



LIVING THROUGH AN ALGAL INFECTION PANDEMIC

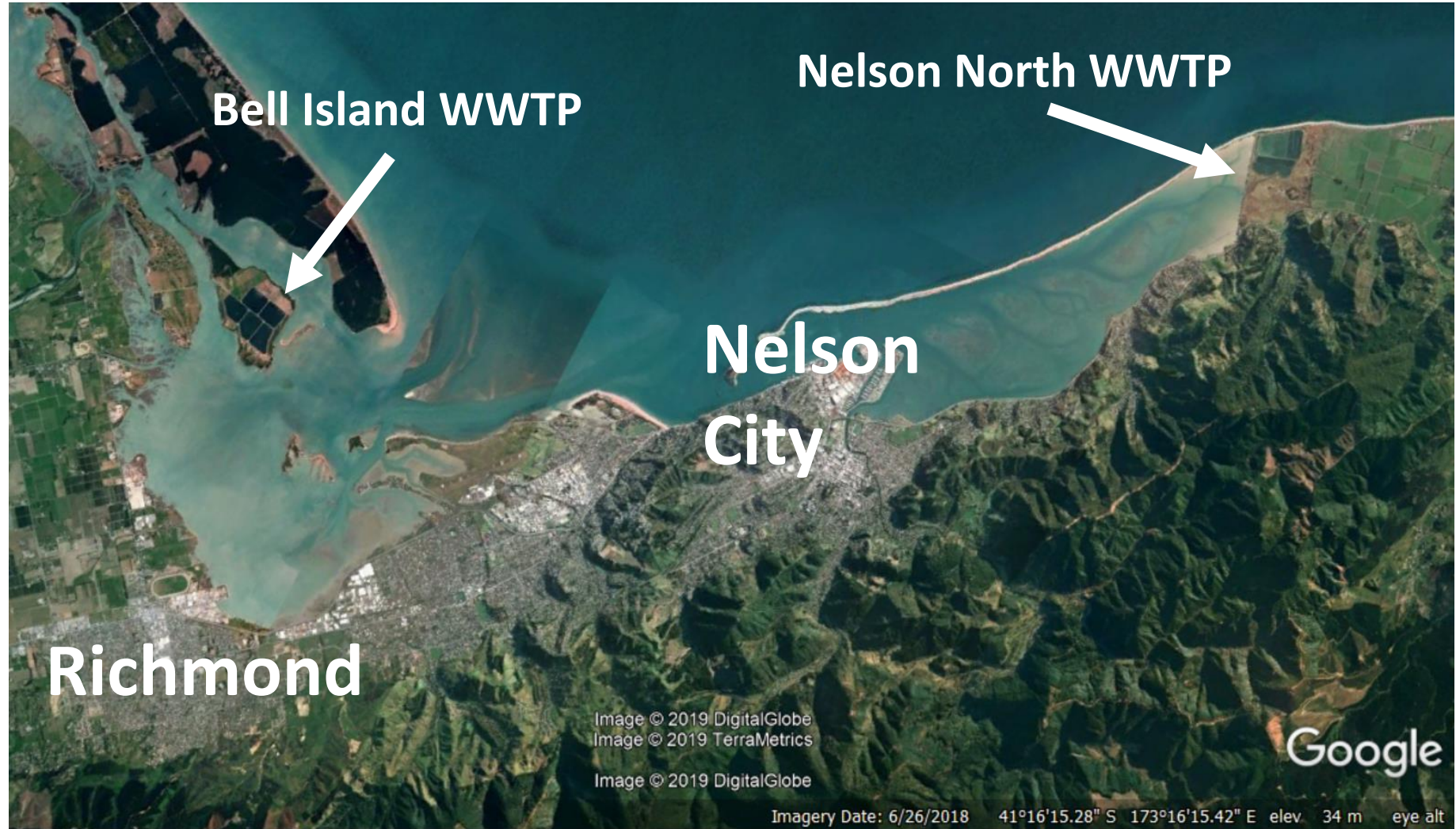
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Lindsay Bell – Special Projects . Nelmac Ltd, Nelson

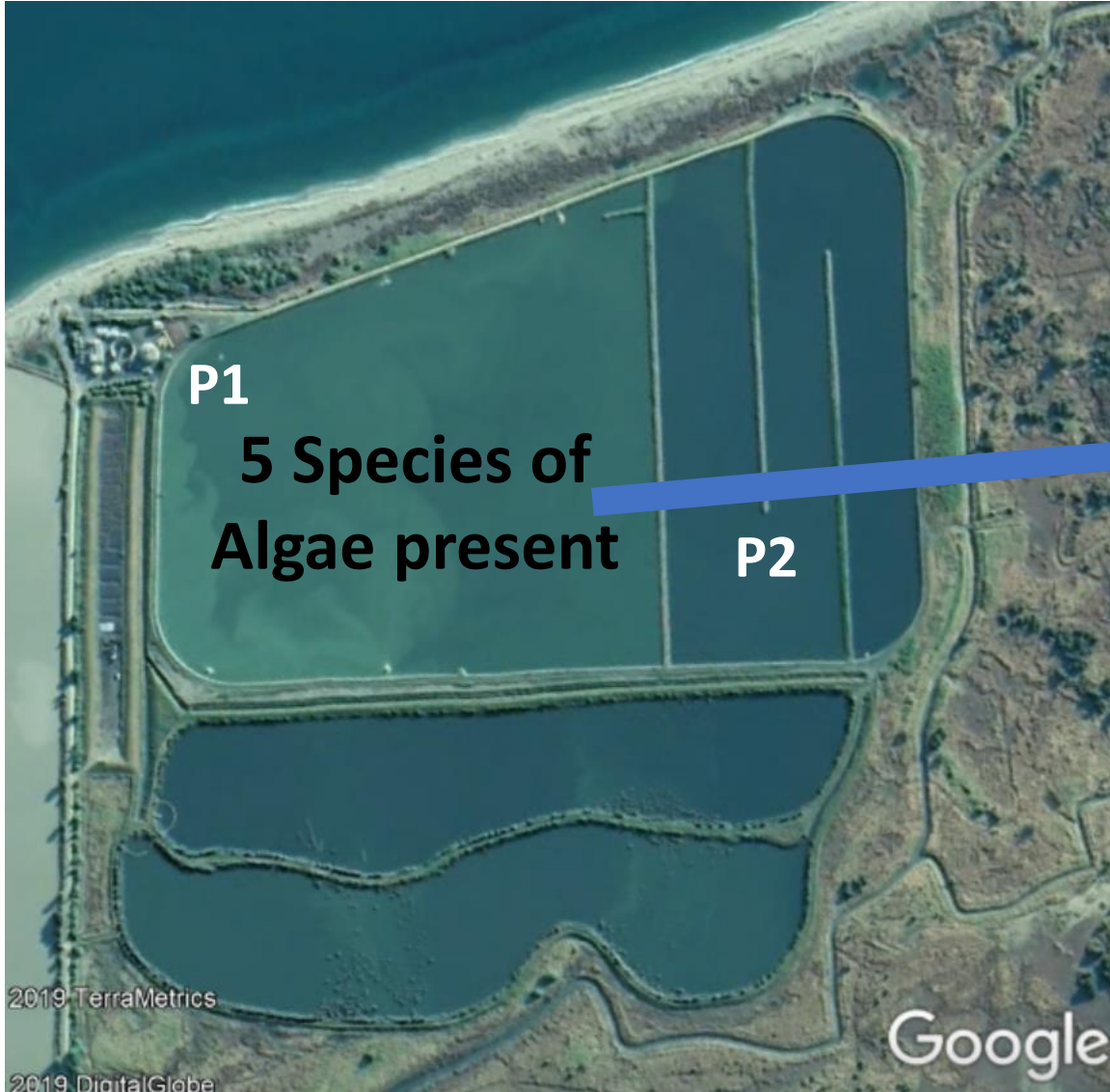
Gemma Tolich Allen – Microbiologist, HydroBio Ltd, Auckland

Kirsten Norquay – Wastewater Specialist, Stantec, Dunedin

- Nelmac operates the two WWTP's servicing the Nelson/Richmond area
- Both plants rely heavily on oxidations ponds for the treatment of wastewater
- In the spring/summer of 2018 the ponds at the NWWTP were hit with an algal infection pandemic



