



**UNIVERSITY OF
KWAZULU-NATAL**

HOWARD COLLEGE

SCHOOL OF CHEMICAL ENGINEERING

Pollution Research Group

RESEARCH EQUIPMENT AND FACILITIES

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Equipment Portfolio

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1. Personal Protective Equipment (PPE) requirements for the tests

Table 1 lists the PPE requirements for each test that is carried out in the laboratory. The following PPE will be provide by PRG:

- Latex powder free gloves
- Dust masks
- Glasses

Researchers are required to provide all other PPE.

A price list is attached in **Appendix 1** for purchase within South Africa.

2. Vaccines required for all tests

The following vaccines are required for working in the laboratory. It is recommended that overseas visitors obtain these prior to coming to South Africa. Information on the reasons for these vaccinations is provided in **Appendix 2**.

- Hepatitis A and B
- Tetanus
- Typhoid

3. List of analyses

Table 2 lists the analyses that can be carried out in the PRG laboratory together with the type of samples that can be analysed and the equipment required (with reference to the equipment section).

4. Costs of analyses

A detailed cost break down of each test is currently being compiled. The PRG has a budget line to cover the costs of basic analyses. Anything over and above these tests needs to be budgeted for by the Grantees. It is requested that Grantees requiring analyses to be undertaken seek clarification from the PRG on any additional costs that may be incurred.

Table 1: List of PPE required

Personal Protective Equipment	Test															
	Sampling	TKN	COD	Ammonia	Spectroquant	Respirometer	Centrifugal Mixing	GC Analysis	Titrations	pH Analysis	Volatile/ Total Solids	Oven/ Furnace	Thermal Conductivity	Calorimeter	Viscosity	Filtration
White labcoats (Small/Medium/Large)		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Safety boots	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Powder free latex gloves (Small/Medium/Large)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
FFP2 dust masks	✓	✓		✓							✓					
Safety glasses	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Face Shield		✓	✓													
Heat protection gloves		✓	✓	✓							✓	✓				
Elbow length thick plastic gloves	✓															
Gum boots	✓															
Overalls	✓															
MSA Advantage Half mask respirator 220LS medium	✓															
Box of MSA flexi-filter P3-OR for the above mask	✓															

Table 2: List of Analyses

Test	Type of sample	Equipment	Reference
TKN	VIP Sludge, UD, Pour flush, Urine	TKN distillation unit, Heating block digester, Pump, Scrubber	5.1
COD	All	Microwave digester, Extractor, Digester vessels	5.2
Ammonia	VIP Sludge, UD, Pour flush, Urine	TKN distillation unit	5.1
Spectroquant test kits -Nitrates and nitrites -Sodium -Potassium -Orthophosphates -Total Phosphates	All	Spectroquant, Spectroquant heating block, Spectro-photometer	5.4
Respirometric tests	Aerobic Sludge	Respirometer	5.5
Centrifugal Mixing	All samples	Centrifuge	5.6
GC analysis	Gas mixtures	Gas Chromatograph	5.7
Titration	All samples	Radiometer/ Auto-burette	5.9
Total solids	Faeces	Oven	5.14
Volatile solids	Faeces	Furnace	5.15
Serum bottles	Anaerobic sludge		5.17
Thermal conductivity	Faeces	Thermal Conductivity Analyser	5.18
Calorific value	Faeces	Calorimeter	5.19
Rheology properties- viscosity	Faeces, Pit latrine samples	Rheometer	5.20
Incubation	Struvite	Incubator	5.21
Preparation of sample for anaerobic tests	Anaerobic sludge	Glove box	5.22
Water distillation	Water	Water distillation unit	5.23
Filtration	All samples	Filtration unit	5.25
Wet sieve rig	Pit latrine samples	Wet sieve rig	5.30
Shear stress	Faeces, Pit latrine samples	Penetrometer	5.31
Ultrasonic mixing	Faeces, Pit latrine Sludge	Ultrasonic mixer	5.32
Nano-filtration/ reverse osmosis	Urine	Nano-filtration rig / reverse osmosis	5.34
Flow measurements	pit latrines	Flow table	5.35
Pit depth	Pit latrine samples	Pit scanner	5.36
Drying behaviour	Faeces	Drying rig	5.37

