CLUTHA WASTEWATER PONDS UPGRADES

Utilising Bioshells®

Prepared for Clutha District Council

November 2021

Executive Summary

Further to our discussions, we are pleased to offer you upgrade options for Clinton, Balclutha and Waihola utilising Bioshells® and floating cover. Based on the data and some judgement calls in terms of effluent quality, this solution will meet your needs. The exception is Waihola, where the addition of UV or other means to reduce E-Coli is required, and a recommendation to negotiate with ORC on phosphorus. At this stage, the proposal is based on the use of Bioshells, the addition of UV could be priced as part of the augmentation if required.

In summary, we have targeted the following key parameters removal at each of the pond systems for which Bioshells® are an appropriate technology:

Plant	BOD kg/day	TSS kg/day	NH4-N kg/day
Clinton	0.9	4.4	0.26
Balclutha	60	70+	5.6
Waihola	12	18	0.4

We recommend a review of the target qualities as the targets suggested in this proposal are assessed with some judgement due to current data being 2 data points at the same time each year. The proposal can be adjusted accordingly for any change in targets CDC may choose to adopt. In addition, Bioshells® are modular in nature and future augmentation is therefore simple.

MPL (Marshall Projects Limited) is operating under a formal relationship with WCS (Wastewater Compliance Systems) from Utah for the manufacture and on selling of their patented technology for the enhancement of wastewater ponds using BioShells® and Bio-Domes®. MPL is the NZ trademark owner of this technology. This technology is specifically designed for Ammonia reduction in existing pond systems after BOD and TSS have also been addressed which are also improved with this technology.

The combined technical experience of MPL and WCS including Professor Kraig Johnson (developer of the technology) means the best technical experience that could be applied to this technology is available.

The technology is a submergible aerated biofilm reactor specifically designed to ensure maximum surface area and optimum air flow. The BioShell® and Bio-Dome® technology is well proven in Northern America and is transferrable to the southern hemisphere with more extreme environments existing in North America compared to the temperate climate of New Zealand. This technology has been installed in 25 locations in North America and three locations in New Zealand. Of particular note is the Paihia project where 554 3-layer Bioshells® were installed and resulted in ammonia discharge being <2mg/L compared to 30-40mg/L prior to the upgrade.

Marshall Projects was established in 2005 and is supported by the Marshall family business, Marshall Industries Limited, established in 1936 and jointly has 52 full-time employees plus subcontracted resources when required.

The technology proposed utilises the pond asset and therefore is a relatively cheap means of providing enhancement to the treatment process compared to the installation of a fully automated mechanical process plant. As the technology only requires air, after installation, there

is no onerous requirement for operator attendance, thereby providing a cost-effective operational plant with a relatively low operational cost.

We look forward to working with Clutha District Council in the execution of this project and look forward to discussing the design and project details with you in more detail.

Tom Marshall
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Section 2.

Pricing

Note all pricing in this section excludes GST.

2.1 Schedule of Prices – Clinton

Item	Descriptions	Amount
1	General & Preliminaries	$11,100
2	Design	$3,300
3	Curtain & Cover	$92,000
4	Bioshells® manufacture (11 units)	$48,400
5	Installation	$34,200
6	Mechanical and Electrical	$42,900
7	Commissioning	$4,400
8	Cost Increase Allowance	$24,000
	TOTAL SUM	**$260,300**

2.2 Schedule of Prices – Balclutha

Item	Descriptions	Amount
1	General & Preliminaries	$61,500
2	Design	$18,400
3	Curtain & Cover	$265,400
4	Bioshells® manufacture (170 units)	$748,000
5	Installation	$118,500
6	Mechanical and Electrical	$93,500
7	Commissioning	$4,400
8	Cost Increase Allowance	$131,000
	TOTAL SUM	**$1,440,700**

2.3 Schedule of Prices – Waihola

Item	Descriptions	Amount
1	General & Preliminaries	$20,100
2	Design	$6,000
3	Curtain & Cover	$100,000
4	Bioshells® manufacture (38 units)	$167,200
5	Installation	$64,200
6	Mechanical and Electrical	$65,400
7	Commissioning	$4,400
8	Cost Increase Allowance	$43,000
	TOTAL SUM	**$470,300**

Section 3.