- In the months prior to the infection, pond health was looking to be in great shape with a plentiful stock of algae in all ponds



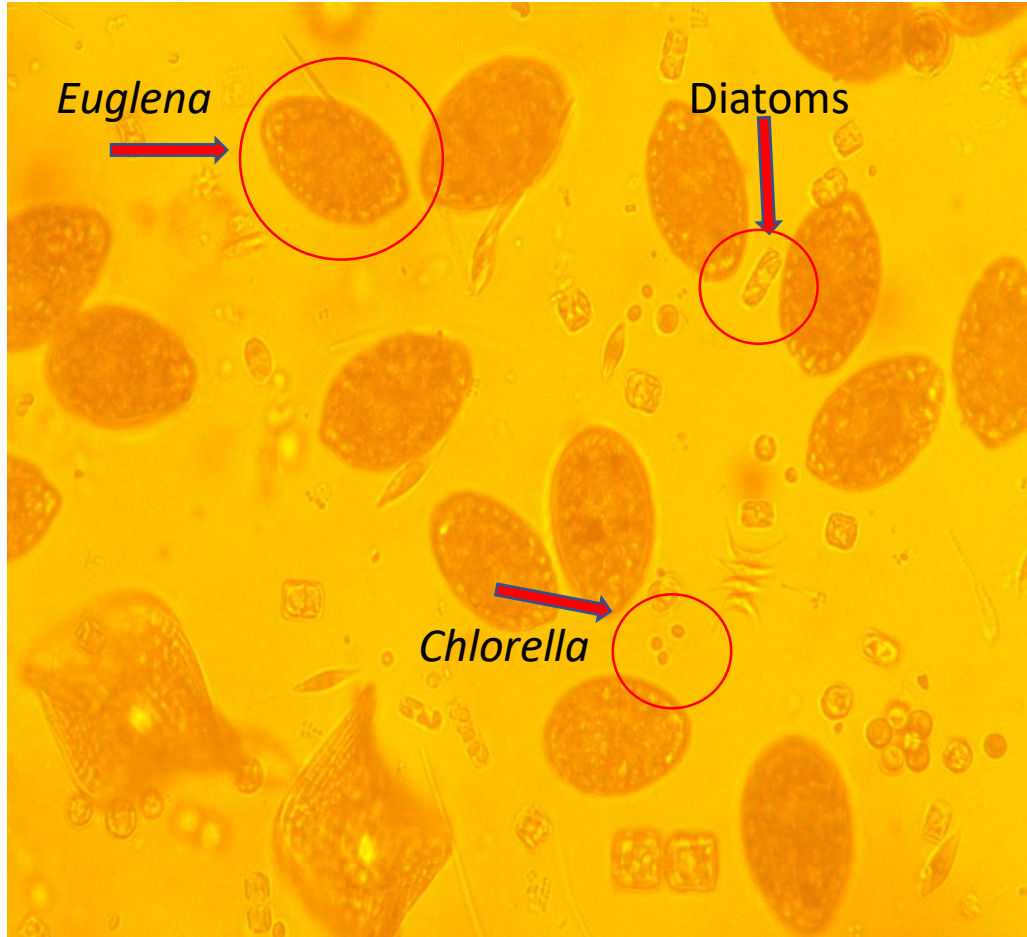
Date	03/09/18		05/09/18	
PHYTOPLANKTON	P1	P2	P1	P2
P1				
<i>Chlorella / Selanastrum</i>	361,000	49,000	168,000	
<i>Ankistrodesmus falcatus</i>	35,000	23,000	15,000	3,000
<i>Scenedesmus</i> spp.		4,000		1,000
<i>Actinastrum hantzschii</i>				
<i>Dictyeosphaerium</i>				
<i>Cryptomonas erosa</i>				7,000
<i>Coelastrum</i>	123,000	6,000	11,000	5,000
<i>Chlamydomonas</i>				
<i>Cyclotella (diatom)</i>	273,000	48,000	143,000	2,000
CYANOPHYCEAE				
<i>Oscillatoria</i>				
<i>Microcystis</i>				
EUGLENOPHYCEAE				
<i>Euglena manxi</i>		1,000		
<i>Euglena gracilis</i>	41,000	88,000	19,000	54,000
<i>Euglena polymorpha</i>				
<i>Euglena fundoversata</i>				
<i>Phacus</i>		3,000		
<i>Euglena fusca</i>				
Brachionus rotifers				
Total Cells per ml	833,000	223,000	356,000	72,000