Test	Type of sample	Equipment	Reference
Fermentation	Anerobic sludge	Fermenter	5.38
Chlorides	All samples	Chloride analyser	5.39
Osmosis	All samples	Osmometer	5.40
Moisture content	All samples	Moisture balance	5.41
Particle size distribution	Pit latrine	Particle size analysis	5.42
Urine analysis	Urine	Struvite reactor	5.43
Nitrification	Urine	Nitrification reactor	5.44
UASB Process	Anaerobic sludge	UASB	5.45
Anaerobic reactions	Anaerobic sludge	Anaerobic reactor	5.46
Metals analysis	Fresh Faeces; VIP sludge	Microwave Plasm-Atomic Emission Spectrometer	5.47
Processing of pit latrine sludge	Pit sludge	LaDePa (LAtrine DEhydration and PAsteurisation)	5.48
Suspended solids	All samples	Filtration unit, oven	5.25; 5.14
Ash	All samples	Oven , Furnance	5.14
Sludge volume index	Sludge		-
VFA	All samples	Autotitrator	-
Heat capacity	All samples	Thermal Conductivity	-
Density			-
Plastic and liquid limits			-
Sump tests			-
Parasites (Ascaris, etc)		External laboratory	-
Pathogens		External laboratory	-

5. Laboratory Equipment

This section provides pictures of the equipment that are currently in the laboratory, as well as those that are on order. Test-specific equipment is listed, as well as general laboratory equipment.

5.1 Total Kjeldhal Nitrogen



Distillation Unit (UDK127-VELP)



Heating Block Digester (DK20-VELP)



Pump-VELP

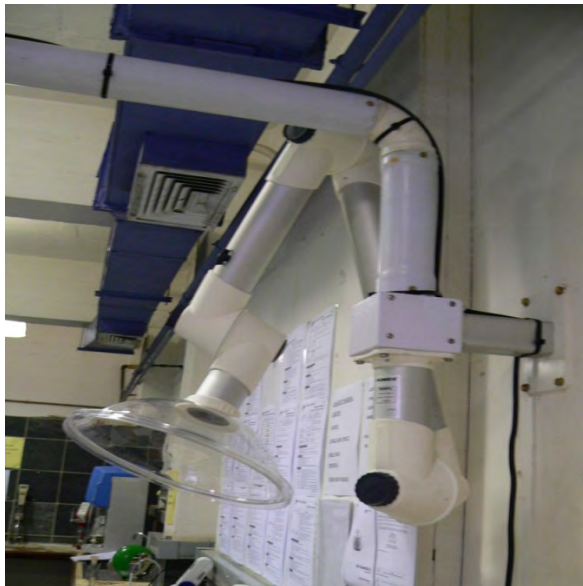


Scrubber-VELP

5.2 Chemical Oxygen Demand



Microwave Digester (Ethos 1-Milestone)



Extractor (MT-1500-75-Fumex)

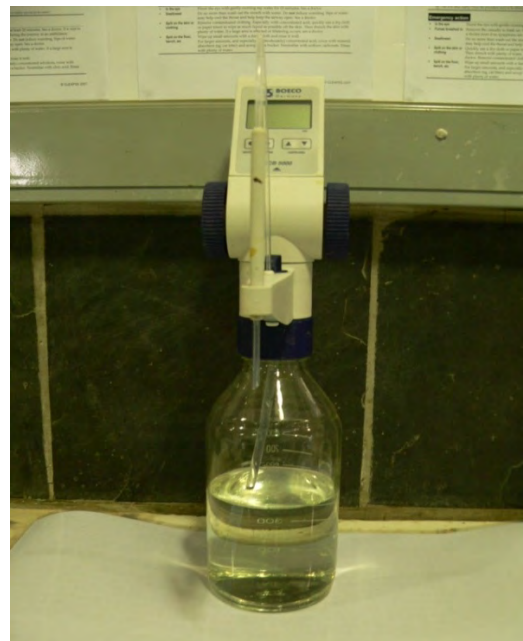
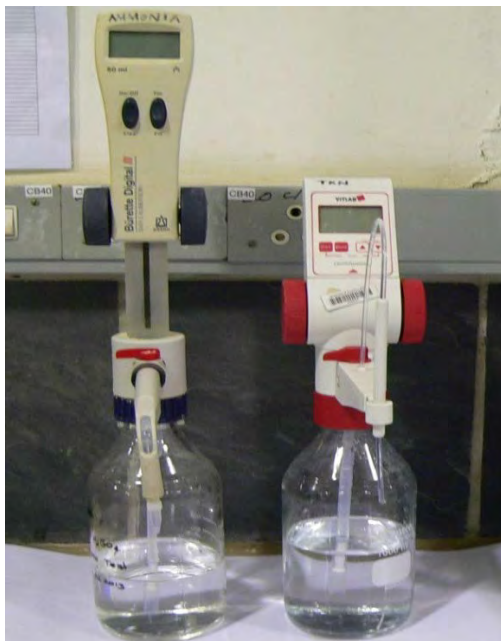


Microwave Digester Vessels

5.3 COD/TKN/Ammonia



Bottle Top Dispenser (BOECO)



Digital Burette (BRAND, VITLAB, BOECO)

5.4 Spectroquant



Spectroquant Heating Block (TR320-Merck)



Spectrophotometer (Pharo 300-Merck)



Spectroquant (Nova 60- Merck)

5.5 Respirometric Tests (OUR,DO)



BM-Evo Respirometer (Statos-Eco-Surcis SL)

5.6 Centrifugal Mixing



Centrifuge (Z323-Hermle)



Tube size: 20ml

5.7 GC Analysis



Gas Chromatograph (GC-2010 Plus-Shimadzu)



Gas Chromatograph (Gow Mac)

5.8 Mass/ Weighing



Mass Balance (HCB 1002- Adam)



Analytical Balance (PA 214-Ohaus)



Analytic Balance (PA 214C)

5.9 Titration



Radiometer (ABU 52-Trilab, TIM 860)



Auto-burette (TIM 870)

5.10 pH Analysis



pH Meter/ Conductivity Meter (Hanna)

5.11 Stirring



Magnetic Stirrer (MMS 3000)

5.12 Drying of glassware



Drier (310-Labotec)

5.13 Cooling



Desiccator (FMH)

5.14 Total Solids



Oven (Gallenkamp) – Temperature: 105 °C



Oven (VISMARA)

5.15 Volatile Solids



Furnace (E160) - Temperature: 550 °C



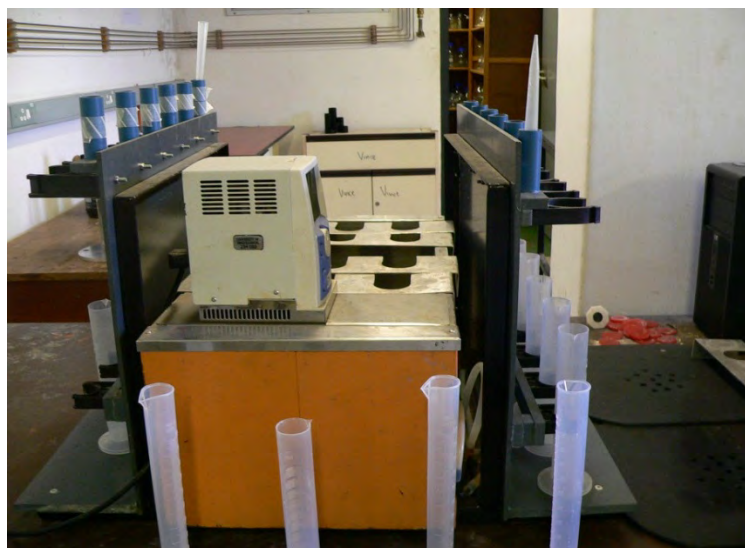
Furnace - Inside View

5.16 Temperature Control



Water Bath Circulator (GR 150 – Scientific)

5.17 Serum Bottles



5.18 Thermal Conductivity



Thermal Conductivity Analyser (TCi-2-A)

5.19 Calorific Value



Calorimeter (6200- Anton Paar)

5.20 Viscosity



Rheometer (MCR 51- Anton Paar)

5.21 Incubation



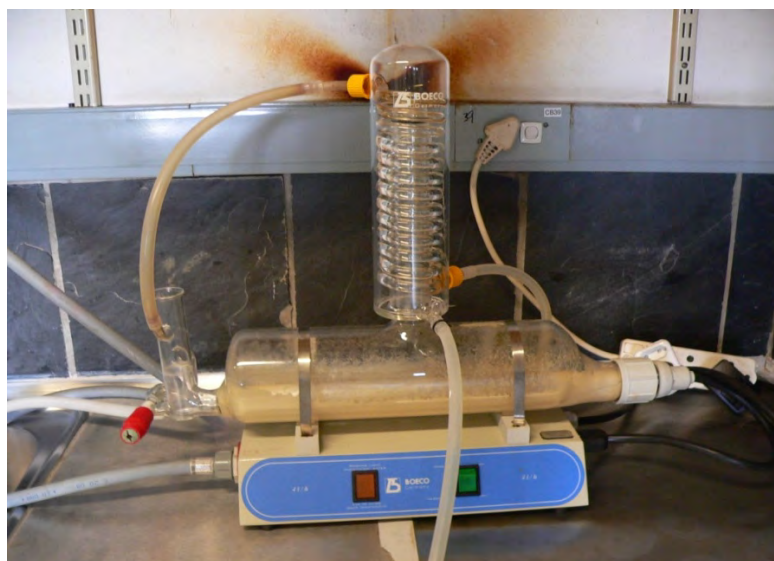
Incubator (MEMMER)

5.22 Preparation of Samples for Anaerobic Tests



Glove Box (Gallenkamp)

5.23 Water Distillation



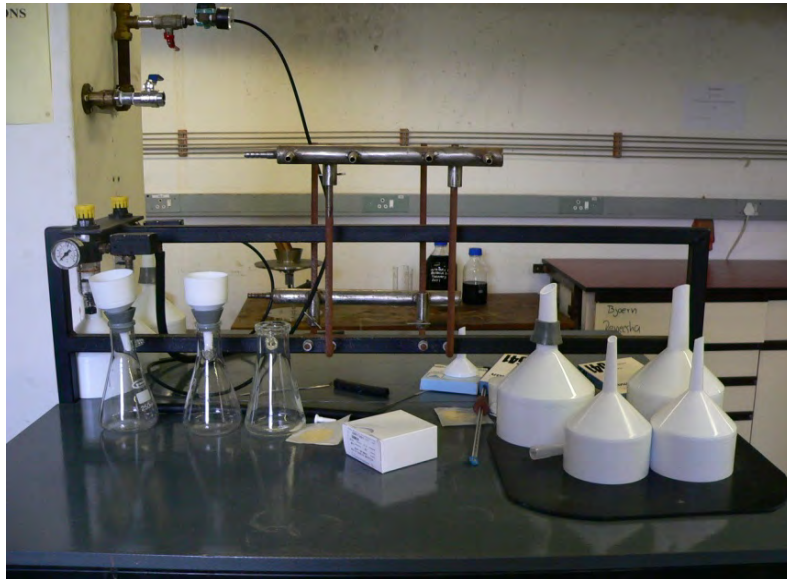
Water Distillation Unit (BOE 8704000)

5.24 Fume Hood Extraction



Fume Cupboards

5.25 Filtration



Filtration Unit

5.26 Disposal of Biological Samples



Sluice

5.27 Cleaning of Glassware



Dishwasher

5.28 Disinfection



Autoclave (HL 340)

5.29 Storage of Samples



Cold Room – Outside View



Cold Room – Inside View

5.30 Wet Sieve Rig



Wet sieve rig

5.31 Shear Stress



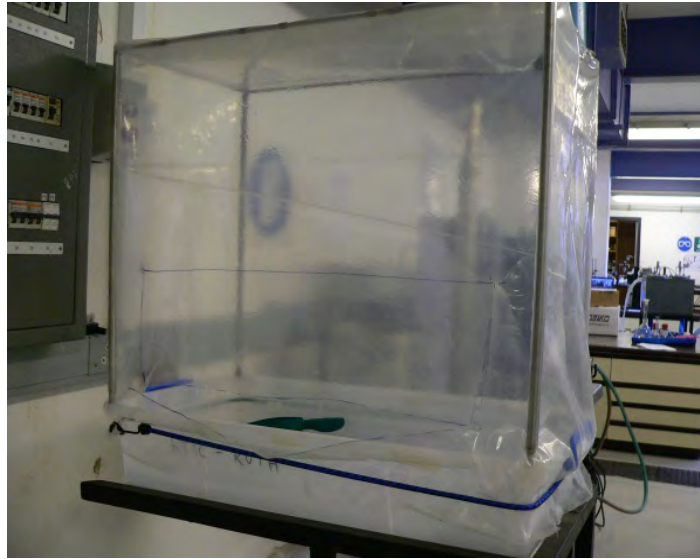
Penetrometer

5.32 Ultrasonic Mixing



Ultrasonic Mixer

5.33 Sample Preparation



Sample Preparation

5.34 Nano-Filtration/ Reverse Osmosis



Nano Filtration Rig/ Reverse Osmosis

5.35 Flow Measurements



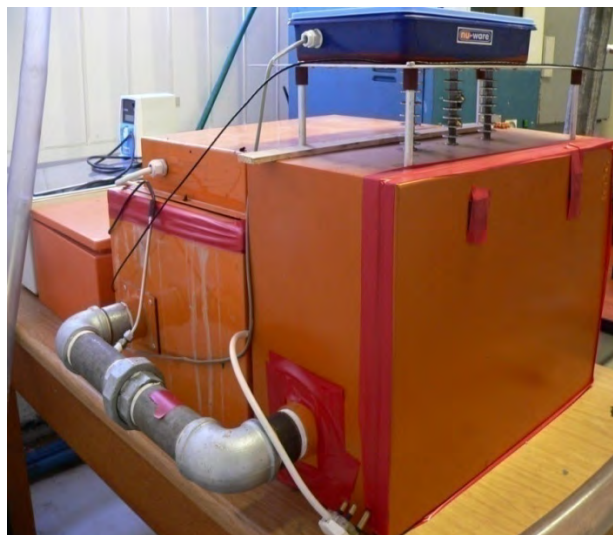
Flow Table

5.36 Pit Depth



Pit Scanner

5.37 Drying Behaviour



Drying Rig

5.38 Fermentation



Fermenter

5.39 Chloride Analysis



Chloride Analyser (Sherwood Model 9260)

5.40 Osmosis



Osmometer (OSMOMAT 3000)

5.41 Moisture Content



Moisture Balance (Radwag max 50)

5.42 Particle Size Distribution



Particle Size Analyser (Malvern)

5.43 Urine Analysis



Struvite Reactor

5.44 Nitrification



Nitrification Reactor

5.45 UASB Process



UASB

5.46 Anaerobic Reactions



Anaerobic Reactors

5.47 Metal Analysis



Agilent 4100 MP-AES

5.48 Processing of Pit Sludge



LaDePa (Latrine dehydration and pasteurisation) machine (laboratory scale)

5.49 Gas Line



LP Gas Valve

5.50 Extraction



Extractor

5.51 Dilution Mixing



Blender

5.52 Measuring



Micro-pipettes

5.53 Urine Storage



Urine Tanks

5.54 Pathogen Filtration



Hepa Filters

5.55 Storage Cupboards



Safety Storage Cabinet



Glassware Storage Room

5.56 Internet



Wi-Fi and Lan Connection

6. General Laboratory Overview

This section provides an overview of the laboratory in order to provide an indication of the layout and access.

6.1 Washing/ Shower Area



Cleaning/Washing-up Area



Emergency Wash Station and Shower

6.2 Access Control



Front Entrance/Exit

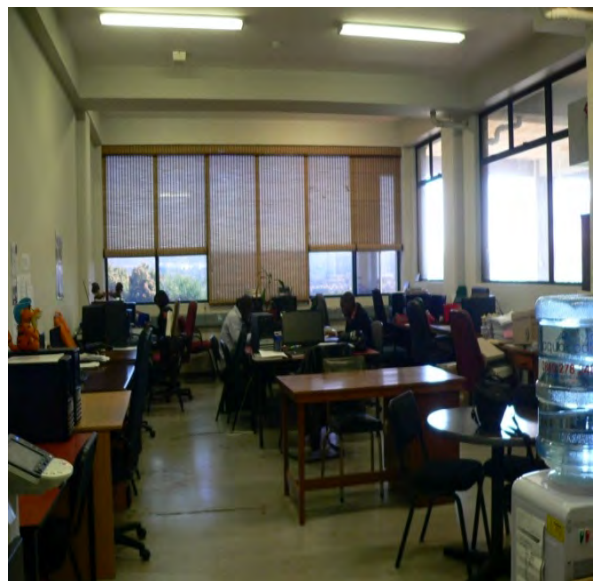


Ground Floor Large Access

6.3 Offices



Main Office Area



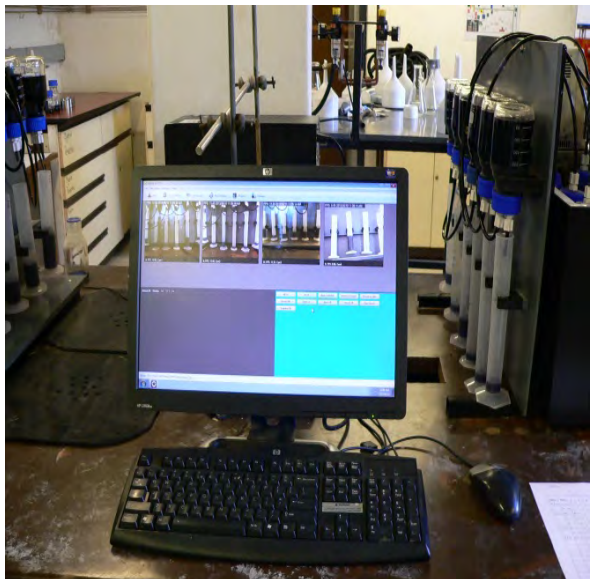
Post-grad Office

6.4 Clean Room



Preparation Area

6.5 Personal Computers



Personal Computers for Lab Equipment

6.6 Vents



Ventilation System and Air- Conditioning Duct

6.7 Upper Lab

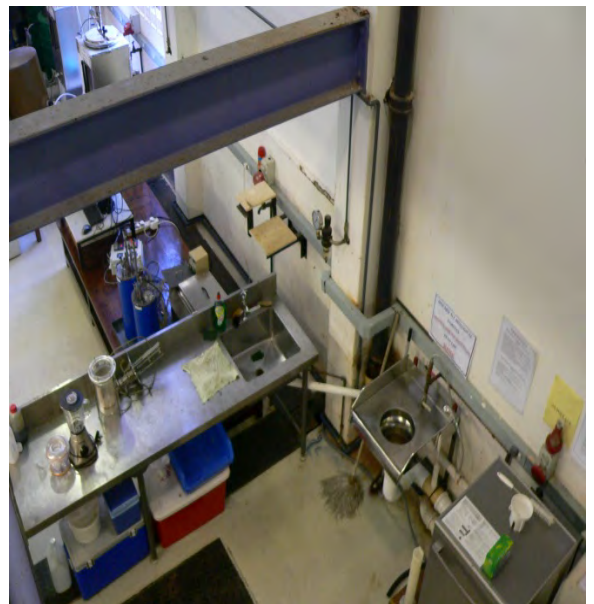
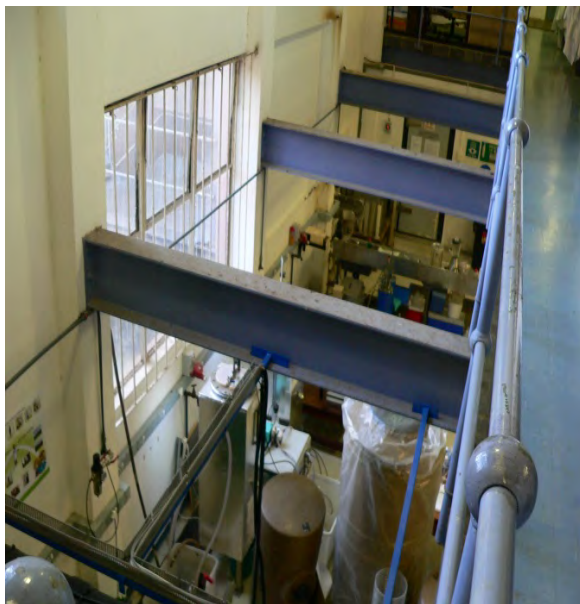
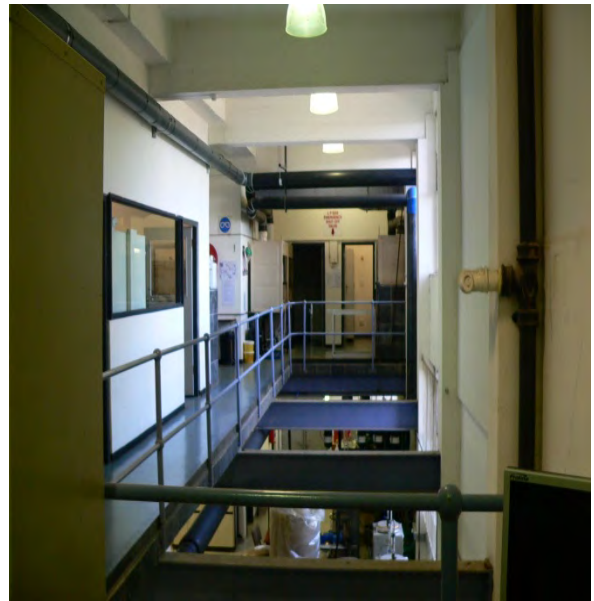


General View of upper lab



Staircase leading to bottom lab

6.8 Lower lab

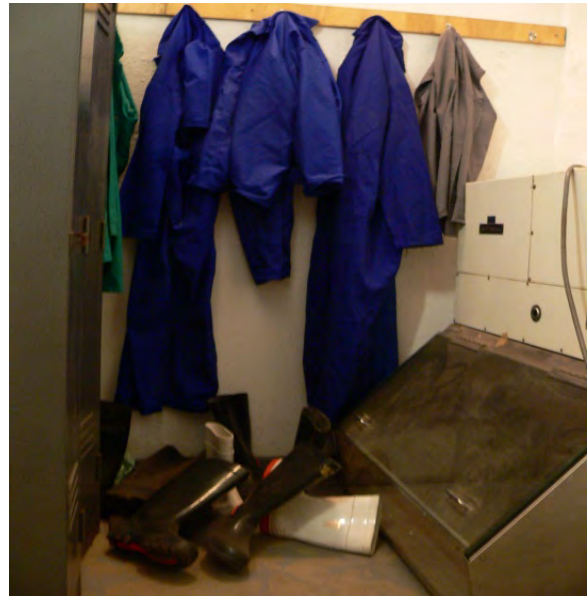


Lower lab - Birds eye view

6.9 General View of Lower Lab



6.10 Personal Protective Equipment



Labcoat, Goggles, Gloves, Boots, Dust mask

6.11 Emergency Facilities



First aid kit



Fire Extinguisher

Appendix 1: Price list for PPE

Table1.1

Personal Protective Equipment (PPE)	Cost Price(R)	Supplied
S/M/L white lab coat	70.00	No
Safety boots	199.00	No
S/M/L powder free latex gloves (box)	70.00	Yes
Box of FFP2 dust masks	74.00	Yes
Safety glasses	8.50	Yes
Face Shield	72.00	No
Elbow length thick plastic gloves for sampling	27.00	No
Gum boots for sampling	81.00	No
MSA Advantage Half mask respirator 220LS medium	176.75	No
Box of MSA flexifilter P3-OR for the above mask	102.15	No

Appendix 2: Information on Vaccinations

Hepatitis A

What is the Hepatitis A?

Hepatitis is a disease that causes an inflammation or swelling of the liver. Hepatitis A is one of the viruses that cause this condition.

What are the symptoms?

Symptoms appear within 28 days of exposure and can include a flu-like illness, aches and pains, abdominal pain, dark urine, loss of appetite and yellowing of the skin and eyes (jaundice). Some people do not have symptoms but can still infect others. Symptoms usually go within 4 weeks. While hepatitis A can make infected people very sick for a number of weeks, it will not result in long-term liver damage. Deaths caused by hepatitis A are very rare.

How is it spread?

People with hepatitis A can pass on the virus from 2 weeks before the symptoms appear, and up to one week after they develop jaundice (yellowing of the eyes and skin).

Hepatitis A is transmitted from person to person when infected faeces (poo/shit) come into contact with another person's mouth. This usually happens when eating or drinking contaminated food or water, by sharing a cigarette or smoking equipment, or during sex.

Who is at risk?

All unvaccinated people are at risk of contracting hepatitis A. People at most risk are:

- travellers to developing countries
- child care workers
- children who attend day care
- people living with poor hygiene and sanitation

People who have had hepatitis A in the past are immune and cannot get hepatitis A again.

How is it prevented?

You can reduce the risk of spreading hepatitis A by maintaining good personal hygiene, especially by washing hands carefully after going to the toilet, before eating, drinking or smoking.

Hepatitis A is preventable. The following groups of people should be vaccinated:

- anyone who works with sewerage

How is it diagnosed?

A blood test can show if you have the virus or if you are immune to it.

How is it treated?

There is no cure for hepatitis A which is why vaccination is very important. A person infected with hepatitis A needs to rest, avoid alcohol and drink plenty of fluids. Symptoms usually last between one to three weeks.

If you have recently been in close contact with someone who has hepatitis A, an injection called immunoglobulin can be given to reduce the chance of you becoming infected. Immunoglobulin should be given within 14 days of exposure and be followed by vaccination soon after. People who have had hepatitis A develop immunity to the virus and can't be infected again.

Hepatitis B

Hepatitis B is a serious infection that is spread through blood or bodily fluids. Immunisation is recommended for all children, and for adults at risk of disease. Safe sex and use of sterile instruments and equipment are important in prevention.

What is Hepatitis B?

- Hepatitis B is an infection of the liver caused by a virus called hepatitis B. 'Hepatitis' means 'inflammation or swelling of the liver'.
- Once infected, people will either clear the infection and have no further problems; or
- Become chronically infected. People with chronic infection are sometimes known as 'carriers'.
- Some people with chronic infection can have health problems related to the infection, while others will not. Whether a person clears the infection or becomes chronically infected depends mainly on their age: 90% of newborn babies, 20-50% of children aged 1-5 years, and 1-10% of older children and adults, become chronically infected. People with chronic infection are usually infectious for life, and may develop ongoing hepatitis. After many years this can result in complications such as cirrhosis or liver cancer.

What are the symptoms?

- Many people will have no symptoms when they are newly infected.
- When symptoms are present they usually include jaundice (yellowing of the skin and eyes), dark urine, pale stools, fatigue, abdominal pain, loss of appetite, nausea, vomiting and joint pain.

How is it spread?

Hepatitis B is passed on to others when blood or bodily fluids (for example, saliva, semen and vaginal secretions) that contain the hepatitis B virus enter a person's body through:

- Broken skin
- Mucous membranes

The bloodstream by sharing contaminated injecting equipment or using needles after an infected person, needlestick injury, or contaminated instruments.

Who is at risk?

- People at risk of infection include:
- Sex partners of infected people
- Injecting drug users
- Babies born to infected women
- Health care workers
- Children of people born in countries with high rates of hepatitis B infection
- Household contact with people infected with hepatitis B

How is it prevented?

Immunisation

Hepatitis B vaccine is very effective in preventing infection. It is recommended for:

- Vaccines are given in the birth hospital and by your local doctor or clinic as part of the routine childhood vaccinations.
- All 12 year old children who were not immunised as babies. Vaccines are offered at high at school.
- Those who have household or sexual contact with chronically infected people
- People who receive blood products for clotting disorders
- People with chronic liver disease or hepatitis C infection
- Residents and staff of facilities for persons with intellectual disabilities
- