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Taronga Zoo Reptile & Amphibian Conservation Centre

Services Concept Design Report

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Taronga Zoo Reptile & Amphibian
Conservation Centre

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1 Introduction

1.1 Brief

CNF & Associates has been engaged to prepare a Concept Design for the required services for the proposed new reptile and amphibian conservation centre (RACC) to be built at the Taronga Zoo.

The design is based on preliminary and concept information provided by Taronga staff and design consultants.

The brief includes:

- a) Water systems
- b) Electrical systems
- c) HVAC systems

1.2 Design Basis

In preparing this concept design, the following documents and information were used as the “basis of design”:

- 1) Architectural plans and elevations prepared by Design Worldwide Partnership (DWP) issued via Acconex correspondence TZ-GCCOR-0027, TZ-GCCOR-037, and TZ-GCCOR-039
- 2) Room Datasheets completed by Taronga staff and issued via Acconex correspondence TZ-GCCOR-037.
- 3) General discussions during meetings held on 18th May 2021 and 25th May 2021.
- 4) Site inspection and briefing with Taronga staff on 18th May 2021.

1.3 Design Imperatives

The major design imperative is animal welfare. Many exhibits are animals that are rare or endangered and it is essential to provide strict environmental conditions to suit each animal’s natural habitat.

Secondary imperatives include guest comfort, keeper operability, and energy efficiency, each of which should be maximised within the constraints of the major imperative.

2 Water Systems

Taken as a whole, the various competing requirements for water systems leads to a determination that three distinct and separate water systems are required. They are:

- Potable Water
- Dechlorinated Water
- Reverse Osmosis Water

The Room Datasheets were used to determine the required water service, treatment system and filling/draining requirements for each pool in each exhibit, and the result of this analysis is included in Appendix A of this report. Pool characteristics were collated so that each pool can be classified into five distinct pool “types”:

- **Type 1** – Small pool, potable water feed, no filtration required.
- **Type 2** – Large pool, potable water feed, pressure filtration plant located in plant room.
- **Type 3** – Small pool, potable water feed, filtration provided by plug-in filtration equipment located locally to the pool (“Eheim” type filter/pump units).
- **Type 4** – Small pool, dechlorinated water feed, filtration provided by plug-in filtration equipment located locally to the pool (“Eheim” type filter/pump units).
- **Type 5** – Large pool, dechlorinated water feed, pressure filtration plant located in plant room.

Piping and Instrumentation drawings for each pool type are included in Appendix B of this report.

In summary, the requirements for each system are:

No.	System Name	Application	Capacity m3/hr
1	Potable Water	Most enclosures with pools and staff amenities	64.075
2	Dechlorinated Water	Most Amphibians and pools where fish may be added	11.75
3	RO Water	Frogs & tadpoles pools, and misting sprays	0.25

The main potable water line feeding the new centre will need to provide source water for the Dechlorinated Water and RO Water systems to be installed in the plant room, so it will need to be able to provide approximately 75m3/hr (peak flow without diversity). A single 100mm diameter incoming potable water service will provide adequate capacity to the facility (operating at a flow velocity of under 2.5m/s).

This incoming water supply will be split into four sub-systems:

- Services water to Back of House (BOH) – 50mm diameter.
- Potable water to Type 1 and Type 3 pools – 100mm diameter.
- Potable water feed to dechlorinated water plant located in plant room – 50mm diameter.
- Potable water feed to Potable Water Supply Tanks located in plant room – 50mm diameter.
- Potable Water Feed to Reverse Osmosis Plant located in plant room.

The incoming main and each of the subsystems will be fitted with flow monitoring devices that will report instantaneous and totalised flow to the facility's PLC/SCADA system and site-wide EMS/BMS. This information will be used for ESD reporting.

To allow future flexibility, the design includes the provision of five water manifolds that will run adjacent to each exhibit room, with tee-off connections as required. If the facility is re-configured in the future, and the exhibit room requirements change, it will be a simple matter of teeing into the appropriate manifold and running small-bore piping into the exhibit room to achieve the new configuration.