Process Design

3.1 Design Criteria - Clinton

3.1.1 Plant Capacity

- Based on consent, max flow is 400m3/day;
- Data average: 120m3/day
- Data 90th percentile 220m3/day

3.1.2 Quality

Existing Quality vs Consent

The quality data provided exiting the Pond and consent requirements are summarised as:

	Existing Data			Consent	
Parameter	50%ile	90%ile	Max	50%ile	90%ile
Ammonia N (mg/L)	13.2	16.4	17.6	13	17.5
TSS (mg/L)	40	47	50	26	46
BOD (mg/L)	24	37	48	24	37
TP (mg/L)	4.7	10.4	10.6	4	11
E-Coli	550	1,840	3,500	550	3400

Required Quality

By inspection, it can be seen that the plant is essentially compliant. However, it is noted most data for existing performance is in February and August. Therefore, some judgement is required for extrapolation of the data plus "headroom".

As a starting point, we provide the following suggestions in terms of targets that could be adopted:

	Target Performance		Consent	
Parameter	50%ile	90%ile	50%ile	90%ile
Ammonia N (mg/L)	12	16.5	13	17.5
TSS (mg/L)	20	30	26	46
BOD (mg/L)	20	30	24	37
TP (mg/L)	4.7	10.6	4	11
E-Coli	550	3,500	550	3400

At this stage we are only addressing ammonia, TSS and BOD being the parameters that Bioshells® can address.

3.1.3 Ammonia removal using BioShells®

Ammonia reduction required based on above assumptions is:

- 50%ile 1.2mg/L
- 90%ile NIL

If we assume 50%ile requirement with a 90%ile flow, we need 0.26kg/day NH-4 removal. This will require 4 @ 2-layer Bioshells®.

Prior to the BioShells® commencing nitrification, both BOD and TSS must be <30mg/L.

3.1.4 Suspended Solids/BOD Improvement

To enable the nitrification, we propose that BOD and TSS be improved. TSS needs to be reduced by:

- 50%ile 20mg/L; and
- 90%ile 17mg/L.

Case 1: 50%ile load @ 90%ile flow = 4.4kg/day removal. This will require 7 @ 2-layer Bioshells®.

BOD improvement required is:

- 50%ile 4mg/L; and
- 90%ile 7mg/L.
-

Case 1: 50%ile load @ 90%ile flow = 0.9kg/day removal. This will require 1 @ 2-layer Bioshells®.
Case 2: 90%ile load @ 50%ile flow = 0.84kg/day removal. This will require 1 @ 2-layer Bioshells®.

Therefore, it is proposed to install 7 @ 2-layer Bioshells® for TSS/BOD improvement.

3.1.5 Temperature

Liquid Temperature of 6-10 deg. C has been used for the design basis.

3.1.6 Pond Depth

For cost reasons, the proposal is for all BioShells® to be installed at the back end of the Ponds. It is assumed the liquid depth available is ≥1.2m.

3.1.7 TSS reduction

There are two mechanisms that work well for TSS reduction. Bioshells® can be used or a cover to prevent the growth of algae. We are proposing both.

3.1.8 Summary & Air Requirements

Our proposal for Clinton is:

- NH4-N removal 4 Bioshells®;
- TSS/BOD removal 7 Bioshells®
- Total 11 Bioshells®

Air required is 1scfm/Bioshell® = 11scfm (19NM3/hr.) @ 0.15-0.6bar

3.2 Design Criteria - Balclutha

3.2.1 Plant Capacity

- Based on consent, max flow is 2,500m3/day;
- Data average: 2016m3/day
- Data 90th percentile 2790m3/day

3.2.2 Quality

Existing Quality vs Consent

The quality data provided exiting the Pond and consent requirements are summarised as:

	Existing Data			Consent	
Parameter	50%ile	90%ile	Max	50%ile	Max
Ammonia N (mg/L)	19	24	26	20	30
TSS (mg/L)	73	112	123	75	150
BOD (mg/L)	36	55	59	50	80
TP (mg/L)	3	4	4.4	10	15
E-Coli	54,000	146,000	270,000	80,000	500,000

Required Quality

By inspection, it can be seen that the plant is essentially compliant. However, it is noted most data for existing performance is in February and August. Therefore, some judgement is required for extrapolation of the data plus "headroom".

