HAGEN Aqualab

USERS MANUAL

April, 2004

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The following document is aimed at introducing users, potential users and informed parties to the scope and features available in the Hagen Aqualab.

INTRODUCTION

The Hagen Aqualab was built in 1995 under a joint initiative between the University of Guelph, several industry donors and an NSERC major installation grant (Tanks and recirculation equipment; environmental chambers and rooms). Facilities built under this initial phase included all of the central facilities (hot and cold glycol systems, regenerative air, water supply and treatment, computer control system, dry lab, freezer, access control, backup generator, high and low pressure steam). This phase took up three quarters of the available space inside Aqualab. The remaining one quarter of the space (phase 2) was left completely unfinished until May 2001 when a CFI/OIT funding initiative (Enhancing Fish Performance: From Genes to Populations) in February 2000 provided the monies to begin construction to finish Aqualab. Phase 2 was turned over to the University in May 2002 and setup of the various systems commenced. Aqualab was initially approved for use in January 1996 when the first research project began.

The Hagen Aqualab is a technologically advanced aquatic research facility. This facility is operated primarily by the Department of Integrative Biology of the University of Guelph. The Aqualab utilizes recirculation systems to maintain water quality and is a state of the art research facility that is designed with flexibility in mind. The systems where designed to accommodate research projects of moderate size, this facility was not designed for large scale production experiments. The facility uses up to 90% re-circulated water in the experimental rooms and 95% re-circulated water in the general holding room. Aqualab was designed for a wide variety of aquatic related activities such as embryology, physiology, behaviour, toxicology, parasitology, disease and genetics.

Mandate

To facilitate research on a wide variety of aquatic organisms, such as microorganisms, animals and plants, living in marine, brackish or fresh water habitats from arctic, temperate or tropical climes.

To foster the training of undergraduate and graduate students in advanced research techniques.

To encourage interaction and collaboration among universities, government and the private sector.

The Hagen Aqualab consists of a variety of research rooms with integrated recirculation systems that include computer controlled pumps, a filtration system (sand, screen, gravel bed or combination), UV sterilization and temperature control.
Systems include:

- Three research rooms with integrated recirculation system and a single operating water temperature.
- One environmental chamber with integrated recirculation system and a single operating water temperature.

- Five research rooms with integrated recirculation systems and three operating water temperatures.
- One environmental chamber with integrated recirculation system, three operating temperatures and a serial dilutor, designed for toxicological research.
- One isolation room set up for experiments designed to study diseases in fish. This room is the only room in the facility that has a flow through system. The room was designed to be a Level 2 containment for fish.
- One general holding room with integrated recirculation system for twenty five 2 m^3 tanks.
- Four environmental chambers 20 m^2.
- Seven environmental chambers 9 m^2.
- Twelve ECARS (Environmentally Controlled Aquatic Recirculating Systems). These systems are environmental chambers for water.

Aqualab has a decentralized computer control system that controls, monitors and alarms functions within the facility. Features include data logging, monitoring and alarming of all sensors (temperature, flow, water level, photoperiod, O_2, pH, etc), control of devices that enable air and water flow (recirculated and make-up), photoperiod, temperature control (both air and water). Photoperiod can be controlled on an daily basis to emulate sunrise and sunset for any global position.

All rooms are supplied with untreated well water. This facility is salt water capable with two research rooms dedicated to marine holding and research.

To date, research focuses primarily on salmonid fish. However, there are holding rooms devoted to turtle, amphibian and tropical fish research as well. The Aqualab has also provided space for research on aquatic plants.

ADMINISTRATION

The facility is administered by the Aqualab Management Committee. This committee is comprised of the Aqualab Manager, Director, Assistant Manager and the Aqualab Vet.

STAFF

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ADMISSION REQUIREMENTS

Project Approval: Application for the use of these facilities must be made to the Aqualab Management Committee. Space request forms may be obtained from the Facility Manager. Signed and completed forms must be submitted to the Manager who will forward them to the committee. Project approval must come from the committee.

Animal Utilization Protocol numbers must be submitted with the application for space. No animals will be permitted into the facility without a valid AUP number.

Animal Utilization Protocols (AUP): The local animal care committee is responsible for providing AUP numbers. Submission of the latest AUP form is necessary. When calculating the number of animals required please take into account the number of years the project will run, numbers on the AUP are not an annual figure, but rather the total number required for the project.

All animals brought into the facility must be reported to the Aqualab office. Please complete an **Animal Acquisition/Transfer Form** prior to bringing animals through the

door, or providing or acquiring animals from another researcher. These forms can be found in the hall outside the office door.

Records of animal utilization and mortality must be kept. Please keep your **Animal Utilization Records** and **Animal Mortality Sheets** current. These sheets can also be found in the hall outside the Aqualab office.

Standard Operating Procedures (SOP's): Standard operating procedures have been written for all animals currently held within Aqualab. Users must follow these procedures. If there is no SOP for the animal or procedure you are using you will be asked to write one. **Once an SOP is in place it must be followed**. Modifications to SOP's are possible, please consult with the Aqualab Manager.

Collection Permits: Animals collected from the field must be accompanied by a field collection permit from the appropriate Provincial or Federal Ministry. A copy of this permit must be submitted along with the AUP and Space Request Form prior to bringing animals through the door.

DESCRIPTION OF ANIMAL HOLDING ROOMS

Room 150:

This aquatic research room is setup to house a swim flume.

Room: The walls are epoxy coated concrete block and the floor is a specially hardened concrete to prevent water penetration. There is a grate covered trench located along the center of the room. The drain line for the tanks is located within this trench, as is a drain to the sanitary sewer.

Aeration: Low pressure air for tank aeration is supplied through black ABS pipe that circles the room. Air is supplied from three 1 hp Gast regenerative air blowers located in room 174.

Power: This room has five 115 V single phase and two 250 V 3 phase electrical circuits. There are two duplex receptacles per 115 V circuit. Two receptacles on the east wall and two receptacles on the west wall are controlled by the Argus™ system. Each receptacle is ground fault protected. A circuit breaker panel is located on the south wall in the room, near the door. Please do not open this panel without proper authorization.

If power is lost to a receptacle, check the buttons located in the middle. If one is sticking out, press it back in to reset the power. If power is lost again,

Lights: Lighting in this room is provided by weatherproof incandescent fixtures. This room has a fully programmable photoperiod (i.e., the photoperiod can be programmed to emulate that found at any latitude in the world or any artificial photoperiod that the researcher requires). At “dawn” the incandescent bulbs slowly ramp up in intensity, and at “dusk” they slowly dim. The time required to ramp to full intensity and the final intensity of the lights is programmable. Each room is equipped with a photosensor to monitor light operation. The **Photoperiod Alarm** is set to activate if the lights do not turn on or off as the program requires. For after hours monitoring, the lights can be turned on manually from a timer switch located in the hall. The lights can also be set to manual from the Argus panel or the control computer. An alarm situation will occur if the lights are left on manual for too long.

Recirculation system: Located on the east wall are three pipes, these pipes supply the room with recirculated water of three different temperatures. The recirculation system can be found in room 161 and is composed of a 600 V March pump, a gravel bed filter, and

three Armstrong plate heat exchangers. The system is controlled by Argus™. To understand more of the function of this system see the section on room 161.

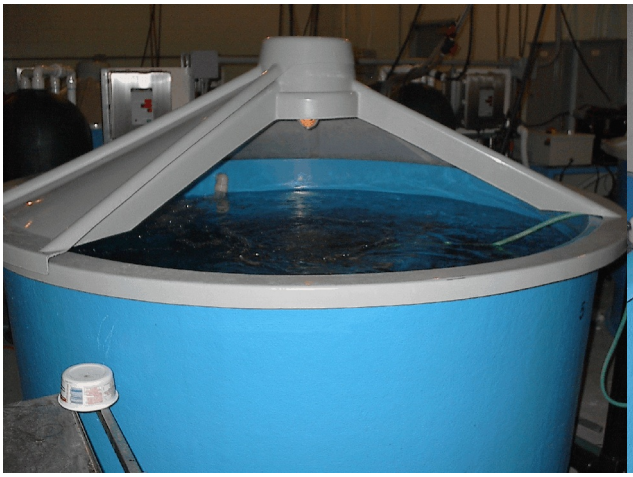
Control System: Argus™ controls and monitors the pump, the make-up water supply, the water temperature, the water level in the reservoir, the room's photoperiod and four receptacles located on the east and west walls of the room.

> **Flow**: The system has three paddlewheel flow sensors, one on each water supply line, that are monitored and alarmed. The pump has a temperature sensor located on the output to monitor and protect from overheating caused be cavitation.
> **Make-up water**: A paddlewheel flow sensor is integral to the make-up water system. An Ultrasonic level sensor is used to maintain and monitor water level in the sump pit.
> **Water Level in Sump**: The water level in the sump pit is monitored by an ultrasonic level sensor. This sensor is set to alarm if the water level drops within the sump pit past a preset level. This will also cause the recirculation pump to shut down triggering a flow alarm.
> **Water Temperature**: Each heat exchanger has a temperature sensor used to control, monitor and alarm water temperature.
> **Photoperiod**: A photosensor is located within the room to monitor light operation.

To understand more of the function of each system see the section on room 161.

Room 151: ECARS Room

ECARS is an acronym for Environmentally Controlled Aquatic Recirculating System. Each system is made up of a double drain tank with an external standpipe, a pump, a bubble washed bead filter, a UV sterilizer and a temperature controller. These systems were designed in Aqualab for small system setups. Each system is computer controlled. There are twelve units in this room. Access to tanks 1-6 is through the door 151a, for tanks 7-12 through door 151b.



Tank: The tanks used for these systems are six feet in diameter with double drains and two inches of insulation on the sides and bottom. Each tank is supplied with a photolid complete with a photoperiod controlled light and a sliding door. The tank has a reservoir in the centre below the airstone, due to the flow dynamics of the tank excess food and faeces are drawn into this reservoir and concentrated. The reservoir is part of the external standpipe/drain system for the tank. The standpipe is a loop with a valved bypass at the base. This valve needs to be opened daily to expel the waste built up in the reservoir. Opening this valve will also drain the tank.

Please do not drain the tank at the end of an experiment without consulting Aqualab staff. The temperature controller and the pump must be shutoff prior to draining the tank otherwise damage to these pieces of equipment can occur.

Filter: The filter supplied with the system is a bubble washed bead filter. Due to the flow dynamics of the tank this filter acts as a biofilter. Water for recirculation is drawn from the small peripheral drain.

UV Sterilization: The UV sterilizer located on the system is a single bulb Aqualogic

sterilizer provided by Trojan Industries. It is located between the bubble bead filter and the temperature controller.

Temperature control: Temperature control is achieved in much the same way as it is accomplished in an environmental chamber. These custom made controllers (Constant Temperature Control) are composed of a refrigeration compressor, a hot gas bypass valve, a heat exchanger and a computer interface. The units run continuously and temperature control is maintained by modulation of the hot gas bypass valve and monitored by a thermistor mounted in the outflow of the heat exchanger.

Makeup water: Raw water is added to the tank's recirculation system on a regular basis. The volume added is determined by the user, the Argus™ system opens and closes the make-up water solenoid valve (a pulse). The number of pulses per day is determined by the volume to be added per day and the volume of water that passes the paddlewheel flow sensor in 1 minute. The make-up water system is composed of a paddlewheel flow sensor and a solenoid valve on a ½" PVC supply line. Water is fed directly from Aqualab's pre-filtration system into the tank's recirculation return line. Water is replaced by overflowing an external standpipe. Tank volume can be changed up to two times daily.

Control System: Argus™ controls and monitors the pump, the make-up water supply, the water temperature, the tank's photoperiod and two receptacles located on the walls of room 151.

Flow: The system has a paddlewheel flow sensor on the recirculation return line, that is monitored and alarmed. The pump has a temperature sensor located on the output to monitor and protect it from overheating caused be cavitation.

Make-up water: A paddlewheel flow sensor is integral to the make-up water system.

Water Temperature: The heat exchanger has a temperature sensor used to control, monitor and alarm water temperature.

Alarms: There are a number of parameters within the ECARS that can be alarmed. These are primarily recirculation flow and temperature deviation:

No Flow Alarm

Temperature Deviation Alarm

Pump Overheating Alarm

There is also a **Temperature Control Override** for the system (both electronic and manual). If the water temperature rises above a preset point or drops below another preset point, the control system will cut all power to the controller. Immediately the system will go into the highest alarm state and activate the **Control Override Alarm,** an audible alarm will sound and the auto dialer will be activated to notify personnel of the problem. Power will be restored when water temperature returns to normal or by the Facility Manager. Operating in conjunction with the electronic control overrides are manual temperature controllers. These manual controllers also act to cut power to the ECAR System during times of temperature extreme. There is also a **Low Air Pressure Alarm** on the regenerative air system.

The manual controls need to be reset after environmental conditions are changed usually at the beginning of new experiments.

ECARS Room:

Lights: Lighting in this room is provided by weatherproof incandescent fixtures. This room has a fully programmable photoperiod (i.e., the photoperiod can be programmed to emulate that found at any latitude in the world or any artificial photoperiod that the researcher requires). At “dawn” the incandescent bulbs slowly ramp up in intensity, and at “dusk” they slowly dim. The time required to ramp to full intensity and the final intensity of the lights is programmable. The room is equipped with a photosensor to monitor light operation. The **Photoperiod Alarm** is set to activate if the lights do not turn on or off as the program requires. For after hours monitoring, the lights can be turned on manually from a timer switch located in the hall. The lights can also be set to manual from the Argus panel or the control computer. An alarm situation will occur if the lights are left on manual for too long.

Power: **115V single phase**: The ECARS pumps and interface panels are powered from a single split duplex receptacle mounted in the walls or from 4 ceiling drops. Each receptacle is fed two circuits that are controlled by 115V 15 Amp relays (relays are found in three boxes mounted on the north wall and labeled **ARGUS**). Each box controls 8 circuits or 4 ECARS. The relays are controlled by the Argus™ system. Each receptacle is ground fault protected in the breaker panel. The circuit breaker panels are located on the north wall in the. ECARS 1-6 are fed from the east panel and 7-12 are fed from the west panel closest to door 151B. Please do not open this panel without proper authorization. **250V three phase**: The ECARS temperature controllers are powered by twelve 250V three phase power cord drops. The circuit breakers for these feeds can be found in the panels on the north wall between the doors. ECARS 1-6 are fed from the east panel and 7-12 are fed from the west panel closest to door 151B.

Room 152:

This aquatic research room is setup to house 8 six foot diameter tanks.

Room: The walls are epoxy coated concrete block and the floor is a specially hardened concrete to prevent water penetration. There is a grate covered trench located along the center of the room. The drain line for the tanks is located within this trench, as is a drain to the sanitary sewer.

Aeration: Low pressure air for tank aeration is supplied through black ABS pipe that circles the room. Air is supplied from three 1 hp Gast regenerative air blowers located in room 174.

Power: This room has five 115 V, two 250 V 3 phase electrical circuits. There are two duplex

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receptacles per 115 V circuit. Two receptacles on the east wall and two receptacles on the west wall are controlled by the Argus™ system. Each receptacle is ground fault protected. A circuit breaker panel is located on the south wall in the room, near the door. Please do not open this panel without proper authorization.

Lights: Lighting in this room is provided by weatherproof incandescent fixtures. This room has a fully programmable photoperiod (i.e., the photoperiod can be programmed to emulate that found at any latitude in the world or any artificial photoperiod that the researcher requires). At "dawn" the incandescent bulbs slowly ramp up in intensity, and at "dusk" they slowly dim. The time required to ramp to full intensity and the final intensity of the lights is programmable. Each room is equipped with a photosensor to monitor light operation. The **Photoperiod Alarm** is set to activate if the lights do not turn on or off as the program requires. For after hours monitoring, the lights can be turned on manually from a timer switch located in the hall. The lights can also be set to manual from the Argus panel or the control computer. An alarm situation will occur if the lights are left on manual for too long.

Recirculation system: Located on the east wall are three pipes, these pipes supply the room with recirculated water of three different temperatures. The recirculation system can be found in room 161 and is composed of a 600V March pump, a PRA rotating screen filter, a gravel bed filter, a Trojan 2 bulb UV sterilizer and three Armstrong plate heat exchangers. The system is controlled by Argus™. To understand more of the function of this system see the section on room 161.

Control System: Argus™ controls and monitors the pump, the make-up water supply, the water temperature, the room's photoperiod and four receptacles located on the east and west walls of the room.

Flow: The system has three paddlewheel flow sensors, one on each water supply line, that are monitored and alarmed. The pump has a temperature sensor located on the output to monitor and protect from overheating caused be cavitation.

Make-up water: A paddlewheel flow sensor is integral to the make-up water system. An Ultrasonic level sensor is used to maintain and monitor water level in the sump pit.

Water Level in Sump: The water level in the sump pit is monitored by an ultrasonic level sensor. This sensor is set to alarm if the water level drops within the sump pit past a preset level. This will also cause the recirculation pump to shut down triggering a flow alarm.

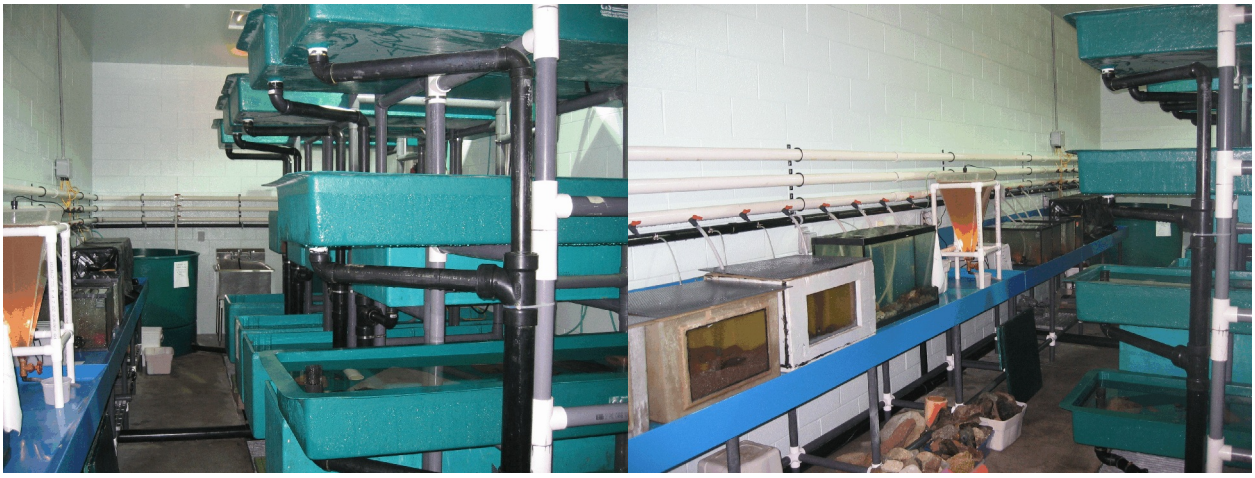
Water Temperature: Each heat exchanger has a temperature sensor used to control, monitor and alarm water temperature.

Photoperiod: A photosensor is located within the room to monitor light operation.

To understand more of the function of each system see the section on room 161.

Room 154: Undergraduate Marine Teaching Lab

This room is setup to house the undergraduate teaching collection of marine fish and invertebrates.



Room: The walls are epoxy coated concrete block and the floor is a specially hardened concrete to prevent water penetration. There is a grate covered trench located along the center of the room. The drain line for the tanks is located within this trench, as is a drain to the sanitary sewer.

Tanks: There are seven 2.25 m long trays, four 1.5 m long tanks and four 2 m long tanks. These tanks are arranged into five banks. One bank is composed of 4 trays while the other four banks have one of each size tank (2.25 m tray on top, 1.5 m tank in the middle and the 2 m tank on the bottom). Each tank or tray is sullied with an internal standpipe. The room also has three 1.2 m diameter tanks complete with internal standpipes.

This room also has two twelve foot long wet tables that can be used to set aquaria on for small experiments. System water and low pressure air are available for the aquaria on these tables.

Biofiltration: The biofiltration for this room is accomplished in the gravel bed located in the sump pit in room 161. New biofilters need time to grow bacterial cultures. *Nitrosomonas* sp. grow first, converting ammonia to nitrite. There is a lag time before *Nitrobacter* sp. start to grow. It is during the time that *Nitrobacter* sp. is becoming established that elevated levels of nitrite could become dangerous to fish. *Nitrobacter* sp. converts nitrite to nitrate a much less toxic form of organic nitrogen.

Aeration: Low pressure air for tank aeration is supplied through the black ABS pipe that circles the room. Air is supplied from three 1 hp Gast regenerative air blowers located in room 174.

Power: This room has five 115 V, two 250 V 3 phase electrical circuits. There are two duplex receptacles per 115 V circuit. Two receptacles on the east wall and two receptacles on the west wall are controlled by the Argus™ system. Each receptacle is ground fault protected. A circuit breaker panel is located on the south wall in the room, near the door. Please do not open this panel without proper authorization.

If power is lost to a receptacle, check the buttons located in the middle. If one is sticking out, press it back in to reset the power. If power is lost again,

Lights: Lighting in this room is provided by weatherproof incandescent fixtures. This room has a fully programmable photoperiod (i.e., the photoperiod can be programmed to emulate that found at any latitude in the world or any artificial photoperiod that the researcher requires). At "dawn" the incandescent bulbs slowly ramp up in intensity, and at "dusk" they slowly dim. The time required to ramp to full intensity and the final intensity of the lights is programmable. Each room is equipped with a photosensor to monitor light operation. The **Photoperiod Alarm** is set to activate if the lights do not turn on or off as the program requires. For after hours monitoring, the lights can be turned on manually from a timer switch located in the hall. The lights can also be set to manual from the Argus panel or the control computer. An alarm situation will occur if the lights are left on manual for too long.

There are also 3 growth lights suspended from the ceiling over the top trays. These lights are also photoperiod controlled and turn on and off, after and before the light ramping sequence.

Recirculation System: Located on the east wall are three pipes, these pipes supply the room with recirculated water of three different temperatures. The recirculation system can be found in room 161 and is composed of a 600V March pump, a gravel bed filter, a Trojan 2 bulb UV sterilizer and three Armstrong plate heat exchangers. The system is controlled by Argus™. To understand more of the function of this system see the section on Recirculation System for Room 161.

Water is not added automatically to this system, if water is lost Aqualab personnel must be notified.

Control System: Argus™ controls and monitors the pump, the make-up water supply, the water temperature, the room's photoperiod and four receptacles located on the east and west walls of the room.

Flow: The system has three paddlewheel flow sensors, one on each water supply line, that are monitored and alarmed. The pump has a temperature sensor located on the output to monitor and protect from overheating caused

be cavitation.

Make-up water: A paddlewheel flow sensor is integral to the make-up water system. An ultrasonic level sensor is used to monitor water level in the sump pit. An alarm will sound immediately if the paddle wheel flow sensor on this system becomes active.

Water Level in Sump: The water level in the sump pit is monitored by an ultrasonic level sensor. This sensor is set to alarm if the water level drops within the sump pit past a preset level. This will also cause the recirculation pump to shut down triggering a flow alarm.

Water Temperature: Each heat exchanger has a temperature sensor used to control, monitor and alarm water temperature.

Photoperiod: A photosensor is located within the room to monitor light operation.

This room has 4 controlled receptacles that can be used to program on/off function for variety of equipment. Currently two of these circuits are in use to control the overhead growth lights. The room also has installed in it a set of controlled extension cords, these cords are located on the west wall over the wet bench to provide the same on/off programmability as the wall receptacles. Also located within this box is wiring to provide sensor input for student experiments.

To understand more of the function of each system see the section on room 161.

Room 155: Disease Research Room

Unlike every other room in this facility this room is designed as a flow-through system. This is due to the nature of fish disease research. The room has several design features that make it unique from the other rooms.

Animal Holding Room

Room: The walls are epoxy coated concrete block and the floor is a specially hardened concrete to prevent water penetration. There is a grate covered trench located along the center of the room. The trench drains into a large underground sump pit that is covered with several FRP panels.

Located on the north wall of the room is a hands free sink. There is also a footbath integrated into the floor in front of the door. A removable stainless steel rail is mounted into the floor between the footbath and the room. Upon entering the animal holding potion of the room you must walk through the footbath to the hands-free sink to wash your hands. Both the drains for the sink and the footbath are connected to the sump pit.

Located on the south wall is a cold water/steam unit for cleaning tanks.

Sump: located along the east wall and below the floor is a sump pit

Aeration: Low pressure air for tank aeration is supplied through black ABS pipe that circles the room. Air is supplied from three 1hp Gast regenerative air blowers located in room 174.

Power: This room has five 115 V, two 250 V 3 phase electrical circuits. There are two duplex receptacles per 115 V circuit. One receptacle on the east wall and one receptacle on the west wall is controlled by the Argus™ system. Each receptacle is ground fault protected. A circuit breaker panel is located on the north wall in the anteroom, near the door. Please do not open this panel without proper authorization.

If power is lost to a receptacle, check the buttons located in the middle. If one is sticking out, press it back in to reset the power. If power is lost again,

Lights: Lighting in this room is provided by weatherproof incandescent fixtures. This room has a fully programmable photoperiod (i.e., the photoperiod can be programmed to emulate that found at any latitude in the world or any artificial photoperiod that the researcher requires). At “dawn” the incandescent bulbs slowly ramp up in intensity, and at “dusk” they slowly dim. The time required to ramp to full intensity and the final intensity of the lights is programmable. The Photoperiod Alarm is set to activate if the lights do not

turn on or off as the program requires. The lights can be turned on manually from the Argus™ panel located in the hall. An alarm situation will occur if the lights are left on manual for too long.

Ventilation: This room has a separate ventilation system to the rest of the facility. Recirculated air is supplied to the room from the building HVAC system, however the room is supplied with its own exhaust fan. This creates a negative pressure within the room causing air to be drawn in. The negative pressure prevents possibly contaminated air from leaving the confines of the room.

Anteroom:

Water Supply: This room is supplied with well water fed directly from Aqualab's pre-filtration system. Flow into the room is monitored by a paddlewheel flow sensor. When this sensor stops it initiates a control sequence that causes the domestic water backup supply line to open. The domestic water supply passes through a carbon filter to remove contaminants (chlorine and copper) from the water before it enters the tanks in the room. When well water flow is restored it initiates a control sequence to return water flow to the well water supply to the fish tanks. Domestic water supply will be an alarm condition.

UV Sterilization: This room is supplied with a one bulb Trojan Aqualogic UV sterilizer located on the north wall in the anteroom.

Water Temperature Control: Water temperature is controlled and monitored by the Argus™ system and consists of two plate heat exchangers supplied with hot and cold glycol. Water temperature is monitored going in and out of the exchangers by thermistors located in the pipes. These thermistors are set to activate an alarm (Water Temperature Deviation Alarm) if the water temperature deviates from the target temperature by a preset margin.

The computer control system regulates the position of two two-position three-way actuated valves to provide either hot or cold glycol. Actuated modulating valves regulate the amount of glycol supplied to each heat exchanger to maintain the target water temperatures. The range of water temperatures in this room is approximately 8°C - 25°C.

Room 156: Toxicology Research Room

This unique aquatic research room is set up inside an environmental chamber. The room itself is a stainless steel-lined Constant Temperature environmental chamber with air temperature control ranging between 5°C-30°C. This air temperature can be alarmed to ±1°C.

Animal Holding Room

Room: This room is a 40 m² environmental chamber. The walls, ceiling and fan units are stainless steel. The floor is a special hardened concrete to prevent water penetration. There is a grate covered trench located along the center of the room. The drain line for the tanks is located within this trench, as is a drain to the sanitary sewer.

The door for animal holding room and the anteroom has a covered window built into it to allow inspection of the room without entry. The door covering the window should remain closed at all times while not in use. There are no handles located in the anteroom.

To exit the animal holding room push on the left side of the door until it opens.

There are no catches to hold the door closed, only a mechanical door closure. There is provision to lock the door. If the door were to be locked while someone was still in the room, a release mechanism is located on the wall inside the room beside the door. Spin the knob until it comes completely off and push on the left side of the door until it opens.

Temperature control: Air temperature in the animal holding portion of the room ranges from 5°C - 25°C and is controlled by the Argus™ system. Temperatures are fully programable, the air temperature could follow a diurnal pattern, rising and dropping with the photoperiod. Temperature is monitored by a thermistor located within the room. The Air Temperature Deviation Alarm can be set to activate with as little as ± 1°C change.

Tanks:

Biofiltration: The biofiltration for this room is accomplished in the gravel bed located in the anteroom. New biofilters need time to grow bacterial cultures. *Nitrosomonas* sp. grows first, converting ammonia to nitrite. There is a lag time before *Nitrobacter* sp. starts to grow. It is during the time that *Nitrobacter* sp. is becoming established that elevated levels of nitrite could become dangerous to fish. *Nitrobacter* sp. converts nitrite to nitrate a much less toxic form of organic nitrogen.

Aeration: Low pressure air for tank aeration is supplied through black ABS pipe that circles the room. Air is supplied from three 1 hp Gast regenerative air blowers located in room 174.

Power: This room has five 115 V, two 250 V 3 phase electrical circuits. There are two duplex receptacles per 115 V circuit. One receptacle on the east wall and one receptacle on the west wall is controlled by the Argus™ system. Each receptacle is ground fault protected. A circuit breaker panel is located on the south wall in the anteroom, near the door. Please do not open this panel without proper authorization.

If power is lost to a receptacle, check the buttons located in the middle. If one is sticking out, press it back in to reset the power. If power is lost again,

Lights: This room has a combination of fluorescent and incandescent lights in weatherproof fixtures. The room has a fully programmable photoperiod (i.e., the photoperiod can be programmed to emulate that found at any latitude in the world or any artificial photoperiod that the researcher requires). At “dawn” the incandescent bulbs slowly ramp up to full intensity, then the fluorescent lights turn on sequentially in three steps. At “dusk” the process reverses with the incandescent bulbs slowly ramping off at “sunset” Photoperiod is monitored by a light sensor located in each room. The Photoperiod Alarm is set to activate if the lights do not turn on or off as the program requires. The lights can be turned on manually from the Argus™ panel located in the hall outside Room 181. An alarm situation will occur if the lights are left on too long.

Alarms: There are a number of parameters within the room that can be alarmed. As previously mentioned, there is an alarm for photoperiod and air temperature deviation. There is also a **Control Override** for the chamber itself. If the air temperature rises above 28°C or drops below 15°C, the control system will cut all power to the chamber. Immediately the system will go into the highest alarm state and activate the **Control Override Alarm,** an audible alarm and the auto dialer will be activated to notify personnel of the problem. Power will be restored when air temperature returns to normal or by the Facility Manager. Operating in conjunction with the control override are manual temperature controllers. These manual controllers also act to cut power to the chamber during times of temperature extreme. These manual controls need to be reset after environmental conditions are changed usually at the beginning of new experiments. There is also a **Low Air Pressure Alarm** on the regenerative air system.

Anteroom

Room: The water treatment system is located in the anteroom and consists of a 2m x 2m x 1.5 m deep sump, two pumps, a screen filter, a one bulb UV sterilizer and three plate heat exchangers. The effluent sump pit is also located here.

The anteroom is also supplied with a sink with hot and cold domestic water, and cupboards above and below the sink for limited storage of chemicals and equipment. A fire extinguisher is located beside the door. Windows in the doors provide visual access to

both rooms.

To exit the anteroom push on the left side of the door until it opens.

There are no catches to hold the door closed, only a mechanical door closure. There is provision to lock the door. If the door were to be locked while someone was still in the room, a release mechanism is located on the wall inside the room beside the door. Spin the knob until it comes completely off and push on the left side of the door until it opens.

Water Temperature Control: Water temperature is controlled and monitored by the Argus™ system and consists of two plate heat exchangers supplied with both hot and cold glycol. Water temperature is monitored going in and out of the exchanger by thermistors located in the pipes. These thermistors are set to activate an alarm (Water Temperature Deviation Alarm) if the water temperature deviates from the target temperature by a preset margin.

The computer control system regulates the position of 2 two-position three-way actuated valves to provide either hot or cold glycol. An actuated modulating valve regulates the amount of glycol supplied to the heat exchanger to maintain the target water temperature. The range of water temperatures in this room is approximately 3°C - 25°C. There is a small amount of flexibility in the system, which is governed by the flow rate of water through the exchanger and the surface area of the plates found in the exchanger itself.

Water Replacement: Water is added to the room's recirculation system on a regular basis. The volume added is controlled by the Argus™ system which in turn controls the make-up water solenoid valve. The make-up water system is composed of a paddlewheel flow sensor and a solenoid valve on a 1" PVC supply line. Water is fed directly from Aqualab's pre-filtration system into the room's sump pit.

Water Recirculation: Water is recirculated around the room from the sump pit to the tanks and back again. Two pumps, located beside the sump pit, draw water through the gravel bed filter located in the sump pit and pump it through the UV sterilizer, and the plate heat exchangers. After the water is filtered and the temperature is modified, it travels to the tanks in the animal holding room. Water overflows stand pipes located within each tank and returns via drain lines to the sump pit. Water is filtered through a rotating screen filter before it passes through the gravel bed filter. The drain lines are found in the trench. Each set of tanks has a set of blade valves to direct flow either into the trench (for cleaning and disinfection) or back to the sump (for recirculation).

Recirculation water flow is monitored by paddlewheel flow sensors which are set to activate an alarm when flow drops below a preset level (Low Flow Alarm). The preset level is dependent upon the minimum required water flow. A No Flow Alarm situation occurs when the pumps shut down.

System Water Volume: The water level in the sump pit is monitored by an ultrasonic level sensor. When the water level drops below a preset point the make-up water solenoid valve opens. Water is added until the sump is once again full. If the water level drops below a preset level (setpoint 1) an alarm is activated (Low Water Level Alarm) and the make-up water solenoid opens. If the water level continues to drop past another prest level (setpoint 2), the pumps will be turned off by the control system, to protect them from overheating and draining the sump pit. This will activate another alarm (No Flow Alarm). When the water level rises above the preset point (setpoint 2) the control system will reactivate the pumps, thereby restoring flow. With the resumption of flow the No Flow Alarm will be deactivated. When the water level rises above first preset point (setpoint 1) the Low Water Level Alarm will be deactivated.

Effluent Water Sump Pit: Effluent from the serial dilutor is collected in this pit. The level of water in this pit is monitored by an ultrasonic level sensor. This sensor controls a submersible pump that pumps water through a charcoal filter before it is directed to the sanitary sewer.

Room 160: General Holding Room

General holding as the name implies holds a variety of species in insulated 1.8 m diameter fiberglass tanks. Each tank has an approximate holding volume of 2 m^3. There are currently 25 of these tanks, twelve 0.6 m diameter tanks and one Heath rack for incubating salmonid eggs.

Room: The walls are epoxy coated concrete block and the floor is a specially hardened concrete to prevent water penetration. There are grate covered trenches located between the tanks. The drain lines for the tanks are located within these trenches, as is a drain to the sanitary sewer.

Air temperature in this room is monitored, but is not under the Argus™ system's control.

Tanks: The 1.8 m tanks are equipped with dual internal stand pipes. The outer standpipe sits higher than the water level in the tank. Holes have been drilled through the bottom of this pipe to effect a self cleaning action for the bottom of the tank. Water is drawn through these holes and up over the inner standpipe. The inner pipe must still be briefly removed either every day or every few days depending upon internal load of fish, to clear waste build-up.

The 0.6 m tanks have a cone shaped bottom, a perforated PVC screen is placed over this cone to prevent small fish from going down the drain. The tanks are designed to self clean. Waste drops through the PVC and is drawn down into the drain line. The cone shape acts to keep waste from settling in the tank. These tanks are also equipped with an external standpipe. The inner standpipe for these tanks must also be removed briefly either every day or every few days depending upon internal load of fish, to clear waste build-up.

Biofiltration: This room is provided with biofilters. The biofilters are located between the inflow lines and the 1.8m tanks.

They are made of green ribbed PVC pipe with a perforated PVC screen on the bottom. Number ½ and 2 plastic Tri-packs™ fill the pipe. New biofilters need time to grow bacterial cultures. *Nitrosomonas* sp. grows first, converting ammonia to nitrite. There is a lag time before *Nitrobacter* sp. starts to grow. It is during the time that *Nitrobacter* sp. is becoming established that elevated levels of nitrite could

become dangerous to fish. *Nitrobacter* sp. converts nitrite to nitrate a much less toxic form of organic nitrogen.

Biofilters should not be allowed to dry out. This is particularly important in marine systems; dry-out will result in sterilization of the biofilter.

Aeration: Low pressure air for tank aeration is supplied through black ABS pipe that circles the room. Air is supplied from three 1 hp Gast regenerative air blowers located in room 174. Each tank is supplied with two 12" x 1.5" x 1.5" air stones.

Power: This room has only two 115 V and two 220 V electrical circuits. They are located around the perimeter of the room. Each circuit has a duplex ground fault receptacle. A circuit breaker panel is located on the wall in the main hallway. Please do not open this panel without proper authorization.

If power is lost to a receptacle, check the buttons located in the middle. If one is sticking out, press it back in to reset the power. If power is lost again,

Lights: Lighting in this room is provided by weatherproof incandescent fixtures. This room has a fully programmable photoperiod (i.e., the photoperiod can be programmed to emulate that found at any latitude in the world or any artificial photoperiod that the researcher requires). At “dawn” the incandescent bulbs slowly ramp up in intensity, and at “dusk” they slowly dim. The time required to ramp to full intensity and the final intensity of the lights is programmable. The **Photoperiod Alarm** is set to activate if the lights do not turn on or off as the program requires. The lights can be turned on manually from two timed switches located on the wall near the door to the room. An alarm situation will occur if the lights are left on too long. The current photoperiod for this room is 12 hours (lights on at 7:00 AM and off at 7:00 PM)

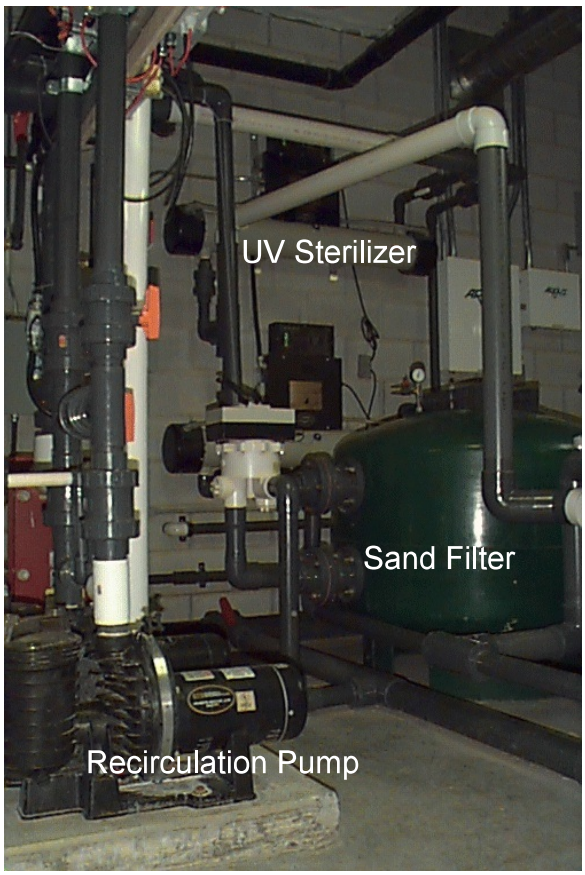
Filtration and Temperature Control located in Room 174

Water Temperature Control: Water temperature is controlled and monitored by the Argus™ system and consists of one plate heat exchanger supplied with cold glycol. Water temperature is monitored going in and out of the exchanger by thermistors located in the pipes. These thermistors are set to activate an alarm (**Water Temperature Deviation Alarm**) if the water temperature deviates from the target temperature by a preset margin.

The computer control system regulates the position of an actuated modulating valve to modify the amount of glycol supplied to the heat exchanger. This acts to maintain the target water temperature. The water temperature in this room is held at 10°C.

Water Replacement: Water is added to the room’s recirculation system on a regular

basis. The volume added is controlled by the Argus™ system which in turn controls the make-up water solenoid valve. The make-up water system is composed of a paddlewheel flow sensor and a solenoid valve on a 1" PVC supply line . Water is fed directly from Aqualab's pre-filtration system into the room's sump pit. 75,000 L of water are added in pulses of one minute duration 540 times a day. The number of pulses per day is determined by the volume of water that passes the paddlewheel flow sensor in one minute.



Water Recirculation: Water is recirculated around the room from the sump pit to the tanks and back again. Two 3 hp pumps, are used to pump water through two sand filters, a charcoal filter, two four bulb UV sterilizers, and the plate heat exchanger. After the water is filtered and the temperature is modified, it travels to the tanks in room 160. Water overflows stand pipes located either within the tank or beside it and returns via drain lines to the sump pit. The drain lines are found in the trench. Each 1.8 m tank or each set of four 0.6 m tanks has a set of blade valves to direct flow either into the trench (for cleaning and disinfection) or back to the sump (for recirculation).

Recirculation water flow is monitored by a paddle wheel flow sensor which is set to activate an alarm when flow drops below a preset level (**Low Flow Alarm**). The preset level is dependent upon the minimum required water flow.

System Water Volume: The water level in the sump pit is monitored by an ultrasonic level sensor. When the water level drops below a preset point the make-up water solenoid valve opens. Water is added until the sump is once again full. If the water level drops below 90 cm in depth an alarm is activated (**Low Water Level Alarm**) and the make-up water solenoid opens. If the water level drops past 60 cm, the pumps will be turned off by the control system, to protect them from burnout. This will activate another alarm (Low Flow Alarm). When the water level rises above 60 cm the control system will reactivate the pumps, thereby restoring flow. When the water level rises above 90 cm the Low Water Level Alarm will be deactivated, and when the water rises to 130 cm the make-up water solenoid will go back into water replacement mode.

Room 160a: The Richard and Jean Ivey Foundation Environmental Chamber

Located in the General Holding Room, this chamber has an area of 9 m². High intensity lights, temperature and humidity are controlled by the computer system.

The door has a covered window built into it to allow inspection of the room without entry. The door covering the window should remain closed at all times while not in use. There is no handle located on the inside of the door.

To exit the room push on the left side of the door until it opens.

There are no catches to hold the door closed, only a mechanical door closure. There is provision to lock the door. If the door were to be locked while someone was still in the room, a release mechanism is located on the wall inside the room beside the door. Turn the handle to the right and push on the left side of the door until it opens.

Lights: Lighting is provided by a fluorescent lighting canopy with eighteen bulbs

configured into six stages of lighting and two incandescent lights in weatherproof fixtures. This room has a fully programmable photoperiod (i.e., the photoperiod can be programmed to emulate that found at any latitude in the world or any artificial photoperiod that the researcher requires). At “dawn” the incandescent bulbs slowly ramp up to full intensity, then the fluorescent lights turn on sequentially in up to six steps if necessary. At “dusk” the process reverses with the incandescent bulbs slowly ramping off at “sunset” The time required to ramp to full intensity and the final intensity of the lights is programmable. The **Photoperiod Alarm** is set to activate if the lights do not turn on or off as the program requires.

Temperature control: Air temperature for this room ranges from 5°C - 25°C and is controlled by the Argus™ system. Temperature is fully programable. Temperature is monitored by a thermistor located within the room. The **Air Temperature Deviation Alarm** can be set to activate with as little as ± 1°C change.

Humidity Control: Room 160 a has two jets to add a fine mist of water to the room. Humidity is additive only and fine control is not possible at this time.

Power: This room has four 115 V electrical circuits. They are located around the perimeter of the room. Each circuit is protected by a duplex ground fault receptacle. A circuit breaker panel is located on the wall outside the chamber. Please do not open this panel without proper authorization.

If power is lost to a receptacle, check the buttons located in the middle. If one is sticking out, press it back in to reset the power. If power is lost again,

Water: Raw water is supplied to this room. A 1" water line can be located in the south east corner of the room. A floor drain was added to this room to provide drainage. The drain is not “trapped” and connected to the floor drains for rooms 160b and c. these drains empty into the trench drain in room 160.

Aeration: Low pressure air is supplied through PVC pipes along each side wall. At the current time there are 24 outlets for air, however, more can be added as the need presents itself.

Alarms: There are a number of parameters within the room that can be alarmed. As previously mentioned, there is an alarm for photoperiod and air temperature deviation. There is also a **Control Override** for the chamber itself. If the air temperature rises above 28°C or drops below 15°C, the control system will cut all power to the chamber. Immediately the system will go into the highest alarm state and activate the **Control Override Alarm,** an audible alarm and the auto dialer will be activated to notify personnel of the problem. Power will be restored when air temperature returns to normal or by the Facility Manager. Operating in conjunction with the control override are manual

temperature controllers. These manual controllers also act to cut power to the chamber during times of temperature extreme. These manual controls need to be reset after environmental conditions are changed usually at the beginning of new experiments. There is also a **Low Air Pressure Alarm** on the regenerative air system.

Rooms 160b - g:

Located in the General Holding Room, these chambers have an area of 9 m². High intensity lights, temperature and humidity are controlled by the computer system.

The door has a covered window built into it to allow inspection of the room without entry. The door covering the window should remain closed at all times while not in use. There is no handle located on the inside of the door.

To exit the room push on the left side of the door until it opens.

There are no catches to hold the door closed, only a mechanical door closure. There is provision to lock the door. If the door were to be locked while someone was still in the room, a release mechanism is located on the wall inside the room beside the door. Turn the handle to the right and push on the left side of the door until it opens.

Lights: Lighting is provided by a fluorescent lighting canopy with eighteen bulbs configured into six stages of lighting and two incandescent lights in weatherproof fixtures. The fluorescent light banks have been removed from rooms 160 c and e. These rooms have fully programmable photoperiods (i.e., the photoperiod can be programmed to emulate that found at any latitude in the world or any artificial photoperiod that the researcher requires). At “dawn” the incandescent bulbs slowly ramp up to full intensity, then the fluorescent lights turn on sequentially in up to six steps if necessary. At “dusk” the process reverses with the incandescent bulbs slowly ramping off at “sunset” The time required to ramp to full intensity and the final intensity of the lights is programmable. The **Photoperiod Alarm** is set to activate if the lights do not turn on or off as the program requires.

Temperature control: Air temperature for this room ranges from -5°C - 30°C and is controlled by the Argus™ system. Temperature is fully programable. Temperature is monitored by a thermistor located within the room. The **Air Temperature Deviation Alarm** can be set to activate with as little as ± 1°C change.

Humidity Control: These rooms have two jets to add a fine mist of water to the room. Humidity is additive only and fine control is not possible at this time. The humidity control is not available at this time.

Power: Each room has four 115V electrical circuits each circuit is controlled by the Argus system. They are located around the perimeter of the room. Each circuit is protected by duplex ground fault receptacles. A circuit breaker panel is located on the wall outside the chamber. Please do not open this panel without proper authorization.

If power is lost to a receptacle, check the buttons located in the middle. If one is sticking out, press it back in to reset the power. If power is lost again,

Water: There is a raw water supply to each room. A 1" water line can be located in the south east corner of each room. A floor drain was added to this room to provide drainage. The drain is not “trapped” and connected to the floor drains for at least one other rooms. These drains empty into the trench drain in room 160.

Aeration: Low pressure air is supplied through PVC pipes along each side wall. At the current time there are 24 outlets for air, however, more can be added as the need presents itself.

Alarms: There are a number of parameters within each room that can be alarmed. As previously mentioned, there is an alarm for photoperiod and air temperature deviation. There is also a **Control Override** for each chamber. If the air temperature rises above 28°C or drops below 15°C, the control system will cut all power to the chamber. Immediately the system will go into the highest alarm state and activate the **Control Override Alarm,** an audible alarm and the auto dialer will be activated to notify personnel of the problem. Power will be restored when air temperature returns to normal or by the Facility Manager. Operating in conjunction with the control override are manual

temperature controllers. These manual controllers also act to cut power to the chamber during times of temperature extreme. These manual controls need to be reset after environmental conditions are changed usually at the beginning of new experiments. There is also a **Low Air Pressure Alarm** on the regenerative air system.

Room 161: Recirculation System Mechanical Room

Access to this room is restricted to authorized personnel only

Room: The water treatment systems for rooms 150, 152 and 154 are located in this room. Each system consists of a 2m x 2m x 2 m deep sump with a gravel bed filter, a screen filter, one pump, one two bulb UV sterilizer and three plate heat exchangers.

A fire extinguisher is located beside the door.

Water Temperature Control: Water temperature is controlled and monitored by the Argus™ system and consists of three plate heat exchangers supplied with hot and/or cold glycol. Water temperature is monitored going in and out of the exchangers by thermistors located in the pipes. These thermistors are set to activate an alarm (Water Temperature Deviation Alarm) if the water temperature deviates from the target temperature by a preset margin.

The computer control system regulates the position of 2 two-position three-way actuated valves to provide either hot or cold glycol. Actuated modulating valves regulate the amount of glycol supplied to each heat exchanger to maintain the target water temperatures. The range of water temperatures in this room is approximately 4°C - 25°C. The range of temperatures between heat exchangers for this room is restricted to the ΔT for the exchanger. The exchanger must be able to change the water from the mixed water temperature found within the sump to the set point in a single pass. Therefore the system can only handle temperature differences between heat exchangers of 3 - 4°C (e.g. 8°C, 12°C, 16°C). There is a small amount of flexibility in the system, which is governed by the flow rate of water through the exchanger and the surface area of the plates found in the exchanger itself.

Water Recirculation: Water is recirculated around the room from the sump pit to the tanks and back again. Water enters the room from the tanks and passes though a rotating screen filter before dropping into the sump pit. The pump, located beside the heat exchangers, draws water down through a gravel bed filter, which acts as a biofilter, then pumps it through the UV sterilizer and the plate heat exchangers. After the water is filtered and the temperature is modified, it travels back to the tanks in the animal holding room. Water overflows stand pipes located either within the tank or beside it and returns via drain lines to the sump pit. The drain lines are found in the trench. Each large tank or each set of smaller tanks or trays has a set of blade valves to direct flow either into the trench (for cleaning and disinfection) or back to the sump (for recirculation).

Recirculation water flow is monitored by paddlewheel flow sensors, one on each water line, which are set to activate an alarm when flow drops below a preset level (**Low Flow**

Alarm). The preset level is dependent upon the minimum required water flow.

A magnetic drive pump is used to recirculate water around the system. The pump is controlled by the Argus system. A temperature sensor located in the outflow pipe directly above the pipe monitors the water temperature of the pump. If the pump starts to cavitate or the supply valves in the room are all shut off, the water in the pump will heat up. The temperature in the pump can rise to dangerous levels causing catastrophic meltdowns of the PVC pipe and internal parts of the pump. To prevent this happening the pump will shut down when the water temperature rises above 20°C. Increased water temperature will also set off the **Pump Overheating Alarm**. The pumps are also controlled by the ultrasonic level sensor. If the water level in the sump drops below a preset point the pump will shutdown (See section on System Water Volume).

Biofiltration: Each system within this room is provided with biofilteration. The biofilter is located in the gravel bed filter in the sump pit. New biofilters need time to grow bacterial cultures. *Nitrosomonas* sp. grows first, converting ammonia to nitrite. There is a lag time before *Nitrobacter* sp. starts to grow. It is during the time that *Nitrobacter* sp. is becoming established that elevated levels of nitrite could become dangerous to fish. *Nitrobacter* sp. converts nitrite to nitrate a much less toxic form of organic nitrogen.

System Water Volume: The water level in each sump pit is monitored by an ultrasonic level sensor. When the water level drops below a preset point the make-up water solenoid valve opens. Water is added until the sump is once again full. If the water level drops below a preset level (setpoint 1) an alarm is activated (**Low Water Level Alarm**) and the make-up water solenoid opens. If the water level continues to drop past another prest level (setpoint 2), the pump will be turned off by the control system, to protect it from overheating or draining the sump pit. This will activate another alarm (**No Flow Alarm**). When the water level rises above the preset point (setpoint 2) the control system will reactivate the pump, thereby restoring flow. With the resumption of flow the No Flow Alarm will be deactivated. When the water level rises above the first preset point (setpoint 1) the Low Water Level Alarm will be deactivated.

Water Replacement: Raw water (untreated water) is added to each room's recirculation system on a regular basis. The make-up water system is composed of a paddlewheel flow sensor and a solenoid valve on a 1" PVC supply line . The volume added is controlled by the Argus™ system which in turn controls the make-up water solenoid valve. Raw water is fed directly from Aqualab's pre-filtration system into the room's sump pit. The number of pulses per day is determined by the volume of water that passes the paddlewheel flow sensor in one minute. Volume to be added is fully programmable and ranges from a few litres to tens of thousands of litres per day. **Salt Water:** Salt water is made up in room 174 in the marine water mixing tanks and is pumped to the pit. Salt water is added manually to the pit for room 154. **Raw water flow into the pit for room 154 is alarmed immediately.**

Rooms 163 and 165:

Room 163

Room 165

These two rooms are located on the main hallway of the Aqualab. They are 20 m² environmental chambers. The rooms are functionally the same. Both have a supply of low and high pressure air, well water, domestic cold water (for cleaning), and salt water. The sink in each room has a supply of domestic hot and cold water, and deionized water.

The walls, ceiling and fan units are stainless steel. The floor is a special hardened concrete to prevent water penetration. Water drains into a trench in the center of the room. This trench must be cleaned at the same time the room is cleaned.

The door for each room has a covered window built into it to allow inspection of the room without entry. The door covering the window should remain closed at all times while not in use. There is no handle located on the inside of the door.

To exit the room push on the right side of the door until it opens.

There are no catches to hold the door closed, only a mechanical door closure. There is provision to lock the door. If the door were to be locked while someone was still in the room, a release mechanism is located on the wall inside the room beside the door. Spin the knob until it comes completely off and push on the right side of the door until it opens.

Temperature control: Air temperature in these rooms ranges from 5°C - 25°C and is controlled by the Argus™ system. Temperatures are fully programable, the air temperature in room 163 follows a diurnal pattern, rising and dropping with the photoperiod. Temperature is monitored by a thermistor located within the room. The Air Temperature Deviation Alarm can be set to activate with as little as ± 1°C change.

Power: Each room has eight 115 V electrical circuits. These are located around the perimeter of the room. Each has a duplex ground fault receptacle. A circuit breaker panel is located on the wall outside the chamber. Please do not open this panel without proper authorization. Room 163 now has 6 of the 8 circuits located around the room controlled by the Argus system.

If power is lost to a receptacle, check the buttons located in the middle. If one is sticking out, press it back in to reset the power. If power is lost again,

Lights: The fluorescent light fixtures are weatherproof. The rooms have fully programmable photoperiods (i.e., the photoperiod can be programmed to emulate that found at any latitude in the world or any artificial photoperiod that the researcher requires). The fluorescent lights turn on and off sequentially at dawn and dusk in three steps. Photoperiod is monitored by light sensors located in each room. The Photoperiod Alarm is set to activate if the lights do not turn on or off as the program requires. The lights can be turned on manually from the Argus™ panel located in the hall outside Room 181. An alarm situation will occur if the lights are left on too long.

Room 180: Falconbridge Thermal Effects Research Room

This aquatic research room has three 1.8 m diameter fiberglass tanks and eight 0.6 m fiberglass diameter tanks located within the holding area. This room is designed to facilitate the study of aquatic thermal effects by providing up to three separate water temperatures.

Animal Holding Room

Room: The walls are epoxy coated concrete block and the floor is a specially hardened concrete to prevent water penetration. There is a grate covered trench located along the center of the room. The drain line for the tanks is located within this trench, as is a drain to the sanitary sewer.

Air temperature in this room is monitored, but is not under the Argus™ system's control.

Tanks: The 1.8 m tanks are equipped with dual stand pipes. The external standpipe sits higher than the water level in the tank. Holes have been drilled through the bottom of this pipe to effect a self cleaning action for the bottom of the tank. Water is drawn through these holes and up over the internal standpipe. The internal pipe must still be briefly removed either every day or every few days depending upon internal load of fish, to clear waste build-up.

The 0.6 m tanks have a cone shaped bottom, a perforated PVC screen is placed over this cone. The tanks are designed to self clean. Waste drops through the PVC and is drawn down into the drain line. The cone shape acts to keep the wastes from settling in the tank. These tanks are also equipped with an external standpipe. The standpipe for these tanks must also be removed briefly either every day or every few days depending upon internal load of fish, to clear waste build-up.

Biofiltration: This room is provided with biofilters. The biofilters are located between the inflow lines and the 1.8m tanks. They are made of green ribbed PVC pipe with a perforated PVC screen on the bottom. Number ½ and 2 plastic Tri-packs™ fill the pipe. New biofilters need time to grow bacterial cultures. *Nitrosomonas* sp. grows first, converting ammonia to nitrite. There is a lag time before *Nitrobacter* sp. starts to grow. It is during the time that *Nitrobacter* sp. is becoming established that elevated levels of nitrite could become dangerous to fish. *Nitrobacter* sp. converts nitrite to nitrate a much less toxic form of organic nitrogen.

Biofilters should not be allowed to dry out. This is particularly important in marine systems, dry-out will result in sterilization of the biofilter.
Aeration: Low pressure air for tank aeration is supplied through black ABS pipe that

circles the room. Air is supplied from three 1 hp Gast regenerative air blowers located in room 174.

Power: Each room has five 115 V electrical circuits. These are located around the perimeter of the room. Each has a duplex ground fault receptacle. A circuit breaker panel is located on the south wall inside the anteroom. Please do not open this panel without proper authorization.

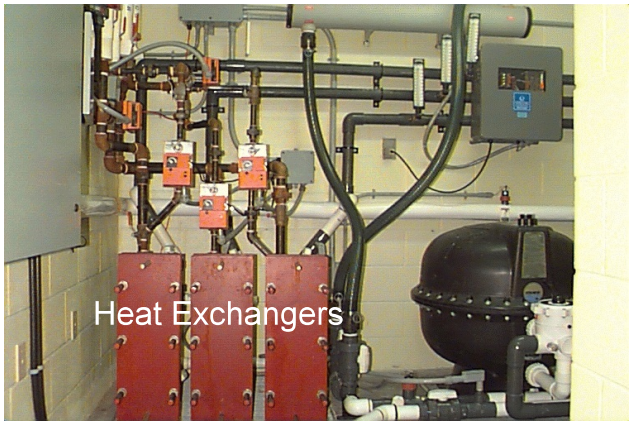
If power is lost to a receptacle, check the buttons located in the middle. If one is sticking out, press it back in to reset the power. If power is lost again,

Lights: Lighting in this room is provided by weatherproof incandescent fixtures. This room has a fully programmable photoperiod (i.e., the photoperiod can be programmed to emulate that found at any latitude in the world or any artificial photoperiod that the researcher requires). At "dawn" the incandescent bulbs slowly ramp up in intensity, and at "dusk" they slowly dim. The time required to ramp to full intensity and the final intensity of the lights is programmable. The Photoperiod Alarm is set to activate if the lights do not turn on or off as the program requires. The lights can be turned on manually from the Argus™ panel located in the hall. An alarm situation will occur if the lights are left on manual for too long.

Anteroom

Room: The water treatment system is located in the anteroom and consists of a 2 m x 2 m x 1.5 m deep sump, two pumps, a sand filter with automatic backwash valve, a charcoal filter with manual backwash valve, a four bulb UV sterilizer and three plate heat exchangers. Water supplied to each of the 1.8 m tanks in this room first passes over a biofilter to convert ammonia to nitrate.

The anteroom is also supplied with a sink with hot and cold domestic water, and cupboards above and below the sink for limited storage of chemicals and equipment. A fire extinguisher is located beside the door. Windows in the doors provide visual access to both rooms, the animal holding room door has a small door over the window.


Heat Exchangers

Water Temperature Control: Water temperature is controlled and monitored by the Argus™ system and consists of three plate heat exchangers supplied with hot or cold glycol. Water temperature is monitored going in and out of the exchangers by thermistors located in the pipes. These thermistors are set to activate an alarm (Water Temperature Deviation Alarm) if the

water temperature deviates from the target temperature by a preset margin.

The computer control system regulates the position of two two-position three-way actuated valves to provide either hot or cold glycol. Actuated modulating valves regulate the amount of glycol supplied to each heat exchanger to maintain the target water temperatures. The range of water temperatures in this room is approximately 4°C - 25°C. The range of temperatures between heat exchangers for this room is restricted to the ΔT for the exchanger. The exchanger must be able to change the water from the mixed water temperature found within the sump to the set point in a single pass. Therefore the system can only handle temperature differences between heat exchangers of 3 - 4°C (e.g. 10°C, 13°C, 16°C). There is a small amount of flexibility in the system, which is governed by the flow rate of water through the exchanger and the surface area of the plates found in the exchanger itself. The Aqualab has spare plates to increase the capacity of the exchangers if the need arises.

Water Replacement: Water is added to the room's recirculation system on a regular basis. The volume added is controlled by the Argus™ system which in turn controls the make-up water solenoid valve. The make-up water system is composed of a paddlewheel flow sensor and a solenoid valve on a 1" PVC supply line . Water is fed directly from Aqualab's pre-filtration system into the room's sump pit. 30,000 L of water are added in pulses of one minute duration 216 times a day. The number of pulses per day is determined by the volume of water that passes the paddlewheel flow sensor in one minute.

Water Recirculation: Water is recirculated around the room from the sump pit to the tanks and back again. Two pumps, located in the pump pit, pump water through the sand filter, the charcoal filter, the UV sterilizer, and the plate heat exchangers. After the water is filtered and the temperature is modified, it travels to the tanks in the animal holding room. Water overflows stand pipes located either within the tank or beside it and returns via drain lines to the sump pit. The drain lines are found in the trench. Each 1.8 m tank or each set of four 0.6 m tanks has a set of blade valves to direct flow either into the trench (for cleaning and disinfection) or back to the sump (for recirculation).

Recirculation water flow is monitored by a paddle wheel flow sensor which is set to activate an alarm when flow drops below a preset level (Low Flow Alarm). The preset level is dependent upon the minimum required water flow.

Pump Pit: A float switch is located near the bottom of the pump pit to indicate water accumulation in this pit. This switch will activate an alarm as soon as it is triggered (Flooded Pump Pit Alarm). This alarm's purpose is to protect the pumps from immersion in the event of a leak into the pump pit.

System Water Volume: The water level in the sump pit is monitored by an air pressure level sensor. When the water level drops below a preset point the make-up water solenoid valve opens. Water is added until the sump is once again full. If the water level drops below 70 cm in depth an alarm is activated (Low Water Level Alarm) and the make-up water solenoid opens. If the water level drops past 30 cm, the pumps will be turned off by the control system, to protect them from burnout. This will activate another alarm (Low Flow Alarm). When the water level rises above 30 cm the control system will reactivate the pumps, thereby restoring flow. When the water level rises above 70 cm the Low Water Level Alarm will be deactivated.

Rooms 181 and 181A: Reptile and Amphibian Rooms

Room: These two rooms are located one behind the other. They are 20 m² environmental chambers. The rooms are functionally similar. Both have a supply of low and high pressure air, well water, domestic cold water (for cleaning). The sink in each room has a supply of domestic hot and cold water, and deionized water.

The walls, ceiling and fan units are stainless steel. The floor is a special hardened concrete to prevent water penetration. Water drains into a trench in the center of each room. This trench must be cleaned at the same time the room is cleaned.

The door for each room has a covered window built into it to allow inspection of the room without entry. The door covering the window should remain closed at all times while not in use. There is no handle located on the inside of the door.

To exit Room 181a push on the right side of the door until it opens.

To exit Room 181 push on the left side of the door until it opens.

There are no catches to hold the door closed, only a mechanical door closure. There is provision to lock the door. If the door were to be locked while someone was still in the room, a release mechanism is located on the wall inside the room beside the door. Spin the knob until it comes completely off and push on the left side (181) or right side (181a) of the door until it opens.

Temperature control: Air temperature in these rooms ranges from 5°C - 25°C and is controlled by the Argus™ system. Temperatures are fully programable, the air temperature in these rooms follows a diurnal pattern, rising and dropping with the photoperiod. Temperature is monitored by a thermistor located within the room. The Air Temperature Deviation Alarm can be set to activate with as little as ± 1°C change.

Humidity Control: Room 181a has two jets to add a fine mist of water to the room. Humidity is additive only and fine control is not possible at this time.

Power: Each room has eight 115 V electrical circuits. These are located around the perimeter of the room. Each has a duplex ground fault receptacle. A circuit breaker panel for each room is located on the wall outside the chamber. Please do not open this panel without proper authorization.

If power is lost to a receptacle, check the buttons located in the middle. If one is sticking out, press it back in to reset the power. If power is lost again,

Lights: These rooms have both fluorescent and incandescent lights in weatherproof fixtures. The rooms have fully programmable photoperiods (i.e., the photoperiod can be programmed to emulate that found at any latitude in the world or any artificial photoperiod that the researcher requires). At “dawn” the incandescent bulbs slowly ramp up to full intensity, then the fluorescent lights turn on sequentially in three steps. At “dusk” the process reverses with the incandescent bulbs slowly ramping off at “sunset”. Photoperiod is monitored by a light sensor located in each room. The Photoperiod Alarm is set to activate if the lights do not turn on or off as the program requires. The lights can be turned on manually from the Argus™ panel located in the hall outside Room 181. An alarm situation will occur if the lights are left on too long.

Room 182: Marine room

This room consists of two 2.1 m square fiberglass tank, four 1.2 m round tanks, three 0.6 m round tanks and six 2.1 m long trays. The water is salt and the photoperiod is an emulation of St Andrews NB.

Animal Holding Room

Room: The walls are epoxy coated concrete block and the floor is a specially hardened concrete to prevent water penetration. There is a grate covered trench located along the center of the room. The drain line for the tanks is located within this trench, as is a drain to the sanitary sewer.

Air temperature in this room is monitored, but is not under the Argus™ system's control.

Tanks: There are four 1.2 m tanks, equipped with dual stand pipes located in this room. The external standpipe sits higher than the water level in the tank. Holes have been drilled through the bottom of this pipe to effect a self cleaning action for the bottom of the tank. Water is drawn through these holes and up over the internal standpipe. The internal pipe must still be briefly removed either every day or every few days depending upon internal load of fish, to clear waste build-up.

This room also has two banks of 2.1 m long fiberglass trays. Each bank consists of three trays.

There are three 0.6 m tanks which have a cone shaped bottom, a perforated PVC screen is placed over this cone. The tanks are designed to self clean. Waste drops through the PVC holes and is drawn down into the drain line. The cone shape acts to keep the wastes from settling in the tank. These tanks are also equipped with an external standpipe. The standpipe for these tanks must also be removed briefly either every day or every few days depending upon internal load of fish, to clear waste build-up.

Aeration: Low pressure air for tank aeration is supplied through black ABS pipe that circles the room. Air is supplied from three 1 hp Gast regenerative air blowers located in room 174.

Power: Each room has five 115 V electrical circuits. These are located around the perimeter of the room. Each has a duplex ground fault receptacle. A circuit breaker panel is located on the south wall inside the anteroom. Please do not open this panel without proper authorization.

If power is lost to a receptacle, check the buttons located in the middle. If one is sticking out, press it back in to reset the power. If power is lost again,

Lights: Lighting in this room is provided by weatherproof incandescent fixtures. This room has a fully programmable photoperiod (i.e., the photoperiod can be programmed to emulate that found at any latitude in the world or any artificial photoperiod that the researcher requires). At “dawn” the incandescent bulbs slowly ramp up in intensity, and at “dusk” they slowly dim. The time required to ramp to full intensity and the final intensity of the lights is programmable. The Photoperiod Alarm is set to activate if the lights do not turn on or off as the program requires. The lights can be turned on manually from the Argus™ panel located in the hall. An alarm situation will occur if the lights are left on manual for too long.

Anteroom

Room: The water treatment system is located in the anteroom and consists of a 2 m x 2 m x 1.5 m deep sump with a gravel bed filter, two pumps, a sand filter with automatic backwash valve, a charcoal filter with manual backwash valve, a four bulb UV sterilizer and one plate heat exchanger.

The anteroom is also supplied with a sink with hot and cold domestic water, and cupboards above and below the sink for limited storage of chemicals and equipment. A fire extinguisher is located beside the door. Windows in the doors provide visual access to both rooms, the animal holding room door has a small door over the window.

Water Temperature Control: Water temperature is controlled and monitored by the Argus™ system and consists of one plate heat exchanger supplied with hot or cold glycol. Water temperature is monitored going in and out of the exchanger by thermistors located in the pipes. These thermistors are set to activate an alarm (Water Temperature Deviation Alarm) if the water temperature deviates from the target temperature by a preset margin.

The computer control system regulates the position of two two-position three-way actuated valves to provide either hot or cold glycol. An actuated modulating valve regulates the amount of glycol supplied to the heat exchanger to maintain the target water temperature. The range of water temperatures in this room is approximately 4°C - 25°C. There is a small amount of flexibility in the system, which is governed by the flow rate of water through the exchanger and the surface area of the plates found in the exchanger itself. The Aqualab has spare plates to increase the capacity of the exchanger if the need arises. Water temperature in this room is set for 10°C.

Water Replacement: Water is not added to this room’s recirculation system on a regular basis.

Water Recirculation: **The salt water in this room is on 100% recirculation**. Water is recirculated around the room from the sump pit to the tanks and back again. Two pumps, located in the pump pit, draw salt water through the gravel bed filter and pump it through the UV sterilizer, and the plate heat exchanger. After the water is filtered and the

temperature is modified, it travels to the tanks in the animal holding room. Water overflows stand pipes located either within the tank or beside it and returns via drain lines to the sump pit. The drain lines are found in the trench. Each tank or each set of tanks has two blade valves to direct flow either into the trench (for cleaning and disinfection) or back to the sump (for recirculation).

Recirculation water flow is monitored by a paddle wheel flow sensor which is set to activate an alarm when flow drops below a preset level (Low Flow Alarm). The preset level is dependent upon the minimum required water flow.

Foam Fractionation: Located on the return line into the sump pit and mounted inside the pit itself is a foam fractionation column. This column is constructed out of 8" PVC sewer pipe and is designed to remove proteins as well as fine particulate suspended material from the effluent water entering the pit.

Filtration and Biofiltration: The filtration and biofiltration in this room is accomplished in the gravel bed located in the sump pit. New biofilters need time to grow bacterial cultures. *Nitrosomonas* sp. grows first, converting ammonia to nitrite. There is a lag time before *Nitrobacter* sp. starts to grow. It is during the time that *Nitrobacter* sp. is becoming established that elevated levels of nitrite could become dangerous to fish. *Nitrobacter* sp. converts nitrite to nitrate a much less toxic form of organic nitrogen.

Pump Pit: A float switch is located near the bottom of the pump pit to indicate water accumulation in this pit. This switch will activate an alarm as soon as it is triggered (Flooded Pump Pit Alarm). This alarm's purpose is to protect the pumps from immersion in the event of a leak into the pump pit.

System Water Volume: The water level in the sump pit is monitored by an air pressure level sensor. If the water level drops below 70 cm in depth an alarm is activated (Low Water Level Alarm). If the water level drops past 30 cm, the pumps will be turned off by the control system, to protect them from burnout. This will activate another alarm (Low Flow Alarm). **Water is not added automatically to this system, if water is lost Aqualab personnel must be notified.**

Room 183: Icy Waters Early Rearing Room

This aquatic research room is set up inside an environmental chamber. The room itself is a stainless steel-lined Constant Temperature environmental chamber with air temperature control ranging between 5°C-30°C. This air temperature can be alarmed to ±1°C.

Animal Holding Room

Room: This room is a 40 m² environmental chamber. The walls, ceiling and fan units are stainless steel. The floor is a special hardened concrete to prevent water penetration. There is a grate covered trench located along the center of the room. The drain line for the tanks is located within this trench, as is a drain to the sanitary sewer.

The door for animal holding room and the anteroom has a covered window built into it to allow inspection of the room without entry. The door covering the window should remain closed at all times while not in use. There are no handles located in the anteroom.

To exit the animal holding room push on the left side of the door until it opens.

There are no catches to hold the door closed, only a mechanical door closure. There is provision to lock the door. If the door were to be locked while someone was still in the room, a release mechanism is located on the wall inside the room beside the door. Spin the knob until it comes completely off and push on the left side of the door until it opens.

Temperature control: Air temperature in the animal holding portion of the room ranges from 5°C - 25°C and is controlled by the Argus™ system. Temperatures are fully programable, the air temperature could follow a diurnal pattern, rising and dropping with the photoperiod. Temperature is monitored by a thermistor located within the room. The Air Temperature Deviation Alarm can be set to activate with as little as ± 1°C change.

Tanks: There are three 1.2 m tanks, equipped with dual internal stand pipes located in this room. The outer standpipe sits higher than the water level in the tank. Holes have been drilled through the bottom of this pipe to effect a self cleaning action for the bottom of the tank. Water is drawn through these holes and up over the inner standpipe. The inner pipe must still be briefly removed either every day or every few days depending upon internal load of fish, to clear waste build-up.

The nineteen 0.6 m tanks have cone shaped bottoms. A perforated PVC screen is placed over this cone to prevent fish from going down the drain. The tanks are designed to self clean. Waste drops through the PVC and is drawn down into the drain line. The cone shape acts to keep waste from settling in the tank. These tanks are also equipped with an external standpipe. The standpipe for these tanks must also be removed briefly either

every day or every few days depending upon internal load of fish, to clear waste build-up.

Biofiltration: This room is not provided with biofilters.

Aeration: Low pressure air for tank aeration is supplied through black ABS pipe that circles the room. Air is supplied from three 1 hp Gast regenerative air blowers located in room 174.

Power: This room has five 115 V electrical circuits. These are located around the perimeter of the room. Each has a duplex ground fault receptacle. A circuit breaker panel is located on the north wall inside the anteroom. Please do not open this panel without proper authorization.

If power is lost to a receptacle, check the buttons located in the middle. If one is sticking out, press it back in to reset the power. If power is lost again,

Lights: This room has a combination of fluorescent and incandescent lights in weatherproof fixtures. The room has a fully programmable photoperiod (i.e., the photoperiod can be programmed to emulate that found at any latitude in the world or any artificial photoperiod that the researcher requires). At “dawn” the incandescent bulbs slowly ramp up to full intensity, then the fluorescent lights turn on sequentially in three steps. At “dusk” the process reverses with the incandescent bulbs slowly ramping off at “sunset” Photoperiod is monitored by a light sensor located in each room. The Photoperiod Alarm is set to activate if the lights do not turn on or off as the program requires. The lights can be turned on manually from the Argus™ panel located in the hall outside Room 181. An alarm situation will occur if the lights are left on too long.

Anteroom

Room: The water treatment system is located in the anteroom and consists of a 2 m x 2 m x 1.5 m deep sump, two pumps, a sand filter with automatic backwash valve, a charcoal filter with manual backwash valve, a four bulb UV sterilizer and one plate heat exchanger.

The anteroom is also supplied with a sink with hot and cold domestic water, and cupboards above and below the sink for limited storage of chemicals and equipment. A fire extinguisher is located beside the door. Windows in the doors provide visual access to both rooms, the animal holding room door has a small door over the window.

To exit the anteroom push on the left side of the door until it opens.

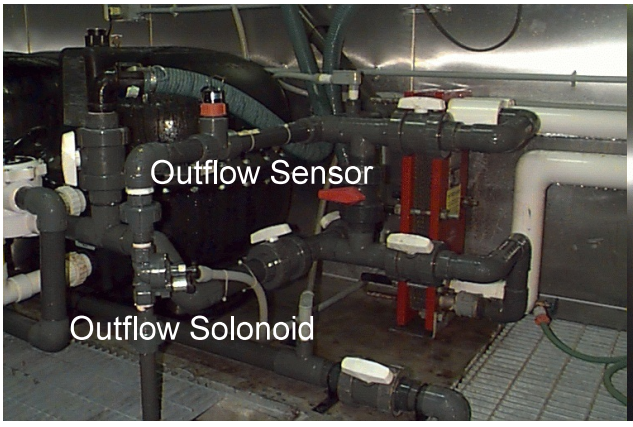
There are no catches to hold the door closed, only a mechanical door closure. There is provision to lock the door. If the door were to be locked while someone was still in the room, a release mechanism is located on the wall inside the room beside the door. Spin the knob until it comes completely off and push on the left side of the door until it opens.

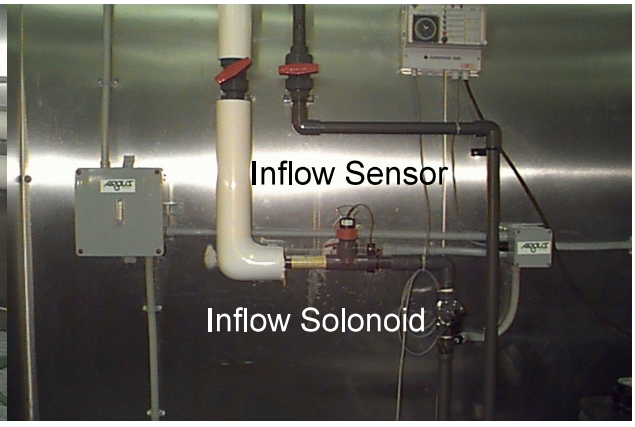
Water Temperature Control: Water temperature is controlled and monitored by the Argus™ system and consists of one plate heat exchanger supplied with hot or cold glycol. Water temperature is monitored going in and out of the exchanger by thermistors located in the pipes. These thermistors are set to activate an alarm (Water Temperature Deviation Alarm) if the water temperature deviates from the target temperature by a preset margin.

The computer control system regulates the position of two two-position three-way actuated valves to provide either hot or cold glycol. An actuated modulating valve regulates the amount of glycol supplied to the heat exchanger to maintain the target water temperature. The range of water temperatures in this room is approximately 3°C - 25°C. There is a small amount of flexibility in the system, which is governed by the flow rate of water through the exchanger and the surface area of the plates found in the exchanger itself.

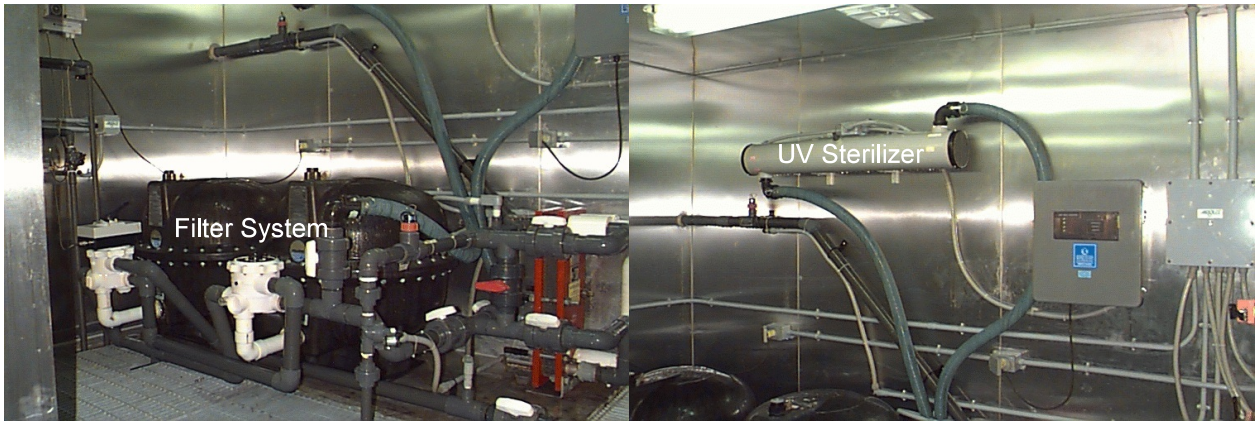
Water Replacement: Water is added to the room's recirculation system on a regular basis. The volume added is controlled by the Argus™ system which in turn controls the make-up water solenoid valve. The make-up water system is composed of a paddlewheel flow sensor and a solenoid valve on a 1" PVC supply line . Water is fed directly from Aqualab's pre-filtration system into the room's sump pit. Unlike the other rooms water is added to replace a specific volume of water that is wasted by the system. Water in this room never overflows the sump pit standpipe. This water leaves from a 1" line, controlled by the outflow solenoid, that is fed directly from the recirculation system after UV sterilization. 10,000 L of water is bled out in pulses of 30 sec duration 675 times a day. The number of pulses per day is determined by the volume of water that passes the outflow paddlewheel flow sensor in 30 seconds.

Water Recirculation: Water is recirculated around the room from the sump pit to the tanks and back again. Two pumps, located in the pump pit, pump water through the sand filter, the charcoal filter, the UV sterilizer, and the plate heat exchangers. After the water is filtered and the temperature is modified, it travels to the tanks in the animal holding room. Water overflows stand pipes located within each tank and returns via drain lines to the sump pit. The drain lines are found in the trench. Each set of trays has a set of blade valves to direct flow either into the trench





(for cleaning and disinfection) or back to the sump (for recirculation).
Recirculation water flow is monitored by a paddle wheel flow sensor which is set to activate an alarm when flow drops below a preset level (**Low Flow Alarm**). The preset level is dependent upon the minimum required water flow.



Pump Pit: A float switch is located near the bottom of the pump pit to indicate water accumulation in this pit. This switch will activate an alarm as soon as it is triggered (**Flooded Pump Pit Alarm**). This alarm's purpose is to protect the pumps from immersion in the event of a leak into the pump pit.

System Water Volume: The water level in the sump pit is monitored by an air pressure level sensor. When the water level drops below a preset point the make-up water solenoid valve opens. Water is added until the sump is once again full. If the water level drops below 70 cm in depth an alarm is activated (**Low Water Level Alarm**) and the make-up water solenoid opens. If the water level drops past 30 cm, the pumps will be turned off by the control system, to protect them from burnout. This will activate another alarm (**Low Flow Alarm**). When the water level rises above 30 cm the control system will reactivate the pumps, thereby restoring flow. When the water level rises above 70 cm the Low Water Level Alarm will be deactivated.

Room 184: Noranda Research Room

Animal Holding Room

Room: The walls are epoxy coated concrete block and the floor is a specially hardened concrete to prevent water penetration. There is a grate covered trench located along the center of the room. The drain line for the tanks is located within this trench, as is a drain to the sanitary sewer.

Air temperature in this room is monitored, but is not under the Argus™ system's control.

Tanks: There are sixteen 1.2 m long tanks arranged in racks of four tanks each, each tank has an internal standpipe. There are also six 1.5 m long tanks arranged in banks two tanks high, each with internal standpipes. Two of these tanks have double standpipes such that they can have the temperature modified external from the main recirculation system.

Aeration: Low pressure air for tank aeration is supplied through black ABS pipe that circles the room. Air is supplied from three 1 hp Gast regenerative air blowers located in room 174.

Power: Each room has eight 115 V electrical circuits. These are located around the perimeter of the room. Each has a duplex ground fault receptacle. A circuit breaker panel is located on the south wall inside the anteroom. Please do not open this panel without proper authorization.

If power is lost to a receptacle, check the buttons located in the middle. If one is sticking out, press it back in to reset the power. If power is lost again,

Lights: Lighting in this room is provided by weatherproof incandescent fixtures. This room has a fully programmable photoperiod (i.e., the photoperiod can be programmed to emulate that found at any latitude in the world or any artificial photoperiod that the researcher requires). At "dawn" the incandescent bulbs slowly ramp up in intensity, and at "dusk" they slowly dim. The time required to ramp to full intensity and the final intensity of the lights is programmable. The Photoperiod Alarm is set to activate if the lights do not turn on or off as the program requires. The lights can be turned on manually from the Argus™ panel located in the hall. An alarm situation will occur if the lights are left on manual for too long.

Anteroom

Room: The water treatment system is located in the anteroom and consists of a 2 m x 2 m x 1.5 m deep sump, two pumps, a four bulb UV sterilizer and one plate heat exchanger.

The anteroom is also supplied with a sink with hot and cold domestic water, and cupboards above and below the sink for limited storage of chemicals and equipment. A fire extinguisher is located beside the door. Windows in the doors provide visual access to both rooms, the animal holding room door has a small door over the window.

Biofiltration: The biofiltration in this room is accomplished in the gravel bed located in the sump pit. New biofilters need time to grow bacterial cultures. *Nitrosomonas* sp. grows first, converting ammonia to nitrite. There is a lag time before *Nitrobacter* sp. starts to grow. It is during the time that *Nitrobacter* sp. is becoming established that elevated levels of nitrite could become dangerous to fish. *Nitrobacter* sp. converts nitrite to nitrate a much less toxic form of organic nitrogen.

Water Temperature Control: Water temperature is controlled and monitored by the Argus™ system and consists of one plate heat exchanger supplied with hot or cold glycol. Water temperature is monitored going in and out of the exchanger by thermistors located in the pipes. These thermistors are set to activate an alarm (Water Temperature Deviation Alarm) if the water temperature deviates from the target temperature by a preset margin.

The computer control system regulates the position of two two-position three-way actuated valves to provide either hot or cold glycol. An actuated modulating valve regulates the amount of glycol supplied to the heat exchanger to maintain the target water temperature. The range of water temperatures in this room is approximately 4°C - 25°C. There is a small amount of flexibility in the system, which is governed by the flow rate of water through the exchanger and the surface area of the plates found in the exchanger itself. The Aqualab has spare plates to increase the capacity of the exchanger if the need arises. Water temperature in this room is set for 13°C.

Water Replacement: Water is added to the room's recirculation system on a regular basis. The volume added is controlled by the Argus™ system which in turn controls the make-up water solenoid valve. The make-up water system is composed of a paddlewheel flow sensor and a solenoid valve on a 1" PVC supply line . Water is fed directly from Aqualab's pre-filtration system into the room's sump pit. 50,000 L of water are added in pulses of one minute duration, 325 times a day. The number of pulses per day is determined by the volume of water that passes the paddlewheel flow sensor in one minute.

Water Recirculation: Water is recirculated around the room from the sump pit to the tanks and back again. Waste water enters the sump pit by first passing through a rotating screen filter. This filter removes the large particulate material (excess feed and faeces)from the water stream and directs it to the waste water sump pit in room 174. The water is then drawn through a gravel bed filter by the recirculation pumps, located in the pump pit. Water is then pumped through the UV sterilizers and the plate heat exchangers. After the water

is filtered, sterilized and the temperature modified, it travels to the tanks in the animal holding room. Water overflows stand pipes located either within the tank or beside it and returns via drain lines to the sump pit. The drain lines are found in the trench. Each 1.2 m tank or each set of four 0.6 m tanks has a set of blade valves to direct flow either into the trench (for cleaning and disinfection) or back to the sump (for recirculation).

Recirculation water flow is monitored by a paddle wheel flow sensor which is set to activate an alarm when flow drops below a preset level (Low Flow Alarm). The preset level is dependent upon the minimum required water flow.

Pump Pit: A float switch is located near the bottom of the pump pit to indicate water accumulation in this pit. This switch will activate an alarm as soon as it is triggered (Flooded Pump Pit Alarm). This alarm's purpose is to protect the pumps from immersion in the event of a leak into the pump pit.

System Water Volume: The water level in the sump pit is monitored by an air pressure level sensor. When the water level drops below a preset point the make-up water solenoid valve opens. Water is added until the sump is once again full. If the water level drops below 70 cm in depth an alarm is activated (Low Water Level Alarm) and the make-up water solenoid opens. If the water level drops past 30 cm, the pumps will be turned off by the control system, to protect them from burnout. This will activate another alarm (Low Flow Alarm). When the water level rises above 30 cm the control system will reactivate the pumps, thereby restoring flow. When the water level rises above 70 cm the Low Water Level Alarm will be deactivated.

Room 185: Freshwater Research Room

This aquatic research room has two 1.2 m diameter tanks and nineteen 0.6 m diameter tanks located within the holding area.

Animal Holding Room

Room: The walls are epoxy coated concrete block and the floor is a specially hardened concrete to prevent water penetration. There is a grate covered trench located along the center of the room. The drain line for the tanks is located within this trench, as is a drain to the sanitary sewer.

Air temperature in this room is monitored, but is not under the Argus™ system's control.

Tanks: There are two 1.2 m tanks, equipped with dual internal stand pipes located in this room. The outer standpipe sits higher than the water level in the tank. Holes have been drilled through the bottom of this pipe to effect a self cleaning action for the bottom of the tank. Water is drawn through these holes and up over the inner standpipe. The inner pipe must still be briefly removed either every day or every few days depending upon internal load of fish, to clear waste build-up.

The nineteen 0.6 m tanks have cone shaped bottoms. A perforated PVC screen is placed over this cone to prevent fish from going down the drain. The tanks are designed to self clean. Waste drops through the PVC and is drawn down into the drain line. The cone shape acts to keep waste from settling in the tank. These tanks are also equipped with an external standpipe. The standpipe for these tanks must also be removed briefly either every day or every few days depending upon internal load of fish, to clear waste build-up.

Aeration: Low pressure air for tank aeration is supplied through black ABS pipe that circles the room. Air is supplied from three 1 hp Gast regenerative air blowers located in room 174.

Power: Each room has eight 115 V electrical circuits. These are located around the perimeter of the room. Each has a duplex ground fault receptacle. A circuit breaker panel is located on the north wall inside the anteroom. Please do not open this panel without proper authorization.

If power is lost to a receptacle, check the buttons located in the middle. If one is sticking out, press it back in to reset the power. If power is lost again,

Lights: Lighting in this room is provided by weatherproof incandescent fixtures. This room has a fully programmable photoperiod (i.e., the photoperiod can be programmed to emulate that found at any latitude in the world or any artificial photoperiod that the researcher

requires). At “dawn” the incandescent bulbs slowly ramp up in intensity, and at “dusk” they slowly dim. The time required to ramp to full intensity and the final intensity of the lights is programmable. The Photoperiod Alarm is set to activate if the lights do not turn on or off as the program requires. The lights can be turned on manually from the Argus™ panel located in the hall. An alarm situation will occur if the lights are left on manual for too long.

Anteroom

Room: The water treatment system is located in the anteroom and consists of a 2 m x 2 m x 1.5 m deep sump with a gravel bed filter, two pumps, a gravel filter with manual backwash valve, a sand filter with automatic backwash valve, a pair of two bulb UV sterilizers and one plate heat exchanger. Water supplied to each of the 1.2 m tanks in this room first passes over a biofilter to convert ammonia to nitrate.

The anteroom is also supplied with a sink with hot and cold domestic water, and cupboards above and below the sink for limited storage of chemicals and equipment. A fire extinguisher is located beside the door. Windows in the doors provide visual access to both rooms, the animal holding room door has a small door over the window.

Water Temperature Control: Water temperature is controlled and monitored by the Argus™ system and consists of one plate heat exchanger supplied with hot or cold glycol. Water temperature is monitored going in and out of the exchanger by thermistors located in the pipes. These thermistors are set to activate an alarm (Water Temperature Deviation Alarm) if the water temperature deviates from the target temperature by a preset margin.

The computer control system regulates the position of two two-position three-way actuated valves to provide either hot or cold glycol. An actuated modulating valve regulates the amount of glycol supplied to the heat exchanger to maintain the target water temperature. The range of water temperatures in this room is approximately 4°C - 25°C. There is a small amount of flexibility in the system, which is governed by the flow rate of water through the exchanger and the surface area of the plates found in the exchanger itself. The Aqualab has spare plates to increase the capacity of the exchanger if the need arises. Water temperature in this room is set for 10°C.

Water Replacement: Water is added to the room’s recirculation system on a regular basis. The volume added is controlled by the Argus™ system which in turn controls the make-up water solenoid valve. The make-up water system is composed of a paddlewheel flow sensor and a solenoid valve on a 1" PVC supply line . Water is fed directly from Aqualab’s pre-filtration system into the room’s sump pit. 50,000 L of water are added in pulses of one minute duration, 325 times a day. The number of pulses per day is determined by the volume of water that passes the paddlewheel flow sensor in one minute.

Water Recirculation: Water is recirculated around the room from the sump pit to the tanks and back again. Waste water enters the sump pit by first passing through a rotating screen

filter. This filter removes the large particulate material (excess feed and faeces)from the water stream and directs it to the waste water sump pit in room 174. The water is then drawn through a gravel bed filter by the recirculation pumps, located in the pump pit. Water is then pumped through the UV sterilizers and the plate heat exchangers. After the water is filtered, sterilized and the temperature modified, it travels to the tanks in the animal holding room. Water overflows stand pipes located either within the tank or beside it and returns via drain lines to the sump pit. The drain lines are found in the trench. Each 1.2 m tank or each set of four 0.6 m tanks has a set of blade valves to direct flow either into the trench (for cleaning and disinfection) or back to the sump (for recirculation).

Recirculation water flow is monitored by a paddle wheel flow sensor which is set to activate an alarm when flow drops below a preset level (Low Flow Alarm). The preset level is dependent upon the minimum required water flow.

Biofiltration: The biofiltration in this room is accomplished in the gravel bed located in the sump pit. New biofilters need time to grow bacterial cultures. *Nitrosomonas* sp. grows first, converting ammonia to nitrite. There is a lag time before *Nitrobacter* sp. starts to grow. It is during the time that *Nitrobacter* sp. is becoming established that elevated levels of nitrite could become dangerous to fish. *Nitrobacter* sp. converts nitrite to nitrate a much less toxic form of organic nitrogen.

Biofilters should not be allowed to dry out. This is particularly important in marine systems, dry-out will result in sterilization of the biofilter.

Pump Pit: A float switch is located near the bottom of the pump pit to indicate water accumulation in this pit. This switch will activate an alarm as soon as it is triggered (Flooded Pump Pit Alarm). This alarm's purpose is to protect the pumps from immersion in the event of a leak into the pump pit.

System Water Volume: The water level in the sump pit is monitored by an air pressure level sensor. When the water level drops below a preset point the make-up water solenoid valve opens. Water is added until the sump is once again full. If the water level drops below 70 cm in depth an alarm is activated (Low Water Level Alarm) and the make-up water solenoid opens. If the water level drops past 30 cm, the pumps will be turned off by the control system, to protect them from burnout. This will activate another alarm (Low Flow Alarm). When the water level rises above 30 cm the control system will reactivate the pumps, thereby restoring flow. When the water level rises above 70 cm the Low Water Level Alarm will be deactivated.

Room 186: TransCanada PipeLines Thermal Effects Research Room

This aquatic research room has five 1.2 m diameter tanks and eighteen 0.6 m diameter tanks located within the holding area. The room is set up to provide up to three separate water temperature to facilitate the study of thermal effects.

Animal Holding Room

Room: The walls are epoxy coated concrete block and the floor is a specially hardened concrete to prevent water penetration. There is a grate covered trench located along the center of the room. The drain line for the tanks is located within this trench, as is a drain to the sanitary sewer.

Air temperature in this room is monitored, but is not under the Argus™ system's control.

Tanks: The 1.2 m tanks are equipped with dual internal stand pipes. The outer standpipe sits higher than the water level in the tank. Holes have been drilled through the bottom of this pipe to effect a self cleaning action for the bottom of the tank. Water is drawn through these holes and up over the inner standpipe. The inner pipe must still be briefly removed either every day or every few days depending upon internal load of fish, to clear waste build-up.

The 0.6 m tanks have a cone shaped bottom, a perforated PVC screen is placed over this cone to prevent fish from going down the drain. The tanks are designed to self clean. Waste drops through the PVC and is drawn down into the drain line. The cone shape acts to keep waste from settling in the tank. These tanks are also equipped with external stand pipes The inner standpipe for these tanks must also be removed briefly either every day or every few days depending upon internal load of fish, to clear waste build-up.

Aeration: Low pressure air for tank aeration is supplied through black ABS pipe that circles the room. Air is supplied from three 1 hp Gast regenerative air blowers located in room 174.

Power: Each room has eight 115 V electrical circuits. These are located around the perimeter of the room. Each has a duplex ground fault receptacle. A circuit breaker panel is located on the south wall inside the anteroom. Please do not open this panel without proper authorization.

If power is lost to a receptacle, check the buttons located in the middle. If one is sticking out, press it back in to reset the power. If power is lost again,

Lights: Lighting in this room is provided by weatherproof incandescent fixtures. This room has

a fully programmable photoperiod (i.e., the photoperiod can be programmed to emulate that found at any latitude in the world or any artificial photoperiod that the researcher requires). At “dawn” the incandescent bulbs slowly ramp up in intensity, and at “dusk” they slowly dim. The time required to ramp to full intensity and the final intensity of the lights is programmable. The Photoperiod Alarm is set to activate if the lights do not turn on or off as the program requires. The lights can be turned on manually from the Argus™ panel located in the hall. An alarm situation will occur if the lights are left on manual for too long.