The water manifolds are as follows:

- Potable Water Pressure Manifold – 100mm diameter.
- Dechlorinated Water Pressure Manifold – 25mm diameter.
- Dechlorinated Water Supply Manifold – 25 mm diameter.
- Potable Water Supply Manifold – 100 mm diameter.
- RO Water Pressure Manifold – 25mm diameter.

Note that "pressure" manifolds will be run at 500kPa, while "supply" manifolds will be run at 25 to 50kPa and will require pumping from plant room pumps.

RO water will be produced by a pair of 3,000 litre per day commercial RO units, similar to the FSA GT1-98 unit available from Filter Systems Australia. Produced water will be stored in a 4,000 litre storage tank and supply the pressure manifold via a pair of pressure pumps rated at 500kPa head and flow of 0.5m³/hr.

The RO water Pressure Manifold will provide reverse osmosis treated water to each of the exhibits' misting and spraying systems via small bore pipework (12mm) and nozzles capable of providing mist/spray at 5 litres per hour. Details of the system can be found in Appendix C of this report.

Dechlorinated Water will be produced by a set of four "carbon block" canister filters (e.g., PureTec CB10MP2 units) installed in parallel, each capable of producing 60 litres/minute. Produced water will be stored in a 4,000 litre storage tank and supplied to the dechlorinated water main via pair of duty/standby pressure pumps capable of delivering 8m³/hr at 500kPa head.

As normal operations will include regular draining and washdown/hose-down of the exhibit pools, a 150mm drain manifold will be provided to run adjacent to all exhibit rooms. Each pool/exhibit will be provided with a minimum 50mm diameter drain line to connect to the drain manifold via a manually operated valve located adjacent to each pool. Floor drains and pool overflow connections will also be connected to the drain manifold but will not be able to be isolated.

The drain manifold will also collect the drains/discharges from the BOH areas and the backwash water from filters and the RO units. The drain will then discharge via a 150mm line to the sewer connection. The design includes a 4,000 litre collection tank and a pair of duty/standby discharge pumps in case gravity flow cannot provide the required peak flow.

To ensure water availability and to allow pumping flexibility, a number of water supply tanks have been included in the design. The tanks are:

- Dechlorinated Water Storage Tank – 4,000 litres.
- Potable Water Supply Tanks – 2 off 4,000 litres.
- RO Treated Water Storage Tank – 4,000 litres.
- Backwash Water Holding Tank – 4,000 litres.

All tanks will be located in the plantroom, and to maximise footprint utilization, “slimline” tanks will be used. Appendix H contains a preliminary layout of RACC plantroom, which includes the tanks and associates water systems equipment.

3 Electrical Systems

The RACC facility will be supplied with electrical power from the existing Taronga power distribution system's substation 4, located to the south of the proposed facility. The total expected load (maximum demand) is 186.95kW or approximately 300 Amps per phase, which can be provided via a new submains feeder comprising of 4 single core XLPE cables of 150mm² copper cables installed in a single underground conduit of 150mm diameter. A single line diagram of the proposed power supply is included in Appendix D of this document.

The potential for solar PV on the roof of the facility was explored but rejected due to the relatively small roof areas available and the poor solar irradiance of the site location.

The electrical load for the facility consists of the following main groupings:

No	Equipment/Devices	Rating (kW)
1	Water Treatment Plant	12.09
2	Ventilation System	4.58
3	HVAC System	47.66
4	Exhibit General Lighting & GPOs	53.85
5	General Lighting & GPOs	45.49
6	Underfloor Heating	23.28

The main incomm and ach load group nominated in the above list will be fitted with energy monitoring devices which will report instantaneous and totalised energy usage to the facility's PLC/SCADA system and site-wide EMS/BMS for use in future ESD reporting.