As a starting point, we provide the following suggestions in terms of targets that could be adopted:

	Target Performance		Consent	
Parameter	50%ile	90%ile	50%ile	Max
Ammonia N (mg/L)	17	25	20	30
TSS (mg/L)	25	30	75	150
BOD (mg/L)	25	30	50	80
TP (mg/L)	8	12	10	15
E-Coli	60,000	450,000	80,000	500,000

At this stage we are only addressing ammonia, TSS and BOD being the parameters that Bioshells® can address.

3.2.3 Ammonia removal using Bioshells®

Ammonia reduction required based on above assumptions is:

- 50%ile 2mg/L;
- 90%ile NIL;

If we assume 50%ile requirement with a 90%ile flow, we need 5.6kg/day NH-4 removal. This will require 70 @ 2-layer Bioshells®.

Prior to the Bioshells® commencing nitrification, both BOD and TSS must be <30mg/L.

3.2.4 Suspended Solids/BOD Improvement

To enable the nitrification, we propose that BOD and TSS be improved. TSS needs to be reduced by:

- 50%ile 48mg/L; and
- 90%ile 82mg/L.

Case 1: 50%ile load @ 90%ile flow = 134kg/day removal. This will require 192 @ 2-layer Bioshells®.
Case 2: 90%ile load @ 50%ile flow = 165kg/day removal. This will require 236 @ 2-layer Bioshells®.

BOD improvement required is:

- 50%ile 11mg/L; and
- 90%ile 25mg/L.

Case 1: 50%ile load @ 90%ile flow = 31kg/day removal. This will require 17 @ 2-layer Bioshells®.
Case 2: 90%ile load @ 50%ile flow = 60kg/day removal. This will require 24 @ 2-layer Bioshells®.

Therefore, it is proposed to install 24 @ 2-layer Bioshells® for BOD improvement.

TSS will be more efficiently controlled by the use of a floating cover. In addition, as TSS does need to be lowered, we assess based on experience that 100 units should be installed together with the cover for BOD & TSS.

3.2.5 Temperature

Liquid Temperature of 6-10 deg. C has been used for the design basis.

3.2.6 Pond Depth

For cost reasons, the proposal is for all Bioshells® to be installed at the back end of the Ponds. It is assumed the liquid depth available is ≥1.2m.

3.2.7 TSS reduction

There are two mechanisms that work well for TSS reduction. Bioshells® can be used or a cover to prevent the growth of algae. We are proposing both.

3.2.8 Summary & Air Requirements

Our proposal for Balclutha is:

- NH4-N removal 70 Bioshells®;
- TSS/BOD removal 100 Bioshells®
- Total 170 Bioshells®

Air required is 1scfm/Bioshell® = 170scfm (290NM3/hr.) @ 0.15-0.6bar.

3.3 Design Criteria - Waihola

3.3.1 Plant Capacity

- Based on consent, max flow is 1,020m3/day;
- Based on consent, ave flow is 680m3/day
- Data average: 108m3/day
- Data 95th percentile 183m3/day

3.3.2 Quality

Existing Quality vs Consent

The quality data provided exiting the Pond and consent requirements are summarised as:

	Existing Data			Consent	
Parameter	50%ile	95%ile	Max	50%ile	95%ile
Ammonia N (mg/L)	22	33	35	23	31
TSS (mg/L)	97	198	1,300	100	175
BOD (mg/L)	63	144	300	75	140
TP (mg/L)	6	8	15	5.7	7.7
E-Coli	101,000	420,000	720,000	80,000	315,000

Required Quality

By inspection, it can be seen that the plant is essentially non-compliant by small margins. However, it is noted most data for existing performance is in February and August. Therefore, some judgement is required for extrapolation of the data plus "headroom". In addition, Waihola requires TP and E-Coli improvements.

As a starting point, we provide the following suggestions in terms of targets that could be adopted:

	Target Performance		Consent	
Parameter	50%ile	90%ile	50%ile	Max
Ammonia N (mg/L)	20	30	23	31
TSS (mg/L)	25	30	100	140
BOD (mg/L)	25	30	75	140
TP (mg/L)	5.7	7.7	5.7	7.7
E-Coli	70,000	300,000	80,000	315,000

At this stage we are only addressing ammonia, TSS and BOD being the parameters that Bioshells® can address.

3.3.3 Ammonia removal using BioShells®

Ammonia reduction required based on above assumptions is:

- 50%ile 2mg/L;
- 90%ile 3 mg/L;

Case 1: If we assume 50%ile requirement with a 90%ile flow, we need 0.4kg/day NH-4 removal. This will require 5 @ 2-layer Bioshells®.

Case 2: If we assume 95%ile requirement with a 50%ile flow, we need 0.32kg/day NH-4 removal. This will require 5 @ 2-layer Bioshells®.

Prior to the Bioshells® commencing nitrification, both BOD and TSS must be <30mg/L.

3.3.4 Suspended Solids/BOD Improvement

To enable the nitrification, we propose that BOD and TSS be improved. TSS needs to be reduced by:

- 50%ile 72mg/L; and
- 90%ile 168mg/L.

Case 1: 50%ile load @ 90%ile flow = 13kg/day removal. This will require 19 @ 2-layer Bioshells®.
Case 2: 90%ile load @ 50%ile flow = 18kg/day removal. This will require 26 @ 2-layer Bioshells®.

BOD improvement required is:

- 50%ile 38mg/L; and
- 90%ile 114mg/L.

Case 1: 50%ile load @ 90%ile flow = 7kg/day removal. This will require 4 @ 2-layer Bioshells®.
Case 2: 90%ile load @ 50%ile flow = 12kg/day removal. This will require 7 @ 2-layer Bioshells®.

Therefore, it is proposed to install 33 @ 2-layer Bioshells® for BOD/TSS improvement.

3.3.5 Temperature

Liquid Temperature of 6-10 deg. C has been used for the design basis.

3.3.6 Pond Depth

For cost reasons, the proposal is for all Bioshells® to be installed at the back end of the Ponds. It is assumed the liquid depth available is >1.2m.

3.3.7 TSS reduction

There are two mechanisms that work well for TSS reduction. Bioshells® can be used or a cover to prevent the growth of algae. We are proposing both.

3.3.8 Bioshell® Summary & Air Requirements

Our proposal for Waihola is:

1. NH4-N removal 5 Bioshells®;
2. TSS/BOD removal 33 Bioshells®
3. Total 38 Bioshells®

Air required is 1scfm/Bioshell® = 38scfm (65NM3/hr.) @ 0.15-0.6bar.

3.3.9 TP Removal

Our suggestion at this stage is to see if proposed consent can be varied. There is an option to chemically remove phosphorous within the Bioshells®. This has been done at trial level in the US. Essentially a dosing system injects chemical coagulant (Alum or similar) into the top of the Bioshells® where mixing occurs, and

the coagulant reacts with the phosphorous and settles in the pond. However, the coagulant also reacts with the organics and the sludge production increases significantly.

There are other process options, for example with MF using a coagulant. This option can be done and will also address the E-Coli.

Both options are expensive.

Other options for biological phosphorous removal exist but we suggest further advice on this be sought as we do not have experience in pond modifications for phosphorous removal.

3.3.10 E-Coli reduction

As per earlier proposals, E-Coli can be addressed with the installation of MF. However, with the improvements in TSS proposed with the Bioshells®, UV could be a feasible option.

