposal. The report essentially concludes there should be no significant adverse impact in respect to ground water issues.

The post-quarrying conceptual model shows that the water level in the quarry void will likely stabilize to approximately the same elevation as the current Coomera River (that is ~0 m AHD).

The groundwater table within the alluvium will likely recover back to a level that is comparable to current conditions.

Post-closure, the groundwater flow regime will recover approximately back to its pre-development configuration, with the quarry pit only capturing a small portion of the groundwater flow that would have otherwise discharged to the Coomera River under current conditions.

Extraction of the quarrying operations will result in the following changes to the groundwater regime:

- A localised deepening of the existing quarry pit from approximately 5 m AHD to -95 m AHD, which will extend the excavation below the regional groundwater table. This will result in groundwater seepage into the quarry pit and drawdown within the surrounding water bearing Neranleigh-Fernvale Beds rock mass.
- Groundwater inflows of 4 L/s or 130 ML/yr are predicted and are considered more likely to be representative of the magnitude of inflows to be observed during operations.
- The maximum radius of influence is predicted to be approximately 1,400 m but is more likely to be in the order of 700 m from the quarry pit. The maximum predicted radius of influence includes a private water bore (RN 124033), a portion of the Coomera River and approximately 400 m of riparian wetland located upstream of the Gold Coast wave park. Providing there is hydraulic connectivity between the Coomera River, the associated alluvium and the Neranleigh-Fernvale Beds, the Coomera River will act as a flow boundary limiting the western extent of the radius of influence. The riparian wetland located upstream of the Gold Coast wave park is fed by surface water from the Coomera River originating upstream of the Oxenford Quarry.
- The quarrying will not impact surface water flow in the Coomera River or the surface water flow supplying these riparian wetlands. Nucrush will install a new monitoring bore (MB-05) along the project's eastern boundary to monitor groundwater eastwards beyond the project's eastern boundary.

A full copy of the groundwater report is included within section 4 of this development application package.

Attachment B2 - From Section 7.3 Groundwater Inflows of Groundwater Impact Assessment

Groundwater Impact Assessment.pdf 48 / 154

The inflows from Zone 1, the pit walls, varies from 15.1 ML/yr to 72.4 ML/yr when the permeability of the bedrock is varied from 0.001 m/d to 0.01 m/d. The 0.001 m/d value represents the anticipated permeability of the rock at depth, due in large part to the closure of fractures from the overburden pressure. The 0.01 m/d value represents the permeability of the bedrock as measured in the monitoring bores completed for this project.

The inflows from Zone 2, the pit floor, varies from 113.6 ML/yr to 359.2 ML/yr when the permeability of the bedrock is varied from 0.0001 m/d to 0.001 m/d. The 0.0001 m/d value represents low permeability rock at depth, due in large part to the closure of fractures from the overburden pressure. The 0.001 m/d value represents the highest probable floor permeability.

The inflow predictions show that the inflows are predominately from groundwater entering through the pit floor where the Neranleigh_Fernvale Beds are saturated. The inflows predicted by the low bedrock conductivity scenario (i.e. 4 L/s or 130 ML/yr) are considered more likely to be representative of the magnitude of inflows to be observed during operations.

Table 7.2 Analytical results

Scenario	Zone	K_{h1} (m/day) / K_{h2} (m/day)	Radius of influence (m)	Q (L/s)	Q (ML/yr)	Total (ML/yr)
Low bedrock conductivity	1	0.001	700	0.5	15.1	130 (best case)
	2	0.0001	700	3.6	113.6	
High bedrock conductivity	1	0.01	1,418	2.3	72.4	186
	2	0.0001	1,418	3.6	113.6	
High bedrock wall and floor conductivity	1	0.01	1,418	2.3	72.4	432 (worst case)
	2	0.001	1,418	11.4	359.2	

Attachment B3 - Radius of Influence is between 1.4km anf 700m

Groundwater Impact Assessment.pdf

7.4 Radius of influence

The actual radius of influence of the pit will be dependent upon the hydraulic parameters of the groundwater system (hydraulic conductivity and storage parameters) of which only hydraulic conductivity is considered in this equation, as it is a steady-state approximation only. Furthermore, the Marinelli and Niccoli (2000) analysis does not include any no flow boundaries, such as catchment boundaries, rivers, or geological structures, which can limit the radius of influence. The greatest magnitude of drawdown will occur closest to the quarry and will diminish with distance from the quarry walls.

The radius of influence based on low permeability bedrock in the pit wall is estimated to be 700 m (Table 7.2). The Coomera River and the Water Polishing Pond off Oxenford-Tamborine Rd are both located within this radius of influence and may therefore provide a source of water for quarry inflows. If there is hydraulic connectivity between the Coomera River, the associated alluvium and the Neranleigh-Fernvale Beds, the Coomera River will act as a flow boundary that will limit the western extent of the radius of influence.

Radius of influence is between 700m and 1418m

The radius of influence assuming high permeability bedrock and high permeability pit floor is estimated to be 1,418 m (Table 7.2). This scenario extends the radius of influence to include private water bore (RN 124033), a more extensive portion of the Coomera River and approximately 400 m of riparian wetland located upstream of the Gold Coast wave park. Providing there is hydraulic connectivity between the Coomera River, the associated alluvium and the Neranleigh-Fernvale Beds, the Coomera River will act as a flow boundary limiting the western extent of the radius of influence. The riparian wetland located upstream of the Gold Coast wave park is fed by surface water from the Coomera River originating upstream of the Oxenford Quarry. The low permeability scenario indicates quarrying operations will not impact surface water flow supplying these riparian wetlands, so they are highly unlikely to be impacted by the proposed development. Whilst groundwater level decline at the one private active water-supply bore (RN 124033) is located within the potential radius of influence, this is likely to be negligible.

Groundwater affected

Regardless of the radius of influence and the inflows reporting to the quarry during operations, the groundwater levels in the vicinity of the quarry void are assessed to recover once quarry development ceases and the quarry void is allowed to fill. The elevation at which the quarry void water level stabilises will be governed by the surface water balance of the post-closure landscape and the elevation of a spill point within the final pit void.

Translated as:
"Whatever happens to the groundwater levels it will be ok in 100+ years"

Attachment B4 - Discharge of water

7.2 Conceptual model during and after extraction

The quarry will require dewatering to remain dry. Any water that flows to the quarry would be available for use on site and any excess likely discharged. The conceptual flow diagrams depicted in Figure 7.3 and Figure 7.4 show that the pit will capture groundwater flow from the eastern and southern portion of the project site. The future excavation will capture groundwater all the way to the current divide running along the topographic high.

Attachment B5 - Acid sulfate Technical Manual

queensland-ass-management-guideline-2014.pdf

Queensland Acid Sulfate Soils Technical Manual: Soil Management Guideline

8.6.2 Acidic groundwater

There may need to be consideration of other complicating factors such as the presence of acidic groundwater on site in conjunction with deeply weathered sediments (such as those commonly found around the Sunshine Coast, Maryborough and Burrum Heads). Upon excavation of soil or sediment, acidic groundwater can come into contact with clay particles, causing aluminium and other metals to dissolve. If sustainable management options cannot be used with these soils, then avoidance would be the most appropriate solution.

Attachment B6 - Pyrite

mining-technology.com/features/featurethe-11-most-dangerous-minerals-4256873/

Pyrite

Pyrite, which is a sulphide mineral composed of iron and sulphur, is a major contaminator of ground water and streams due to acid mine drainage from sulphide mine tailings. Oxidation of pyrite releases toxic metals and metalloids such as Arsenic (As), which is poisonous for humans. Arsenic-containing pyrite in coals still poses a severe health problem for millions of people in the Guizhou province in China.

Sulphur and sulphuric acid used to be produced from Pyrite ore but are currently obtained as by-products of natural gas and crude oil processing leaving very limited economic value to Pyrite so the mineral is currently mined only for specimen purposes.

Attachment B7 - Effects on Local ecosystem

queensland-ass-management-guideline-2014.pdf

Queensland Acid Sulfate Soils Technical Manual: Soil Management Guideline

6. Avoidance strategies

6.3.1 Sensitive wildlife

A precautionary approach is recommended when ASS underlie, are in close proximity to or are hydrologically connected to the habitat of sensitive species. Avoidance is often the only effective management strategy in situations where ASS underlie habitats and ecosystems that contain sensitive wildlife or where off-site disturbances can indirectly impact with these areas. Coastal environments often contain areas of high biodiversity and/or species with high conservation significance – for example, aquatic fauna such as the frogs, fish and other biota that live in the low pH, organic-rich, soft waters of some coastal wetlands. These include pH-sensitive amphibians (e.g. the Wallum froglet and the Cooloola sedgefrog), as well as coastal freshwater fish like the Oxleyan pygmy perch and the Honey Blue-eye. Disturbance and/or treatment of ASS may negatively affect them. Neutralising agents are an essential component of most ASS management proposals and the impacts of using these products in naturally soft acidic freshwater habitats are not adequately understood. What is known is that neutralising agents can alter naturally low pH environments that have organic-sourced acidity and can increase water hardness, causing changes to habitat that ultimately result in species, population and ecological system shifts.