2019 TerraMetrics

2019 DigitalGlobe

Google

By mid October – Ponds were still fizzing by normal measures (look, DO and ORP) although species diversity in the ponds had declined to a mostly mono culture of *Euglena*



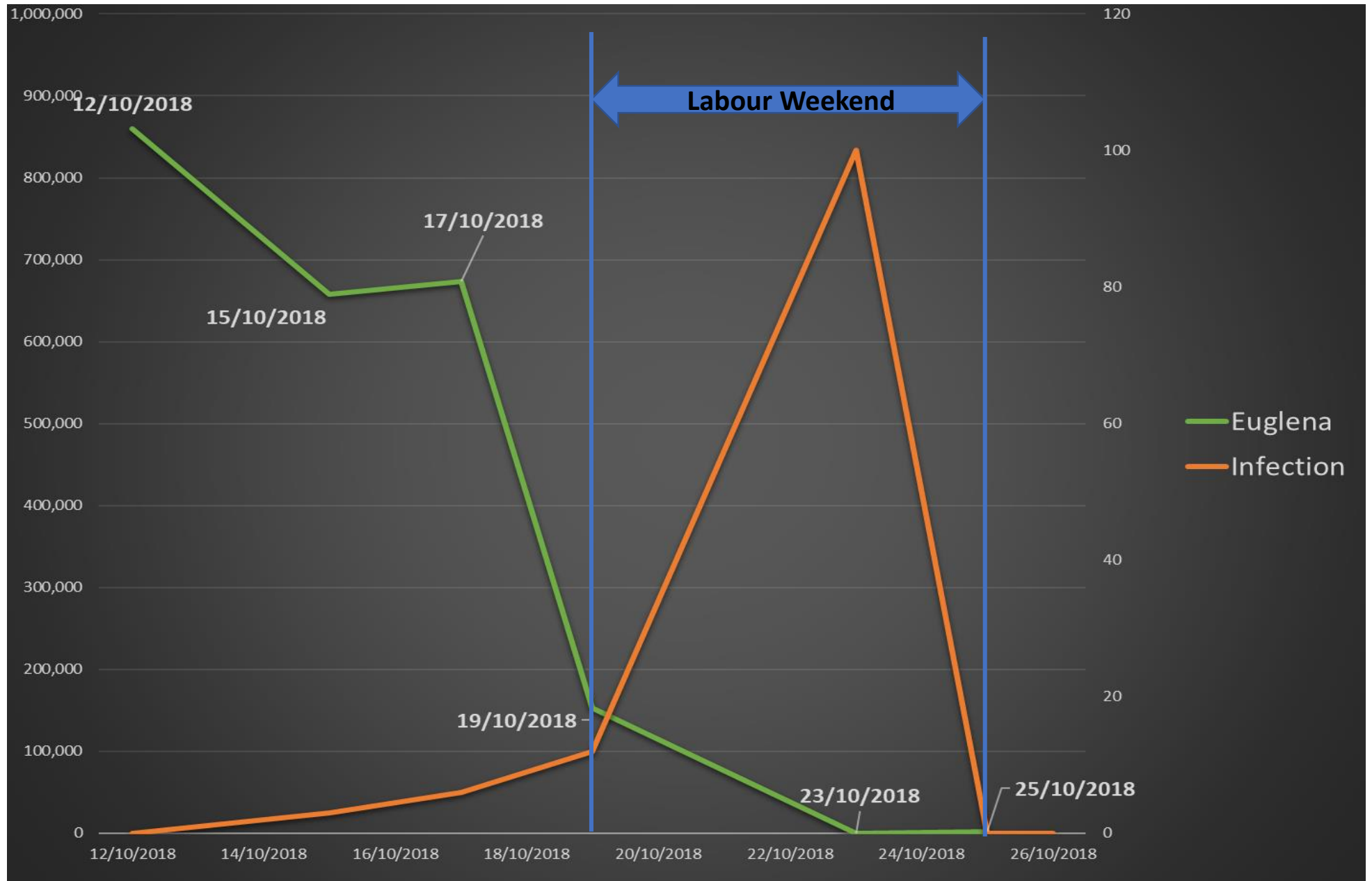
Euglena size compared to other algae species

Date	10/10/18		12/10/18	
PHYTOPLANKTON	P1	P2	P1	P2
CHLOROPHYCEAE				
<i>Chlorella / Selanastrum</i>		2,000		
<i>Ankistrodesmus falcatus</i>				
<i>Scenedesmus</i> spp.				
<i>Coelastrum</i>				
<i>Cryptomonas erosa</i>	1,000	4,000	1,000	
<i>Microactinium</i>				
<i>Chlamydomonas</i>				
<i>Dictyosphaerium</i>				
<i>Oocystis</i>				
Diatom (<i>Cyclotella</i>)				
CYANOPHYCEAE				
<i>Microcystis</i> sp				
<i>Arthrospira / Oscillatoria</i> .				
EUGLENOPHYCEAE				
<i>Phacus</i>				
<i>E. manxi</i>			1,000	
<i>Euglena polymorpha</i>				
<i>Euglena agilis</i>	5,000			
<i>Euglena gracilis</i>	561,000	97,000	860,000	366,000
% FUNGAL INFECTION	2%		1%	
Total Cells per ml	567,000	103,000	862,000	366,000

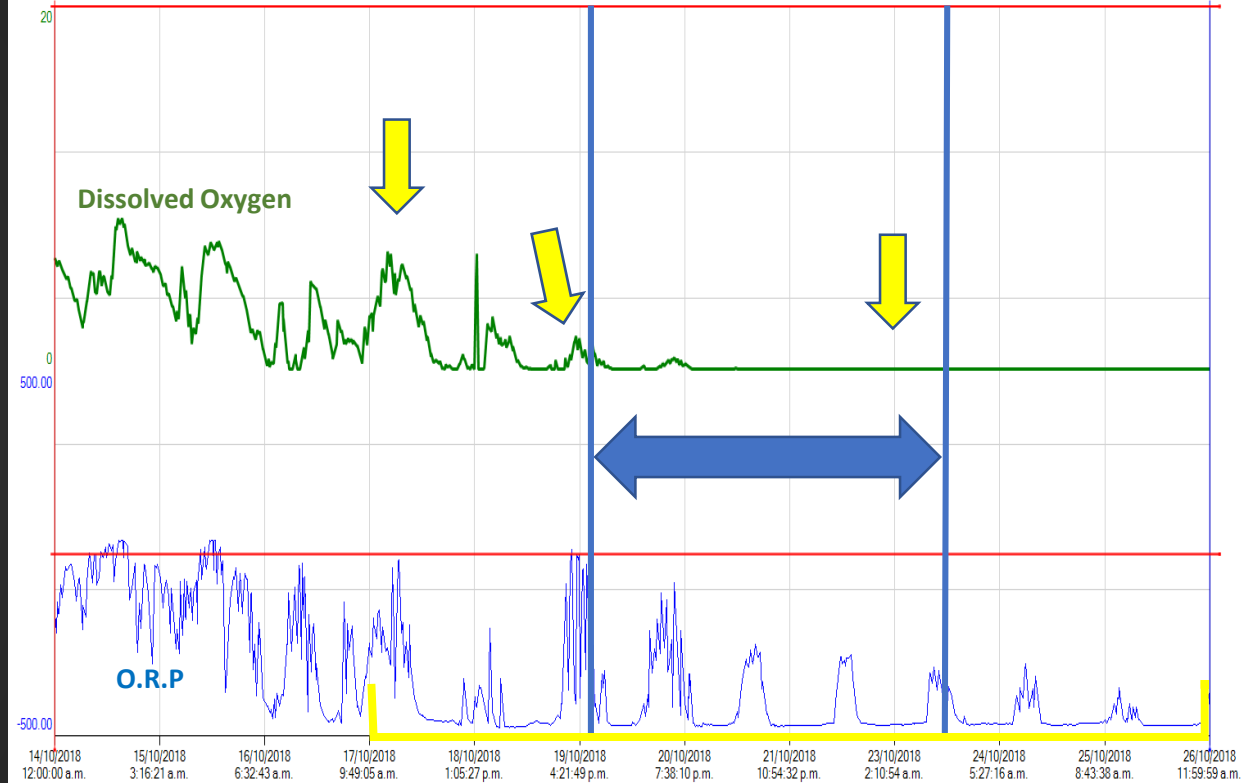
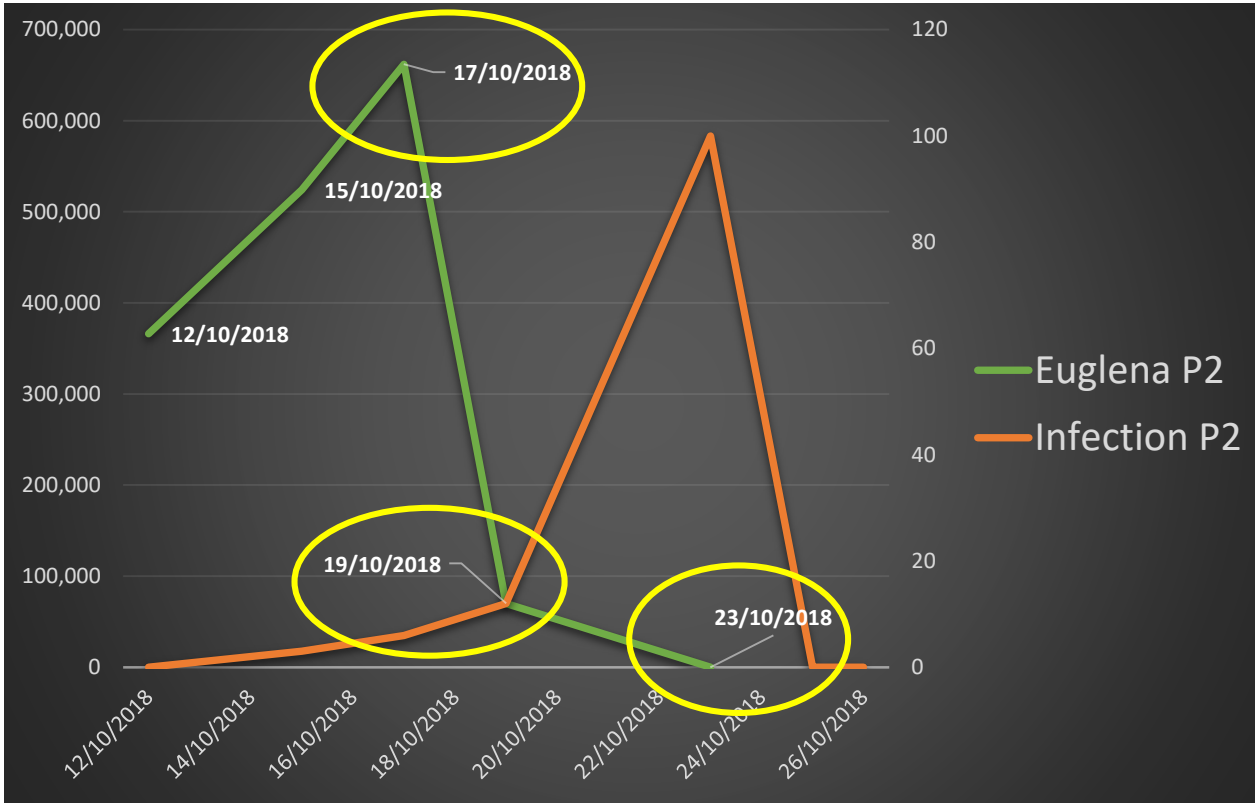
Due to its comparatively large size and oxygen producing capacity this species had been maintaining the ponds in a highly aerobic state

Infection had been present at a low level 2-4% since the 10th October but had not been increasing

Unfortunately, these algae were completely wiped out by fungal parasitism within a 24 hour period over Labour weekend



- Rapid onset of infection coincides with a dramatic decline in algae
- As algal numbers drop so does the DO concentration and the ORP pattern shows longer negative periods
- By the end of Labour weekend the ponds were in an anoxic/anaerobic state with no dissolved oxygen



NEW ZEALAND / NELSON REGION

Sewage smell plagues Nelson

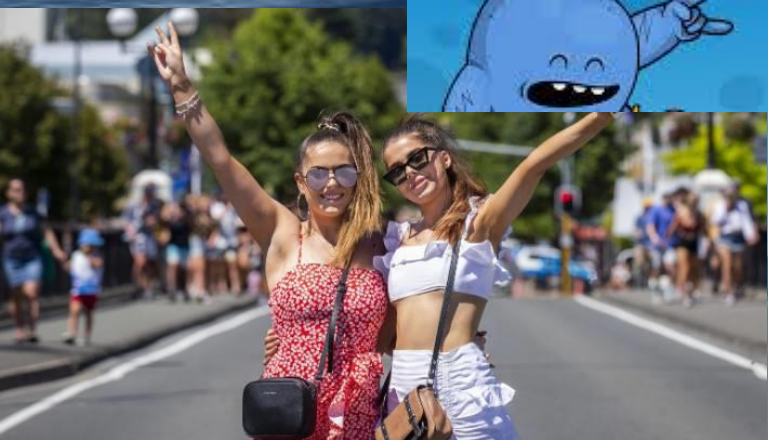
4:04 pm on 27 October 2018

Share this      

The smell of sewage is wafting over Nelson again, as warmer weather upsets treatment ponds north of the city.



- 26 hectares of oxidation ponds creating foul odours
- Media coverage in local news sources as well as on the internet
- Nelmac facing criticism from local council as to why this has occurred



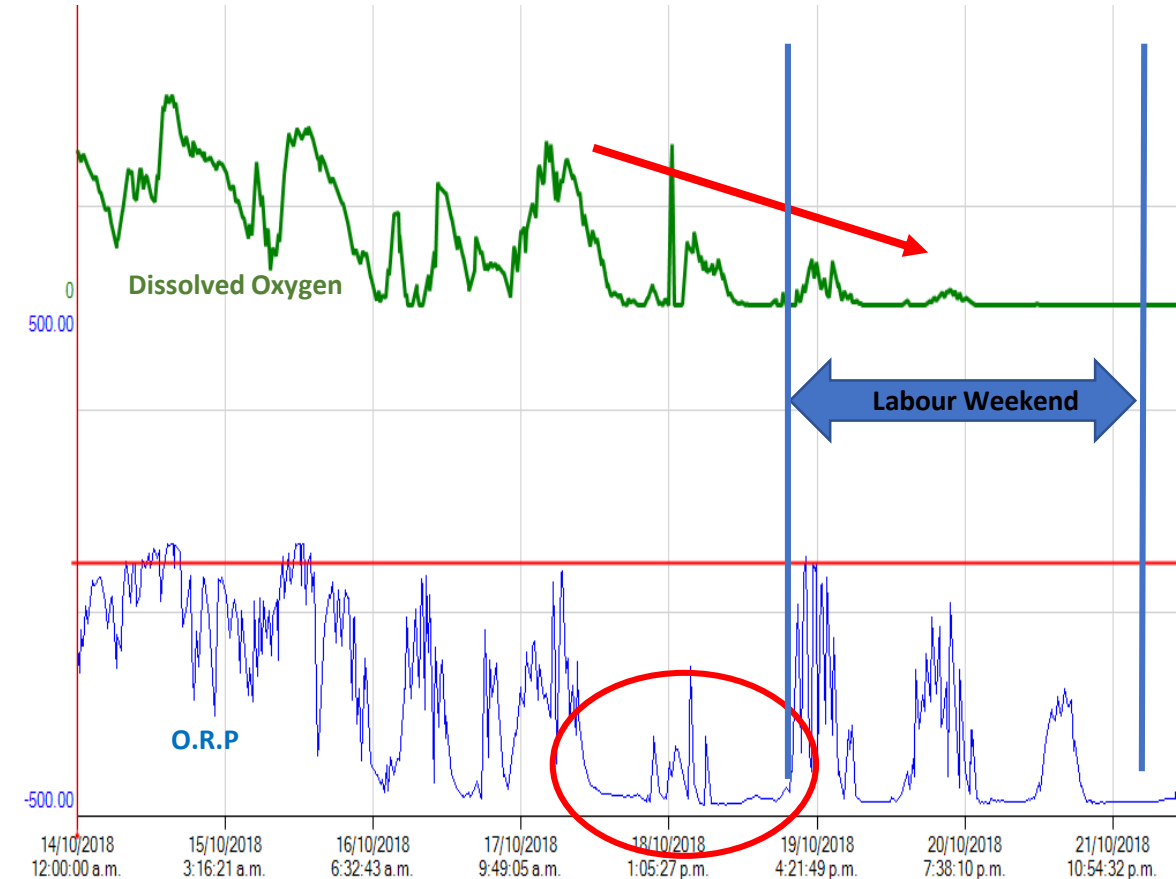
Infection in *Euglena*

- ❑ A healthy *Euglena* cell
- ❑ An infected cell of the same species showing sporangium
- ❑ Dead cell showing cell rupture and escaping zoospores.



Where it all fell apart

- ORP (oxygen reduction potential) had been declining in the days prior to the crash, with an increase in extent and duration of overnight dips. This was not picked up due to the apparent “good” health of the ponds
- Algae results from the microbiologist are around 2-3 days behind. On the Friday of labour weekend (19th), only algae results from the Wednesday (17th) were available, infection rate was still low < 4%
- ORP/DO trends on SCADA were not closely monitored over the long weekend that were clearly indicating a rapidly declining DO in the ponds



Reviving the Fallen Angel

Immediate steps taken –

- Pre-treatment plant; clarifier & trickling filter were brought online to process sludge and remove as much load and sulphide from the pond influent as possible.
- Sodium nitrate dosing at the pond inlet to help improve ORP/DO, stripping sulphur from compounds under the now anaerobic conditions in the pond.
- Pond aerators all switched to manual to maximise DO and maintain circulation in the facultative pond 24/7.
- Increased frequency of algae sampling for analysis by our microbiologist

Additional Contingency Measures

- Tankering of algae approx. 30km from Bell Island ponds to NWWTP – 2 x 40m³ tanker loads per day
- Once it was established by the microbiologist that the wetlands were not infected – portable 6” diesel pumps were set up to seed from the wetlands to both ponds
- Increased consultation with our wastewater specialist and microbiologist to ensure all measures taken were appropriate

This event then brought increased focus on our other treatment plant at Bell Island that has 50Ha of oxidation ponds

Seeding was underway to one facultative pond following events at NWWTP as a precautionary measure as the algal population developed into a mono-culture

Bell Island WWTP

In response to the infection increasing rapidly and across all ponds, additional pumps were sourced to increase recirculation to all affected ponds

All ponds at BIWWTP began developing low level infection on Nov 7

Will this plant suffer from a similar fate??

The increased recirculation effort was successful and prevented a full pond crash by encouraging algal diversity

The *Euglena gracilis* population was completely wiped out by Nov 21

CONCLUSIONS

- Pond recovery was encouraged, by mitigating the toxic conditions – reducing load and increasing aeration.
- De-loading the pond was necessary to cope with the internal load from the abundance of dead algae plus reducing sulphides which are toxic to algae.
- New algae species established via seeding and naturally through pond process
- Favourable weather conditions – lots of sunlight and wind aided recovery
- Throughout the period of the pond crash and recovery the final effluent discharged from the plant remained well within the discharge consent conditions
- The entire pre-treatment plant remained online throughout the summer to reduce any risks of further pond crashes
- The pond system remained unstable through late summer, struggling to cope with increased loading when attempting to bypass the pre-treatment plant. Unclear if this was a long term effect from the pond crash.

Lessons Learnt

“The only real mistake is the one from which we learn nothing.”

— Henry Ford

- Even a low level of 4% infection is cause to raise the alert level
- The development of a predominantly monoculture of algae again increases the risk profile to a point where the risk of pond failure is very high
- When these factors are present, reducing load to the pond is an effective measure to reduce the impact if an infection takes hold
- Educating clients (Council) around basic pond biology so they can appreciate the vulnerability of the system.
- Importance of close monitoring of critical plant trends over long weekends/ public holidays, even if the situation appears “OK”
- Undertaking seeding to encourage a more diverse algal population when there are signs a monoculture is developing, even if the resident algal count is high and all other indicators, DO, colour, etc. are good.
- Increasing the frequency of algae sampling and utilising priority overnight/Saturday delivery courier services.
- Brainstorming new ideas and strategies to avoid, or manage entering a similar situation



Questions?