3.4 Bioshell® Details

3.4.1 Operational & Maintenance Requirements

BioShells®

a. Air Delivery
   - Air must be provided to each unit continuously.
   - 1 SCFM (1.7Nm3/hr.) requirement for each 3-layer Bioshell® unit at sufficient pressure to overcome hydrostatic head pressure and losses.

b. Maintenance
   - Weekly - Visual check surface of lagoon for consistent air and water movement.
   - Monthly - Perform an air purge of the units doubling the air volume for 5-10 minutes this is achieved via isolating some of the BioShells®.
   - 10 Yearly - Perform a visual inspection of bubble release tube and air manifold.
   - 20-year interval – Remove unit from lagoon and replace bubble release tube.

3.5 Future Augmentation

In principle, future augmentation for further nutrient reduction can be undertaken by increasing the number of Bioshells® and associated aeration needs.

Therefore, as both contingency and futureproofing, additional shells can be installed at any time when overall loading on the ponds increases or consent requirements are further tightened.

3.6 Supporting Infrastructure

3.6.1 Building

We have assumed we will not include any buildings with all infrastructure being designed to be installed outside or in a 10-foot container.

3.7 Control Philosophy

The control philosophy for the plant is simple. Essentially no control is required. The blowers will be set to a speed that achieves the desired air flow and occasionally the operator will increase the speed to provide a greater airflow and isolate banks of Bioshells® to "clean" the bubble tube of organic growth. This should be done monthly and will take less than one hour.

The blowers will be connected to allow automatic duty/standby operation.

3.8 Recommended Spares

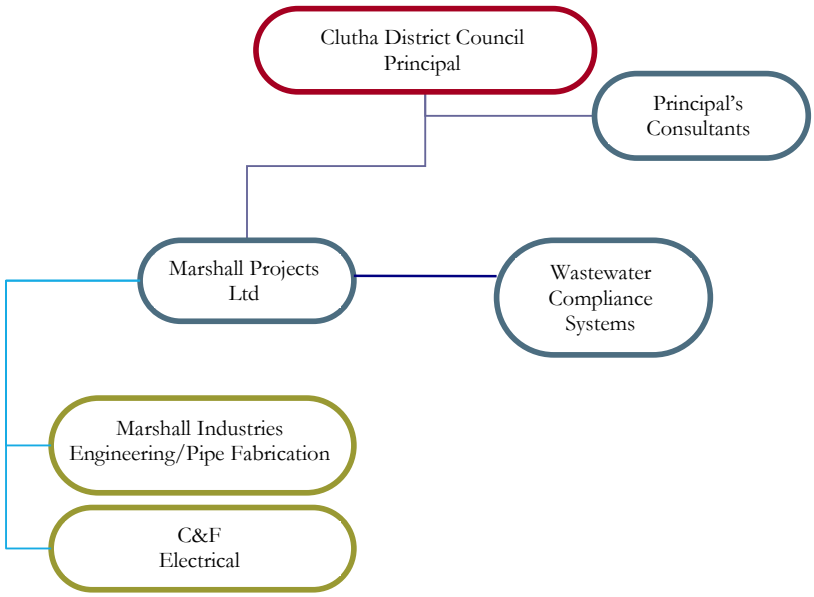
Assuming the blowers are maintained with a service contract for preventative maintenance, no essential spares are required.

Section 4

Technical Experience

4.1 Organisational Structure

4.1.1 Structure



4.1.2 Marshall Projects Ltd

Company:	Marshall Projects Ltd
Administration Office:	PO Box 846, Invercargill
Ownership/Shareholding:	Tom Marshall

MPL provides project design and delivery services to the water and wastewater treatment industries. MPL was founded to utilise the water and wastewater treatment project design and delivery skills of Tom Marshall (founder) and the resources of the associated family business Marshall Industries Limited. MPL is a private New Zealand company and was incorporated in December 2005. Since its formation, MPL has undertaken twenty significant water and wastewater projects.

MPL utilises the skills of MPL, Marshall Industries and long-standing relationships with electrical design and construct contractors, specialist process providers and local sub-contractors to execute water and wastewater treatment projects. The combined experience of MPL and its sub-contracted team provides the ability to deliver Turnkey solutions to projects in a cost-effective manner. The MPL team has the experience, resources and expertise to react and solve any issues that may arise during design, delivery or well into the future after the completion of all contract obligations.

Marshall Industries Limited is a privately-owned company which commenced operation in 1936 trading as Owen Marshall Limited. Marshall Industries has skills and resources primarily based in engineering fabrication and the manufacture of long run roofing products with a permanent staff of 35 and approximately 12 sub-contracted staff.

4.1.3 Wastewater Compliance Systems

Wastewater Compliance Systems Inc. (WCS) was founded in 2008 as an official University of Utah Spinoff company. WCS manufactures and sells patented Bio-Domes®/BioShells®, which are fixed-film bioreactors to provide nutrient removal for wastewater treatment lagoons in mid to small size communities and rural districts. WCS has started providing comprehensive lagoon optimisation options recently. Since 2008, WCS has installed 1,364 Bio-Domes® and 214 BioShells®, as well as involved in the wastewater treatment facility upgrade in 25 locations around the world.

4.2 Project Delivery Team

For the successful delivery of this project, they key to a timely delivery is the availability of technical resources. At this time, valued and experienced technical water resources are in high demand. Marshall Projects has all the resources of Marshall Industries at its disposal. The mixture of resources specific to this project are detailed in the following sections. Tom Marshall is committed to this project and will ensure a successfully delivered project from commencement through commissioning and operational support. During the mechanical installation, electrical and commissioning phases of the project, Marshall Projects will provide additional technical resources in the form of engineers appropriate for the tasks as and when required.

Name	**Tom Marshall** **Contractors Representative/Design Manager**
Qualifications & Training	Bachelor of Engineering (Civil) (Hons) – University of Canterbury Institute of Professional Engineers New Zealand (MIPENZ)
Experience & Performance	Tom Marshall has over 25 years' experience in engineering with the last 19 years being specifically in water and wastewater and with membrane-based systems since 1999. Tom is a Project Manager who has managed the design, delivery and commissioning of complex and large process mechanical plants. Tom has undertaken the role of Engineer to the Contract (or Superintendent) on numerous contracts and is business manager of a medium sized engineering business and owner of MPL. Tom specialised in the management of commissioning of process plants towards the end of his career with CH2M HILL. Tom will be available for the project when required for design preparation, general management, progress meetings/site visits and commissioning management.

Name	**Kraig Johnson (when required)** **Biological Engineer – Bio-Shells**
Qualifications & Training	Ph.D., Civil and Environmental Engineering University of California
Experience & Performance	Kraig is the VP of Wastewater Compliance Systems and leads the Ongoing research and development of the patented aerated submerged bio-film dome structures for wastewater lagoon system enhancement. Current research investigates the removal of nitrogen and phosphorous compounds through aeration cycling. Research is

	conducted in the laboratory, and at pilot installations in several rural communities.

Name	**Donovan Harvey** **Project Manager, Quality Manager, Health and Safety Manager**
Qualifications & Training **Experience & Performance**	Site Safe Supervisor Gold Card, 10 Years Onsite Experience Since late 2007 Donovan has been employed by Marshall Projects Limited as a Construction Manager in the Water Treatment Industry. Primarily as a Project Manager managing; the day to day administration of the contracts; procurement of equipment; construction and installation of the plant within programmed dates. Duties include contract administration, progress reports, on site health and safety and working closely with the client on the project ensuring their needs and expectations are met.

Section 5

Proven Technology

5.1 BioShells® Overview

Developed by the University of Utah, professors Kraig Johnson and Larry Reaveley, Bio-Domes®' award-winning, patented technology consists of concentrically nested domes that are infused with air from the bottom. They sit on the floor of a lagoon and are completely submerged.

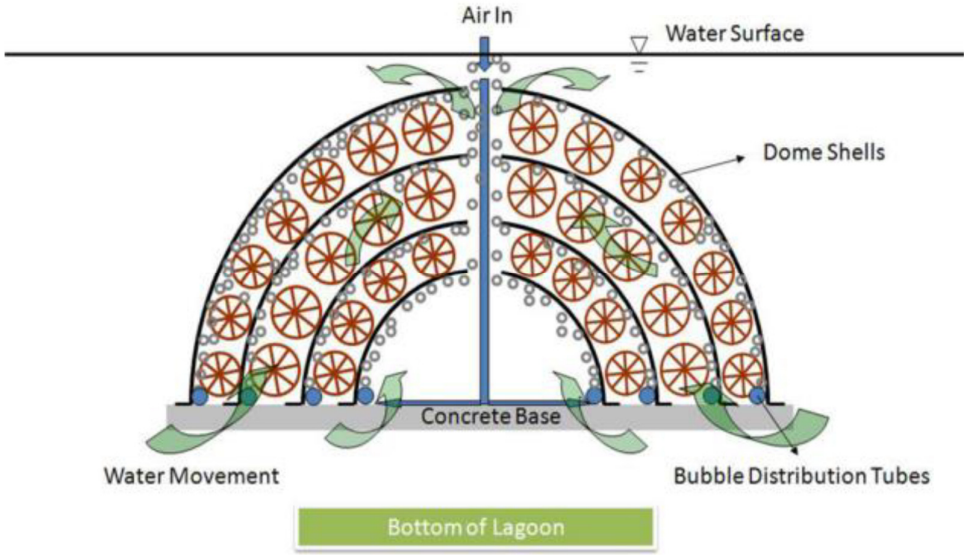
As water flows through them, bottom-to-top, beneficial bacteria (biofilms) effectively reduce Ammonia-Nitrogen, BOD, and TSS in wastewater. Unlike other systems, the growth of the naturally occurring bio-films is maximised by the way in which oxygen is optimally guided through the domes by their geometry.

WCS manufactures and sells patented submergible aerated bio-film reactors under the trade names Bio-Dome® & BioShell® that were developed at the University of Utah to reduce BOD, TSS, or NH4+-N from wastewater streams in a lagoon environment. It is recommended that for this application, that a BioShell® system be used to provide the necessary treatment.

For the 1.2m deep ponds, WCS recommends 2-layer Bioshells® that contain 215m2 of aerated surface designed to remove 1.8kg BOD/Bio-Shell/day and 0.7 kg TSS/Bio-Shell/day, or once BOD and TSS concentrations are below 30 mg/L, 0.11 kg NH4+-N /Bio-Shell/day at 10 deg. C.

Because the Bioshells® rely on fixed film, as opposed to suspended growth, they provide reliable nitrification in water temperatures as low as 0.5degC, however nitrification performance varies greatly depending upon temperature. In the future as the community grows and loading is increased, additional Bioshells® can be installed incrementally on an as needed basis in order to ensure compliance.

A key feature of the Bio-Shells® is their modular nature which allows for seamless growth with the community in order to meet increased populations sizes, loading and even more stringent effluent requirements. Figure 4.1 below depicts how the Bioshells® work.



5.2 History and Performance

WCS has completed operational installations as below utilising this technology.

Further to these installations, many pilot studies have been undertaken. Of relevance is the following:

- In water temperatures down to 1 deg. C;
- BOD reduction;
- Ammonia reduction;
- Denitrification; and
- Phosphorus Removal.

Details can be found on their website: www.wastewater-compliance-systems.com
In summary, the following installations have been completed:

Year	No.	Location	Purpose
2008	50	Utah	BOD/TSS
2009	75	Utah	Phosphorous
2011	185	Nevada	BOD/TSS/Ammonia
2011	20	Missouri	BOD/TSS
2012	50	Montana	BOD/TSS/Ammonia
2012	52	Virginia	BOD/TSS (algae)
2012	6	Colorado	BOD/TSS/Ammonia
2012	4	Pennsylvania	Ammonia Removal
2013	49	New Mexico	TN
2014	38	Wisconsin	Ammonia
2015	50	Alaska	BOD and Odour reduction
2015	20	Wyoming	BOD removal
2015	80	Mississippi	Ammonia
2015	8	Alabama	BOD/TSS
2016	21	Indiana	TSS
2016	8	Utah	Algae
2016	4	Utah	Algae
2016	154	West Virginia	Ammonia
2017	530	Colorado	Ammonia
2017	80	Wyoming	Ammonia
2017	20	Wyoming	BOD/TSS
2018	7	Heriot	BOD/TSS/Ammonia
2018	15	Kaitangata	BOD/TSS/Ammonia
2018	48	Oregon	Ammonia
2018	10	Washington	BOD/TSS
2019	554	Paihia	Ammonia

5.3 Construction Methodology

5.3.1 Design

Starting with P&ID's and layouts, which will then be updated and consolidated into a design report.

5.3.2 Procurement/Manufacturing

Procurement will begin following the design phase with long lead time items being procured first namely BioShell® components and blowers. Manufacturing of the Bioshells® will be undertaken in Invercargill.

5.3.3 Construction

Bioshells® will start to be installed when ready. A purposefully design barge will be used to place the Bioshells®. Once all BioShells® are installed and individually checked for air supply, the curtain will be installed across the pond. And the cover can be added in that area.

5.3.4 Commissioning

Once the blowers have been commissioned by the supplier the BioShells® will be set up to run and testing will be checked on all controls. At this point the BioShells® will need some time to establish within the ponds.

5.3.5 Continuity of Treatment

The Bioshells® are installed in the live operating pond meaning no flow shutdown is required.

5.4 Track Record

Specific Details	Description
Name and type of works provided	Kaitangata & Heriot WWTP – BioShells® followed by Microfiltration
Referee:	Peter Ross Clutha District Council 022 025 0461
Status of Project:	Construction and Commissioning were completed in 2017.
Scale:	$2m completed on time and on budget
Relevance to this Project:	Same technology for the ponds that is proposed for this contract. Same delivery team will be utilised on this contract.

Specific Details	Description
Name and type of works provided	Paihia Upgrade
Referee:	Bill Down Far North District Council
Status of Project:	Project Completed 2020
Scale:	$5.5m completed ahead of time and on budget
Relevance to this Project:	Large Bioshell® project for ammonia removal, <2mg/L achieved.

Section 6

Health and Safety

All site work undertaken by PMWC will be controlled using the MPL health and safety system. The MPL safety system is structured to support a "Zero Harm" objective during all its commercial activities. As an organisation MPL are committed to take all practical steps to avoid harm to our employees, subcontractors, site visitors and the general public. We aim to accomplish this by complying with all relevant legislation and best practice guidelines, applying a pro-active approach to site safety management and promoting the involvement and participation of all stakeholders.

MPL ensures that all personnel are adequately trained, qualified and supervised in relation to the work they will perform. This is achieved via an in-house training program and a formal subcontractor prequalification process. We currently have a Sitewise Green Accreditation and a SHE accreditation recognised by all Central North Island Councils.

A Site-Specific Safety Management Plan is prepared by the MPL Project Manager for submission to the client prior to commencement of site works. This plan is formulated in consultation with the client to ensure that the management of all major risks is considered in the context of site policies and operational requirements. Significant hazards, together with appropriate control strategies, are recorded and publicly displayed in the form of a site hazard register. Emergency response and evacuation procedures are also prepared in advance of the works program.

In the case of a ring-fenced site, specific packages of work are managed via the "Common Permit to Work System" as originally developed by the petrochemical industry. MPL are a committee member of this common permit to work system.
Key Performance Indicators are usually derived in conjunction with the client and reported upon formally on a monthly basis. A formal reporting and investigation process are applied should a site accident or incident occur.

A program of site induction, daily safety briefs and regular toolbox meetings is used to promote participation and awareness on site. Regular housekeeping and work permit audits are conducted to access systems compliance and identify improvement opportunities.

MPL has not been prosecuted by work safe and have had no LTI's or MTI's for the past 5 years. MPL can provide full numbers of MTI, LTI, Serious Injury and near misses on request.