Attachment B8 - Dewatering and Drainage

queensland-ass-management-guideline-2014.pdf

Queensland Acid Sulfate Soils Technical Manual: Soil Management Guideline

11.3 Dewatering and drainage

Earthworks and/or pumping that result in localised drainage or lowering of groundwater may expose sulfidic soils to oxygen and generate acidity as a function of soil type(s), sulfide contents, area exposed and length of time the excavation stays 'dry'. The risk of the dewatering can be assessed using the predicted size of the cone of depression (see ASS tip 31). Large-scale dewatering activities are high-risk, and should not be undertaken without management measures sufficient to reduce risk to levels acceptable to administering authorities. Such measures will necessarily include physical confinement strategies, and no permanent dewatering may be undertaken.

Groundwater drainage or dewatering may start the same acid-generating processes as those described above in section 11.2. It follows that all dewatering operations in ASS areas carry a high environmental risk, except those which cause limited or localised drawdown and promote maintenance of field moisture capacity, minimising sediment oxidation. For example, shallow infrastructure trenching, if it is staged and of short duration, may only cause limited or localised drawdown, and hence carries a lower risk. The risks also decrease if the dry excavation exposes predominantly clayey soils with very low hydraulic conductivity resulting in limited drawdown.

Dewatering ASS in urbanised areas is unacceptable without appropriate management strategies to limit sediment oxidation, due to the potential for acid production and damage to neighbouring buildings and infrastructure.

ASS tip 31: Cone of depression

The cone of depression is the predicted volume of soil around a dewatering point that can become unsaturated (i.e. partially drained) during unconfined dewatering. The eventual cone of depression will be influenced by the permeability of the soil, rainfall events, evapotranspiration, groundwater flow paths and palaeochannels. The acid generation within the cone of depression will be a function of the above factors as well as the duration of the dewatering, the potential and existing acidity and organic matter. In coastal situations, the calculation of the cone of depression is seldom a simple process.

Before dewatering ASS, the extent, location and soil characteristics of the cone of depression should be measured and modelled. This requires a professional hydrogeologist. A preliminary estimate of the cone of depression can be made using the online calculation tool provided by the West Australian Department of Environment Regulation (search at <http://www.der.wa.gov.au>).

Experience indicates that the modelling can sometimes be seriously flawed because the materials surrounding the excavations are rarely homogenous and layers of clays, peat and coffee rock often alternate with sandier deposits. Therefore physical containment will be the expected approach for groundwater disturbances.

Physical containment is rarely perfect, and some leakage may be expected. Some dewatering may result, and contingency plans should be in place to handle the effects of this.

Attachment B9 - The importance of Containment

queensland-ass-management-guideline-2014.pdf

Queensland Acid Sulfate Soils Technical Manual: Soil Management Guideline

9.4.3 Containment

All 'dredge-for-fill' and extractive industry sites should be hydrologically isolated using bunding and diversion drains. Surface neutralisation of the earth bunds and diversion drains can also help neutralise any acidic water. Bunds and diversion banks should not be constructed out of untreated ASS or other materials that may be a source of contaminants to the environment. The materials used should have an appropriately low permeability to avoid leakage and designs must also consider wave action, armour protection, provision of discharge weirs and control devices.

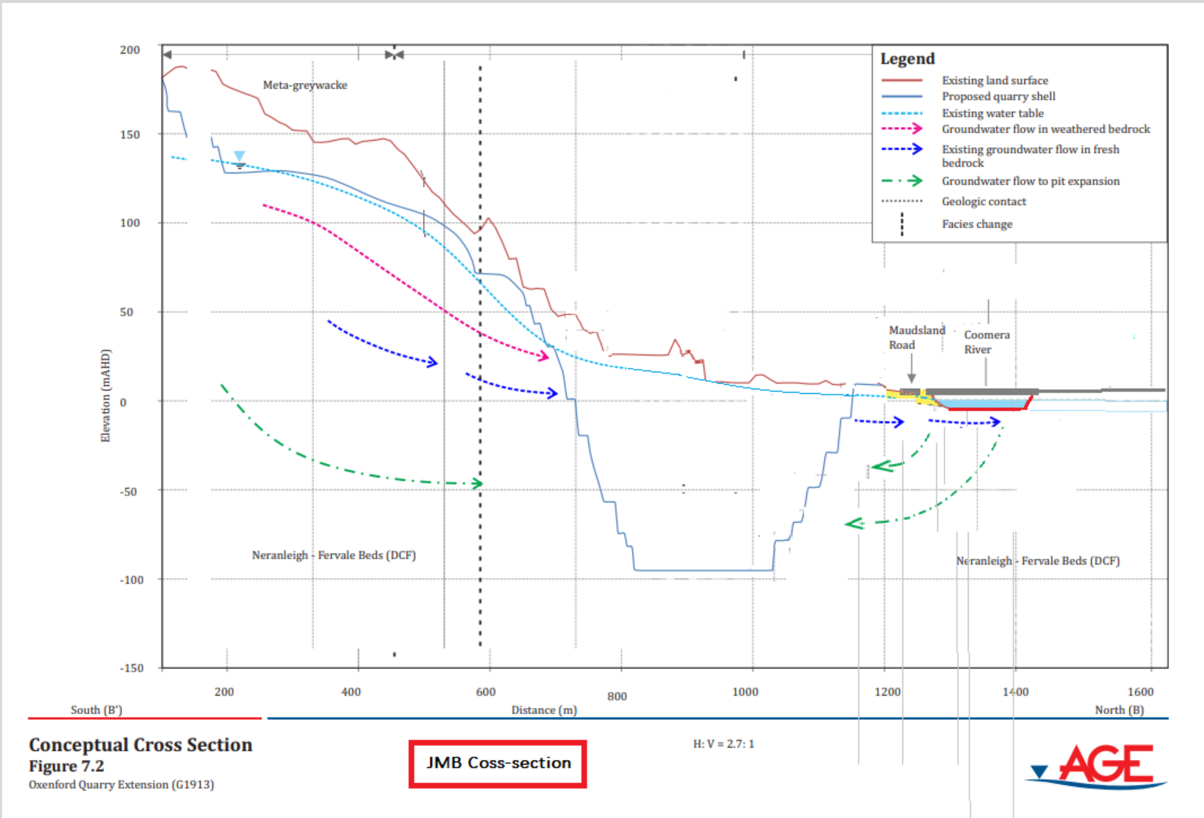
The systems in the sand and gravel extractive industry tend to be closed, with the sulfidic fines concentrated in a series of settlement ponds. Management techniques should make sure that there is no discharge from the settlement ponds until the sulfidic fines have settled on the bottom and water quality within the ponds meets license conditions. The location and dimensions of all settlement ponds should also be documented and reported to assessing authorities.

All processing areas should be graded to make sure that all runoff is captured, and treated if necessary. All runoff and leachate escaping the stockpiled areas should be collected and fully treated on site, especially if it to be reused for purposes such as dust suppression. The processing area used in extractive industry operations should be cleaned up at the end of each working day. Any escaped fines that may have been exposed to oxidising conditions should be treated using neutralisation techniques. In non-enclosed dredging operations, it may be necessary to design and install structures to ensure containment of discharge from the site. In some situations, engineering design will need to account for the installation of gates on pipes or weirs that can be closed to prevent discharge if an acidic event is detected. Installation of an alarm system is necessary to make sure the appropriate persons become aware of the acidic event. Action triggers for water

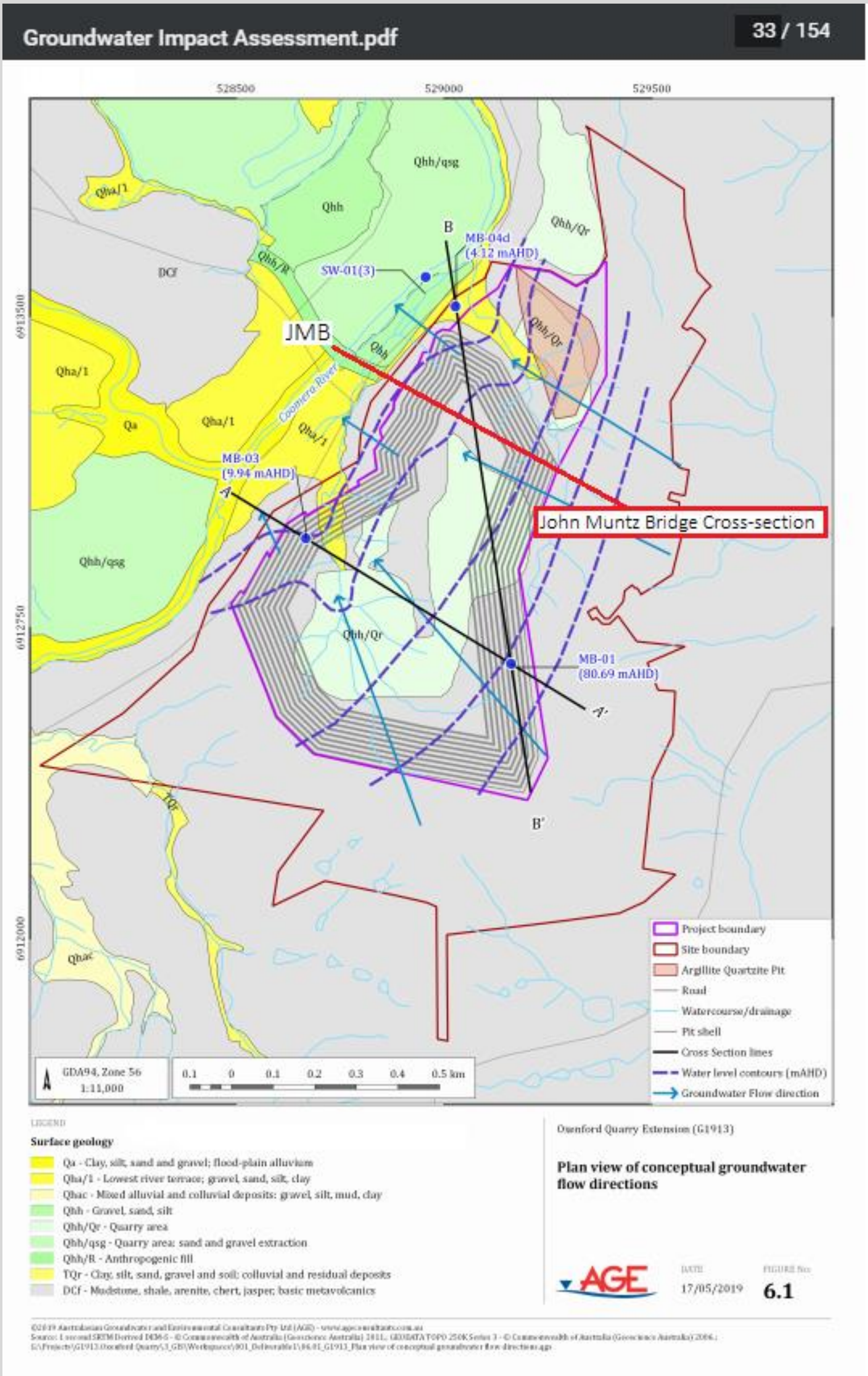
containment (e.g. pH <6.5) will need to be developed. Once the water has been neutralised, the gates can then be reopened.

Silt curtains placed in water bodies act as flexible barriers that can help trap any silt, iron floc or other material that may potentially harm the environment. Silt curtains hang down from the surface of the water and need regular maintenance to ensure ongoing effectiveness. Other standard forms of erosion and sediment control common to construction and industrial sites may be employed in containment of ASS.

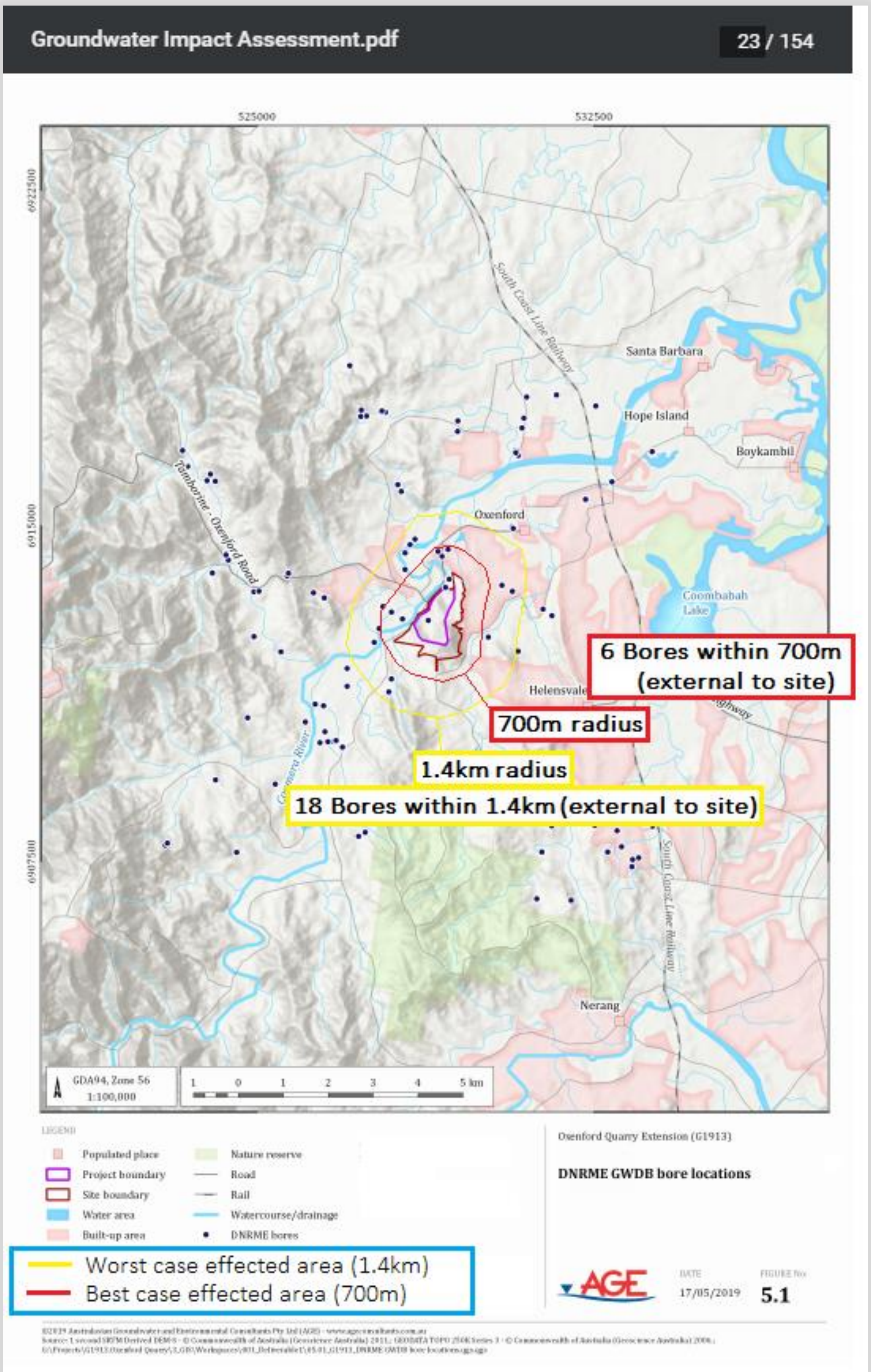
Attachment C1 - Cross section at John Muntz Bridge



Attachment C2 - Cross section position identification at John Muntz Bridge



Attachment D1 - Bore Locations



Attachment E1 - Quarries and the Enviornment - The National Geographic

nationalgeographic.org/encyclopedia/quarry/

NATIONAL GEOGRAPHIC

Quarries and the Environment

Quarries change their environment. They displace huge amounts of soil and plants, and force animals out of the area. Abandoned quarries rarely leave enough soil to allow life to return to the area.

Quarries are prone to flooding because they are sometimes dug below the water table. Environmentalists fear the toxic materials could seep into groundwater if an abandoned quarrys water reaches an areas water table. This is the concern surrounding the Berkeley Pit, a former copper quarry near Butte, Montana. The Berkeley Pit is one of the largest toxic waste sites in the U.S., and its water is within 61 meters (200 feet) of the areas water table.

To avoid contamination, miners must sometimes pump water out of quarries. Quarries are sealed from the surrounding water table. Abandoned quarries can also be turned into landfills.