The Water Treatment Plant loads are estimated to be:

Item	Description	Number of Duty Units	Load (kW) per Unit	Load Total (kW)
1	RO Unit	2	0.24	0.48
2	RO Supply Pumps	1	1.1	1.1
3	Dechlor. Water Supply Pumps	1	2.2	2.2
4	Pool Recirc Pump EX01	1	0.37	0.37
5	Pool Recirc Pump EX36	1	0.37	0.37
6	Pool Recirc Pump EX37	1	0.37	0.37
7	Pool Recirc Pump EX38	1	4	4
8	Waste Discharge Pump	1	2.2	2.2
9	Control Panel	1	1	1
Total				12.09

The total load for the ventilation system is estimated to be 4.58kW. A summary table is below, and details of the system can be found in section 4 of this document.

Item	Fan Service	Fan Size (kW)
1	GF - PLANTRM	1.1
2	GF - FOODPREP	0.37
3	GF-WSHOP	0.19
4	GF-GENSTORE	0.37
5	GF-BULKSTORE	0.095
6	GF-CHEMSTR	0.09
7	GF-WASTESTR	0.09
8	GF-LOADDCK	0.37
9	GF-OA-AC1	0.18
10	GF-OA-AC2	0.37
11	GF-FOODPREP	0.18
12	LIFT SHAFT	0.18
13	LIFT CAR	0.09
14	FF-OA-AC-2	0.37
15	FF-OA-AC-1	0.18
16	FF-OA-AC-3	0.18
17	RT-OA-AC-1	0.12
18	GF-STAFFAMEN	0.05
Total Load		4.575

The total load for the Air Conditioning system is 47.66 kW. A summary table is presented below, and details of the system can be found in section 4 of this document.

Item	Air Conditioner Service	Hitachi Model	Load (kW)
1	GF-AC-1	OPA 150	6.72kW
2	GF-AC-2	OPA 260	10.56kW
3	RT-AC-1	OPA 250	10.56kW
4	FF-AC-1	OPA 150	6.72kW
5	FF-AC-2	OPA 101	5.66kW
6	FF-AC-3	OPA 180	7.44kW
Total Load			47.66

The Room Datasheets were used to construct a table of requirements for general purpose outlets (GPOs) and lights required for the facility. This table is included in Appendix E of this document. In summary, a total of 353 GPOs and 351 LED lights will be used in the facility, and this presents a maximum demand of 99 kW of load as per AS3000. This is broken up as 54kW for the exhibit areas and 45kW for the BOH areas. The design has assumed that high efficiency 15W LED lighting will be used throughout for general lighting requirements.

The final load group identified is the electrically powered floor heating required for specified exhibits. Again the Room Datasheets were used to compile a list of rooms and areas to be fitted with floor heating and a copy of this can be found in Appendix F of this document. A total area of 133 m² of floor area will need to be fitted with floor heating and using a base requirement of 175W/m², this leads to a total load of 23.28kW. Each of the identified 29 floor heating circuits will be wired independently so that each exhibit will have its own temperature control available at the exhibit.

4 HVAC Systems

The animal exhibit rooms have a wide range of temperature and humidity requirements which differ significantly from the personnel areas of the BOH areas which are air conditioned. In response the design has adopted a segmented approach with six separate air conditioning systems installed in the plant room and ducted to the required areas. The total of 99kW of air conditioning will be provided to the facility, with the allocation and break-up as shown on the table below:

Description	Area Number	AC No	Zone AirFlow L/s	Air Grille Size W x H	Main SA Duct Size W x H	Main R/A Duct Size W x H
Back Of House - Ground Floor						
Staff Room & Kitchen	BOH01	GF-AC-1	554	500 x 250	550 x 350	550 x 350
Staff Office 1 - Quiet Rm	BOH02	GF-AC-1	208	300 x 150		
Staff Office 2	BOH03					
Staff Amenities	BOH04					
Loading Dock	BOH05					
Bulk Store	BOH06					
Waste Store	BOH07					
Chemical Store	BOH08					
Holding General	BOH09	GF-AC-2	587	300 x 150	650 x 350	650 x 350
Holding Frogs + Tadpoles	BOH10	GF-AC-2	130	250 x 150		
Holding Venomous	BOH11	GF-AC-2	130	250 x 150		
Holding Tropical	BOH12	GF-AC-2	130	250 x 150		
Holding Aquatic Room	BOH13	GF-AC-2	130	250 x 150		
Holding Incubator Room	BOH14	GF-AC-1	69	200 x 150		
Large Reptile Densx2	BOH15	GF-AC-1	69	200 x 150		
Northern Corroboree Frog Conservation Room	BOH16	GF-AC-2	130	250 x 150		
Southern Corroboree Frog Conservation Room	BOH17	GF-AC-2	130	250 x 150		
Yellow Spotted Bell Frog Conservation Room	BOH18	GF-AC-2	130	250 x 150		
Food Prep Area	BOH19					
Workshop	BOH20					
General Store	BOH21					
External Sunning Aviaries	BOH22					
Plant Room	BOH23					
Species Exhibit Areas						
Komodo Dragon	EX01	RT-AC-1	492	500 x 250	650 x 350	650 x 350
Veiled Chameleon	EX02	FF-AC-1	38	200 x 100	550 x 350	550 x 350
Fijian Crested Iguana	EX04	FF-AC-1	63	200 x 150		

Description	Area Number	AC No	Zone AirFlow L/s	Air Grille Size W x H	Main SA Duct Size W x H	Main R/A Duct Size W x H
Plumed Basilisk	EX05	FF-AC-1	76	200 x 150		
Gila Monster	EX06	FF-AC-1	57	200 x 100		
Green Tree Monitor	EX07	FF-AC-1	139	250 x 150		
Frilled lizard	EX08	FF-AC-2	88	200 x 150	500 x 250	500 x 250
Eastern pilbara spiny-tailed skink	EX09	FF-AC-1	32	200 x 100		
Shingleback skink	EX10	FF-AC-1	57	200 x 100		
Slater's skink	EX11	FF-AC-3	68	200 x 150	650 x 350	600 x 350
Rusty desert monitor	EX12	FF-AC-1	44	200 x 100		
Boyd's Forest Dragon	EX13	FF-AC-3	37	200 x 100		
Grassland earless dragon	EX15	FF-AC-2	50	200 x 100		
Tuatara	EX16	FF-AC-3	111	200 x 150		
Reticulated Python	EX17	FF-AC-3	264	350 x 150		
Monocled Cobra	EX18	FF-AC-3	129	250 x 150		
Eastern Diamondback Rattlesnake	EX19	FF-AC-3	80	200 x 150		
Scrub python	EX21	FF-AC-3	111	200 x 150		
Green Python + White Lipped Tree Frog	EX22	FF-AC-3	37	200 x 100		
Black-headed python	EX23	FF-AC-1	82	200 x 150		
Broad-headed Snake	EX25	FF-AC-2	38	200 x 100		
Coastal taipan	EX26	FF-AC-2	138	250 x 150		
Inland Taipan	EX27	FF-AC-1	70	200 x 150		
Red-bellied Black Snake	EX28	FF-AC-2	75	200 x 150		
Pygmy python	EX29	FF-AC-3	31	200 x 100		
Eyelash Viper / small viper (Alternative find SE species)	EX30	FF-AC-1	38	200 x 100		
Elongated or Star Tortoises	EX31	FF-AC-3	129	250 x 150		
Chinese Three-striped Box Turtle	EX32	FF-AC-3	37	200 x 100		
Aligator Snapping Turtle	EX33	FF-AC-2	81	200 x 150		
Turtles	EX36	FF-AC-2	81	200 x 150		
Mertons Water Monitor	EX37	FF-AC-1	203	300 x 150		
Philippine Crocodile	EX38	RT-AC-1	568	600 x 375		
Red-eyed tree frog	EX39	FF-AC-3	37	200 x 100		
Corroboree Frog	EX40	FF-AC-2	44	200 x 100		
Yellow-spotted Bell Frog	EX41	FF-AC-2	31	200 x 100		
Riverine Frog	EX42	FF-AC-3	31	200 x 100		
Rhino Iguana	EX43	RT-AC-1	180	300 x 150		
Radiated Tortoise	EX44	RT-AC-1	261	350 x 150		

Additionally, to provide adequate ventilation, the design has identified a total of 18 wall-mounted fans will be required to provide 12 air changes per hour for all enclosed areas. The actual air volume that is moved mechanically throughout the facility will be 3.86m³/s.

Appendix G contains the HVAC schematic which shows fan, duct and air-conditioning unit allocations and interconnections. Appendix H contains a preliminary layout of RACC plantroom, which includes the HVAC units.

6 Tie-In to Existing Services

Appendix H of this document contains a drawing showing the proposed tie-in of services to the new facility.

6.1 Electrical Services

Site information provided indicates that the electrical load required for the new facility can be provided from existing substation 4. This substation is rated at 750kVA and currently provides approximately 300kVA to the site.

6.2 Mechanical Services

It is not planned to connect the existing site mechanical services to the new facility, which will be provided with a stand-alone HVAC system.

6.3 Hydraulic Services

A new 100mm diameter potable water line will be connected to the existing site ring main at a location to the southwest of the new facility. It is assumed that the existing main will be able to provide the additional peak flow of 75m³/hr.

The new facility will connect to the existing site sewer via a 150mm diameter pipe at a location to the southwest of the site.

6.4 Gas Services

The design has not identified any requirement for a gas service to be implemented for the new facility. There may be a requirement for heating of some of the larger pools, and rather than using fossil fuel combustion to achieve this requirement, the detailed design phase will develop a waste heat capture system from the air conditioning units via air/water heat exchangers. This approach is in keeping with Taronga's overall ESD initiatives.

6.5 Fire Services

It is expected that the existing fire main will be suitable to provide fire water to the new facility, as the design incorporates materials that will present a low fire load. However, two new fire hose reels and booster stations should be allowed for.

7 Appendices

7.1 Appendix A – Exhibit Water Requirements Summary

Documentation has been collated separate to this design report; please refer to electronic copy of documentation listed in the table below for Appendix D.

DOCUMENT	DESCRIPTION
21-084-SCH-001_A	RACC EXHIBIT WATER REQUIREMENTS SUMMARY

7.2 Appendix B – Process & Instrumentation Drawings

Documentation has been collated separate to this design report; please refer to electronic copy of documentation listed in the table below for Appendix B.

DOCUMENT	DESCRIPTION
21-084-P-001_A	WATER SUPPLY P&ID SHEET 1 OF 2
21-084-P-002_A	WATER SUPPLY P&ID SHEET 2 OF 2
21-084-P-003_A	POOL TYPE 1 P&ID
21-084-P-004_A	POOL TYPE 2 P&ID
21-084-P-005_A	POOL TYPE 3 P&ID
21-084-P-006_A	POOL TYPE 4 P&ID
21-084-P-007_A	POOL TYPE 5 P&ID
21-084-P-008_A	BACKWASH P&ID

7.3 Appendix C – Misting & Spray System Summary

Description	Area Number	Datasheet Page	Pool Volume (m3)	Misting/ Spraying	No. of Nozzles	Misting Flow (Litres/hour)
Komodo Dragon	EX01	48	10	Y	10	50
Veiled Chameleon	EX02	51	0.025	Y	1	5
Unknown - Fallax Murphy Frog?	EX03	54	0.025	Y	1	5
Fijian Crested Iguana	EX04	57	0.75	Y	2	10
Plumed Basilisk	EX05	59	1	Y	4	20
Gila Monster	EX06	62	0.025	N	0	0
Green Tree Monitor	EX07	64	0.75	Y	4	20
Frilled lizard	EX08	66	0.025	N	0	0
Eastern pilbara spiny-tailed skink	EX09	68	0.025	N	0	0
Shingleback skink	EX10	70	0.025	N	0	0
Slater's skink	EX11	72	-	N	0	0
Rusty desert monitor	EX12	74	0.025	N	0	0
Boyd's Forest Dragon	EX13	76	0.75	Y	1	5
Red-barred dragon	EX14	78	0.025	N	0	0
Grassland earless dragon	EX15	80	0.025	N	1	5
Tuatara	EX16	82	0.025	N	2	10
Reticulated Python	EX17	84	-	Y	4	20
Monocled Cobra	EX18	86	0.025	Y	2	10
Eastern Diamondback Rattlesnake	EX19	88	0.025	Y	2	10
Scrub python	EX21	90	0.25	Y	4	20
Green Python + White Lipped Tree Frog	EX22	92	0.5	Y	1	5
Black-headed python	EX23	94	0.025	N	0	0
Centralian Carpet Python	EX24	97	0.025	N	1	5
Broad-headed Snake	EX25	100	0.025	N	2	10
Coastal taipan	EX26	102	0.025	Y	6	30
Inland Taipan	EX27	104	0.025	N	0	0
Red-bellied Black Snake	EX28	106	0.1	Y	2	10
Pygmy python	EX29	108	0.025	N	0	0
Eyelash Viper / small viper (Alternative find SE species)	EX30	110	0.025	Y	1	5
Elongated or Star Tortoises	EX31	112	0.025	N	0	0
Chinese Three-striped Box Turtle	EX32	116	0.75	Y	1	5
Aligator Snapping Turtle	EX33	-	-	-	0	0
Turtles	EX36	119	8	Y	6	30
Mertons Water Monitor	EX37	121	2	Y	6	30
Philippine Crocodile	EX38	123	75	Y	20	100
Red-eyed tree frog	EX39	125	0.25	Y	1	5
Corroboree Frog	EX40	127	0	Y	1	5
Yellow-spotted Bell Frog	EX41	129	0.75	Y	1	5

Riverine Frog	EX42	130	0.25	Y	1	5
Rhino Iguana	EX43	131	0.25	Y	8	40
Radiated Tortoise	EX44	131	0.25	N	0	0
					Total	96
						480

7.4 Appendix D – Substation 4 Single Line Diagram

Documentation has been collated separate to this design report; please refer to electronic copy of documentation listed in the table below for Appendix D.

DOCUMENT	DESCRIPTION
21-084-S-E-001_A	SUBSTATION 4 SINGLE LINE DIAGRAM SKETCH

7.5 Appendix E – Exhibit GPO & Lighting Summary

Description	Area Number	Datasheet Page	Double GPOs	AS3000 Max Demand (kW)	Lights	Light Circuits Max Demand (kW)	Total MD (kW)	3-phase current (A)
Back Of House - Ground Floor								
Staff Room & Kitchen	BOH01	2	12	2.1	10	0.15	2.25	3.13
Staff Office 1	BOH02	4	6	1.5	4	0.06	1.56	2.17
Staff Office 2	BOH03	6	2	1.1	5	0.075	1.175	1.63
Staff Amenities	BOH04	8	2	1.1	6	0.09	1.19	1.65
Loading Dock	BOH05	10	1	1	2	0.03	1.03	1.43
Bulk Store	BOH06	12	1	1	2	0.03	1.03	1.43
Waste Store	BOH07	14	1	1	2	0.03	1.03	1.43
Chemical Store	BOH08	16	1	1	2	0.03	1.03	1.43
Holding General	BOH09	18	30	3.9	10	0.15	4.05	5.63
Holding Frogs + Tadpoles	BOH10	20	16	2.5	6	0.09	2.59	3.60
Holding Venomous	BOH11	22	16	2.5	6	0.09	2.59	3.60
Holding Tropical	BOH12	24	16	2.5	6	0.09	2.59	3.60
Holding Aquatic Room	BOH13	26	16	2.5	6	0.09	2.59	3.60
Holding Incubator Room	BOH14	28	10	1.9	4	0.06	1.96	2.72
Large Reptile Densx2	BOH15	30	6	1.5	6	0.09	1.59	2.21
Northern Corroboree Frog Conservation Room	BOH16	32	20	2.9	10	0.15	3.05	4.24
Southern Corroboree Frog Conservation Room	BOH17	34	20	2.9	10	0.15	3.05	4.24
Yellow Spotted Bell Frog Conservation Room	BOH18	36	20	2.9	10	0.15	3.05	4.24
Food Prep Area	BOH19	38	8	1.7	6	0.09	1.79	2.49
Workshop	BOH20		4	1.3	6	0.09	1.39	1.93
General Store	BOH21	42	4	1.3	6	0.09	1.39	1.93
External Sunning Aviaries	BOH22	44	2	1.1	4	0.06	1.16	1.61
Plant Room	BOH23	47	10	1.9	30	0.45	2.35	3.26
Species Exhibit Areas								
Komodo Dragon	EX01	48	3	1.2	6	0.09	1.29	1.79
Veiled Chameleon	EX02	51	3	1.2	2	0.03	1.23	1.71
Unknown - Fallax Murphy Frog?	EX03	54	3	1.2	2	0.03	1.23	1.71
Fijian Crested Iguana	EX04	57	3	1.2	4	0.06	1.26	1.75
Plumed Basilisk	EX05	59	3	1.2	4	0.06	1.26	1.75
Gila Monster	EX06	62	3	1.2	4	0.06	1.26	1.75
Green Tree Monitor	EX07	64	3	1.2	4	0.06	1.26	1.75

Frilled lizard	EX08	66	3	1.2	4	0.06	1.26	1.75
Eastern pilbara spiny-tailed skink	EX09	68	3	1.2	2	0.03	1.23	1.71
Shingleback skink	EX10	70	3	1.2	2	0.03	1.23	1.71
Slater's skink	EX11	72	3	1.2	2	0.03	1.23	1.71
Rusty desert monitor	EX12	74	3	1.2	2	0.03	1.23	1.71
Boyd's Forest Dragon	EX13	76	3	1.2	2	0.03	1.23	1.71
Red-barred dragon	EX14	78	3	1.2	2	0.03	1.23	1.71
Grassland earless dragon	EX15	80	3	1.2	2	0.03	1.23	1.71
Tuatara	EX16	82	3	1.2	6	0.09	1.29	1.79
Reticulated Python	EX17	84	3	1.2	10	0.15	1.35	1.88
Monocled Cobra	EX18	86	3	1.2	6	0.09	1.29	1.79
Eastern Diamondback Rattlesnake	EX19	88	3	1.2	6	0.09	1.29	1.79
Scrub python	EX21	90	3	1.2	6	0.09	1.29	1.79
Green Python + White Lipped Tree Frog	EX22	92	3	1.2	2	0.03	1.23	1.71
Black-headed python	EX23	94	3	1.2	6	0.09	1.29	1.79
Centralian Carpet Python	EX24	97	3	1.2	6	0.09	1.29	1.79
Broad-headed Snake	EX25	100	3	1.2	2	0.03	1.23	1.71
Coastal taipan	EX26	102	3	1.2	6	0.09	1.29	1.79
Inland Taipan	EX27	104	3	1.2	6	0.09	1.29	1.79
Red-bellied Black Snake	EX28	106	3	1.2	6	0.09	1.29	1.79
Pygmy python	EX29	108	3	1.2	2	0.03	1.23	1.71
Eyelash Viper / small viper	EX30	110	3	1.2	2	0.03	1.23	1.71
Elongated or Star Tortoises	EX31	112	3	1.2	6	0.09	1.29	1.79
Chinese Three-striped Box Turtle	EX32	116	3	1.2	2	0.03	1.23	1.71
Aligator Snapping Turtle	EX33	-	3	1.2	2	0.03	1.23	1.71
Turtles	EX36	119	3	1.2	6	0.09	1.29	1.79
Mertons Water Monitor	EX37	121	3	1.2	10	0.15	1.35	1.88
Philippine Crocodile	EX38	123	6	1.5	20	0.3	1.8	2.50
Red-eyed tree frog	EX39	125	3	1.2	2	0.03	1.23	1.71
Corroboree Frog	EX40	127	3	1.2	2	0.03	1.23	1.71
Yellow-spotted Bell Frog	EX41	129	3	1.2	2	0.03	1.23	1.71
Riverine Frog	EX42	130	3	1.2	2	0.03	1.23	1.71
Rhino Iguana	EX43	131	3	1.2	10	0.15	1.35	1.88
Radiated Tortoise	EX44	131	3	1.2	10	0.15	1.35	1.88
Total		350		92.6	349	5.235	97.835	135.88

7.6 Appendix F – Exhibit Floor Heating Summary

Description	Area Number	Datasheet Page	Room Area (m ²)	Under Floor Heating to 30% of Floor Area	Heated Area m ²	Heat Load (kW)
Species Exhibit Areas						
Komodo Dragon	EX01	48	100	Y	30	5.25
Veiled Chameleon	EX02	51	3	N	0	0.00
Unknown - Fallax Murphy Frog?	EX03	54	1	N	0	0.00
Fijian Crested Iguana	EX04	57	5	Y	1.5	0.26
Plumed Basilisk	EX05	59	10	Y	3	0.53
Gila Monster	EX06	62	5	Y	1.5	0.26
Green Tree Monitor	EX07	64	15	Y	4.5	0.79
Frilled lizard	EX08	66	9	Y	2.7	0.47
Eastern pilbara spiny-tailed skink	EX09	68	1	Y	0.3	0.05
Shingleback skink	EX10	70	5	Y	1.5	0.26
Slater's skink	EX11	72	3	Y	0.9	0.16
Rusty desert monitor	EX12	74	3	Y	0.9	0.16
Boyd's Forest Dragon	EX13	76	2.5	Y	0.75	0.13
Red-barred dragon	EX14	78	1	Y	0.3	0.05
Grassland earless dragon	EX15	80	1	Y	0.3	0.05
Tuatara	EX16	82	12	Y	3.6	0.63
Reticulated Python	EX17	84	30	Y	9	1.58
Monocled Cobra	EX18	86	10	Y	3	0.53
Eastern Diamondback Rattlesnake	EX19	88	10	Y	3	0.53
Scrub python	EX21	90	15	N	0	0.00
Green Python + White Lipped Tree Frog	EX22	92	3	N	0	0.00
Black-headed python	EX23	94	10	Y	3	0.53
Centralian Carpet Python	EX24	97	10	Y	3	0.53
Broad-headed Snake	EX25	100	1.5	Y	0.45	0.08
Coastal taipan	EX26	102	15	Y	4.5	0.79
Inland Taipan	EX27	104	7.5	Y	2.25	0.39
Red-bellied Black Snake	EX28	106	7.5	Y	2.25	0.39
Pygmy python	EX29	108	1.5	Y	0.45	0.08
Eyelash Viper / small viper (Alternative find SE species)	EX30	110	3	Y	0.9	0.16
Elongated or Star Tortoises	EX31	112	15	Y	4.5	0.79
Chinese Three-striped Box Turtle	EX32	116	2.5	N	0	0.00
Aligator Snapping Turtle	EX33	-	-	N	0	0.00
Turtles	EX36	119	10	N	0	0.00

Mertons Water Monitor	EX37	121	20	N	0	0.00
Philippine Crocodile	EX38	123	100	Y	30	5.25
Red-eyed tree frog	EX39	125	1	N	0	0.00
Corroboree Frog	EX40	127	1	N	0	0.00
Yellow-spotted Bell Frog	EX41	129	1.5	N	0	0.00
Riverine Frog	EX42	130	1	N	0	0.00
Rhino Iguana	EX43	131	25	Y	7.5	1.31
Radiated Tortoise	EX44	131	25	Y	7.5	1.31
					Total	133.05
						23.28375

7.7 Appendix G – HVAC System Schematics

Documentation has been collated separate to this design report; please refer to electronic copy of documentation listed in the table below for Appendix G.

DOCUMENT	DESCRIPTION
21-084-M-001_A	EXHIBIT ROOM HVAC SCHEMATIC
21-084-M-002_A	GF STAFF & HOLDING ROOM HVAC SCHEMATIC
21-084-M-003_A	FF & ROOF TOP EXHIBIT ROOM HVAC SCHEMATIC

7.8 Appendix H – Site Services & Plantroom Layout

Documentation has been collated separate to this design report; please refer to electronic copy of documentation listed in the table below for Appendix H.

DOCUMENT	DESCRIPTION
21-084-M-010_A	TARONGA ZOO SERVICES SITE LAYOUT
21-084-M-011_A	RACC PLANTROOM GENERAL ARRANGEMENT