Anteroom

Room: The water treatment system is located in the anteroom and consists of a PRA rotating screen filter, a 2 m x 2 m x 1.5 m deep sump complete with a gravel bed filter, two pumps, a pair of Trojan one bulb UV sterilizers and three plate heat exchangers.

The anteroom is also supplied with a sink with hot and cold domestic water, and cupboards above and below the sink for limited storage of chemicals and equipment. A fire extinguisher is located beside the door. Windows in the doors provide visual access to both rooms, the animal holding room door has a small door over the window.

Water Temperature Control: Water temperature is controlled and monitored by the Argus™ system and consists of three plate heat exchangers supplied with hot or cold glycol. Water temperature is monitored going in and out of the exchangers by thermistors located in the pipes. These thermistors are set to activate an alarm (Water Temperature Deviation Alarm) if the water temperature deviates from the target temperature by a preset margin.

The computer control system regulates the position of two two-position three-way actuated valves to provide either hot or cold glycol. Actuated modulating valves regulate the amount of glycol supplied to each heat exchanger to maintain the target water temperatures. The range of water temperatures in this room is approximately 4°C - 25°C. The range of temperatures between heat exchangers for this room is restricted to the ΔT for the exchanger. The exchanger must be able to change the water from the mixed water temperature found within the sump to the set point in a single pass. Therefore the system can only handle temperature differences between heat exchangers of 3 - 4°C (e.g. 10°C, 13°C, 16°C). There is a small amount of flexibility in the system, which is governed by the flow rate of water through the exchanger and the surface area of the plates found in the exchanger itself. The Aqualab has spare plates to increase the capacity of the exchangers if the need arises.

Water Replacement: Water is added to the room’s recirculation system on a regular basis. The volume added is controlled by the Argus™ system which in turn controls the make-up water solenoid valve. The make-up water system is composed of a paddlewheel flow sensor and a solenoid valve on a 1" PVC supply line . Water is fed directly from Aqualab’s pre-filtration system into the room’s sump pit. 60,000 L of water are added in

pulses of one minute duration 429 times a day. The number of pulses per day is determined by the volume of water that passes the paddlewheel flow sensor in one minute.

Water Recirculation: Water is recirculated around the room from the sump pit to the tanks and back again. Waste water enters the sump pit by first passing through a rotating screen filter. This filter removes the large particulate material (excess feed and faeces)from the water stream and directs it to the waste water sump pit in room 174. The water is then drawn through a gravel bed filter by the recirculation pumps, located in the pump pit. Water is then pumped through the UV sterilizers and the plate heat exchangers. After the water is filtered, sterilized and the temperature modified, it travels to the tanks in the animal holding room. Water overflows stand pipes located either within the tank or beside it and returns via drain lines to the sump pit. The drain lines are found in the trench. Each 1.2 m tank or each set of four 0.6 m tanks has a set of blade valves to direct flow either into the trench (for cleaning and disinfection) or back to the sump (for recirculation).

Recirculation water flow is monitored by a paddle wheel flow sensor which is set to activate an alarm when flow drops below a preset level (Low Flow Alarm). The preset level is dependent upon the minimum required water flow.

Biofiltration: The biofiltration in this room is accomplished in the gravel bed located in the sump pit. New biofilters need time to grow bacterial cultures. *Nitrosomonas* sp. grows first, converting ammonia to nitrite. There is a lag time before *Nitrobacter* sp. starts to grow. It is during the time that *Nitrobacter* sp. is becoming established that elevated levels of nitrite could become dangerous to fish. *Nitrobacter* sp. converts nitrite to nitrate a much less toxic form of organic nitrogen.

Biofilters should not be allowed to dry out. This is particularly important in marine systems, dry-out will result in sterilization of the biofilter.

Pump Pit: A float switch is located near the bottom of the pump pit to indicate water accumulation in this pit. This switch will activate an alarm as soon as it is triggered (Flooded Pump Pit Alarm). This alarm's purpose is to protect the pumps from immersion in the event of a leak into the pump pit.

System Water Volume: The water level in the sump pit is monitored by an air pressure level sensor. When the water level drops below a preset point the make-up water solenoid valve opens. Water is added until the sump is once again full. If the water level drops below 70 cm in depth an alarm is activated (Low Water Level Alarm) and the make-up water solenoid opens. If the water level drops past 30 cm, the pumps will be turned off by the control system, to protect them from burnout. This will activate another alarm (Low Flow Alarm). When the water level rises above 30 cm the control system will reactivate the pumps, thereby restoring flow. When the water level rises above 70 cm the Low Water Level Alarm will be deactivated.

DESCRIPTION OF CENTRAL FACILITIES

Room 136: Workshop

A machine shop is located within the building. **Access is restricted to authorized personnel only**. The shop has two lathes for machining metal or plastic, a milling machine, a table saw, two band saws, a drill press, a belt and disk sander, two chops saws, and a PVC and polypropylene welder. There are also a number of hand and power tools. This shop has the capability to fabricate uncommon parts required for the pursuit of science. If it can't be made in this shop it can be made in the Physics Workshop.

Room 139:

This room is currently being used for storage.

Room 166: Dry Lab

Room 166 is a dry lab for use by all Aqualab users. The lab has a fume hood, a still to produce distilled water, two sinks, a refrigerator, and bench and cupboard space. Access to this room is available from the Aqualab Manager.

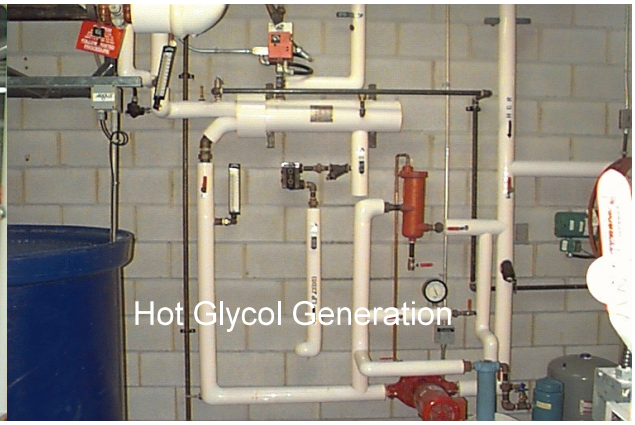
Room 174: Water Supply and Treatment Room

Pre-filtration: Three large aggregate filters complete with timer activated automatic backwash valves filter the incoming well water. The University provides this facility with untreated water drawn from three wells located on campus. While the water quality is exceptionally good it has a tendency to become dirty from the distribution network of pipes on a regular basis. In an effort to maintain the best water quality possible we pre-filter this water prior to piping it to each aquatic research room or ECAR system.

Waste water treatment: Waste water is returned from the research portions of the facility to a sump pit in this room. The water level is monitored by a Miltronics ultrasonic level sensor. This sensor controls two submersible Myers pumps, one is on normal power the other is on emergency power. Water levels in this pit are maintained and alarmed at preset levels. Water leaves the facility for the sanitary sewer after passing two six bulb UV sterilizers.

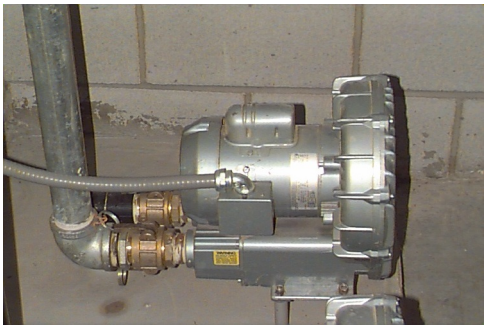
Cold Glycol Generation: Two Carrier™ refrigeration units are used to chill glycol for the plate heat exchangers found in each research room. These chillers are set up for lead /lag operation with one on emergency power while the other is on normal power. Glycol is currently chilled to -7.5°C. These chillers are alarmed by Argus™ but are controlled by their own internal system.

Cold Glycol Generation



Hot Glycol Generation

Hot Glycol Generation: There are two shell and tube steam heat exchangers used to heat glycol for the same plate heat exchangers. Glycol is currently warmed to 60°C. This system is under the control of the Argus™ system.



Regenerative air blowers: Three one HP Gast regenerative air blowers are used to provide aeration for fish tanks. Provision has been made to add a fourth air blower should the need arise. Argus™ controls the operation of these blowers two function at all times with a third as back-up. The system alternates blowers to provide even use. Argus has a pressure sensor located on the main line to monitor and alarm this system.

Marine water mixing station: The station comprises three 1 m³ plastic tanks, a 3 hp pump, a pressure switch and expansion tank. The level in the tanks is monitored by a level switch.

High pressure air: On-Campus Central Air is used to provide instrument air for the level sensors located in the research room sumps. Air is backed up by a single high pressure air compressor. At this time no air pressure sensor is located within this system.

Also located in this room is the Motor Control Center, and the recirculation and water treatment system for General Holding, Room 160.

Walk-in Freezer

A walk-in freezer is located on the main hallway immediately past the facility doors. Access to this freezer is open to all Aqualab users. It may be used for storage of feed. Label all bags with the primary researchers name so that others do not use your feed. **Please clean up any spilled food** with the dustpan and brush located in the hallway outside of the freezer.

Tissue samples may also be stored in this freezer, however they should be moved out as quickly as possible as space is limited.

Dead stock may not be placed in this freezer there is a small upright freezer located in the hall in front of the walk-in that is designated for dead stock. Dead stock must be placed in the containers provided. Only uncontaminated animal tissue is to be placed in these containers. The containers are taken to the OVC incinerator for disposal. OVC will not

accept dead stock for disposal if it is mixed with garbage.

Diesel Generator

Located in a small room off the building's mechanical room (170), is a 250 KVA diesel generator. This generator provides back-up power for the facility. All systems vital to providing a habitable environment for the animals held in this facility are backed up by this generator. The generator has an automatic load transfer switch. In the event of a power failure longer than 10 seconds, the generator starts, within one minute of start-up the buildings power load is switched to emergency power and is picked up by the generator. The generator is tested monthly.

Building Security

KeyScan Door Access Control System: This facility is secured with electronic locks. The front door of the facility is open between the hours of 8:30 AM and 12:00 PM and 1:00 PM and 4:30 PM. Office hours are the same. The door into the animal holding portion of the facility is locked at all times. Access is obtained through the Aqualab office. Once a project is approved electronic pass cards will be issued to authorized personnel. These cards provide access only to those areas that the researcher is authorized to use. As this is an electronic system, records are kept of card usage. **Please do not lend your card to anyone else**. If you loose your card report it immediately to the Aqualab office so that the old card can be deleted from the system and a new card issued.

Card Reader

Doors are secured by either magnetic locks or electronic strikes. All electronic locks need an active card to release the lock. Simply hold the card near the reader to deactivate the lock.

Electric Strikes: The handles on doors with electronic strikes are locked from the

outside at all times, this allows the strike to function as a locking device. These doors can be easily opened from the inside by depressing the door handle. Sometimes the door will appear not to unlock when an active card is passed by the card reader, at this time simply push on the handle and then pull. The strike will not release if there is pressure against it, by pushing on the handle the pressure is relieved and the strike will release. Electronic strikes are located on the doors for rooms 138, 139, 150, 151a, 151b, 152, 154, 155, 161, 180, 182, 184, 185 and 186.

Magnetic Locks: The handles on doors with magnetic locks or mag-locks are unlocked at all times. The locking action is accomplished by the magnet located above the door. If the door handle were to be locked, releasing the magnet would have no effect upon unlocking the door. These doors have motion sensors inside the room to release the lock when someone approaches. However, if someone is standing near the door, the lock may fail to open. If this happens wait quietly or walk away from the door until the light on the motion sensor turns off. Walking back into the sensors field will release the magnet and allow the door to be opened.

Located on the west wall near the facilities door is a blue push button. Pressing this button will release the mag-lock from the inside to allow exit if the door fails to respond to the motion sensor.

All areas that have doors that are locked with mag-locks, with the exception of the workshop, have alternate exits that are readily accessible, however these doors must remain closed at all times, when not in use to exit the building. The workshop has a blue pull station that will deactivate the mag-lock. All mag-locks are released during fire alarms and power failures. Mag-locks are located on the front door and the facility door, and on the doors for rooms 136, 160, 166 and 174.

Biosecurity

Argus™ Control System: The equipment that is directly related to creating your research environment in this facility is controlled and monitored by the Argus™ system. Argus™ panels are located throughout the facility primarily in the corridors. The panels control the equipment located in the anterooms. The system is decentralized. Each set of panels has its own CPU and will continue to function even after communication with the master panel, or the rest of the system, is lost. In the event of panel failure or loss of communication an alarm will sound. Panel replacement can be accomplished within minutes. Aqualab has spare panels in the event of panel failure. Replacement parts for the Argus™ system can be obtained by overnight courier from Argus™ in BC.

Access: Access to this system is controlled by the facility manager. In certain situations passwords will be granted to users to access the controls for the area that they are responsible for. Arrangements must be made with the facility manager.

Alarms: The Argus™ system has several levels of alarm capability. The

system has a variable time interval prior to going into alarm. The user should check with the Aqualab staff, at the time of project setup, what alarms are available or active, and their setup parameters. When an alarm situation

does arise, the panel that is in alarm and the master panel will start to beep and a siren will sound in the hall. There is an alarm silence button located on the wall close to the door to Room 174. The next level of alarm will not be noticeable to users, at this time the system will commence to phone people on the modem list. The first number on this list is the Manager's cell phone, followed by the Manager's home number, followed by the next person who is on call. If no-one answers these calls the system will return to the top of the list and repeat it until someone responds by phoning the system back. The computer will then wait a pre-specified time before staring the whole process again.

Safety

Eye wash stations are located at the ends of each hall and in the workshop. The dry lab has a safety shower/eye wash station beside the door.

Fire extinguishers are located in each room as well as in the hallways. Red pull stations are located throughout the building. Activation of a red pull station will activate the fire alarm as well as disable the magnetic door locks.

First Aid Stations are located in the workshop, the dry lab, the office and in the corridor beside room 180.

Emergency Telephones: there are two phones available for easy access, one is located at the end of the hall by room 185, the second is located beside the door in the dry lab.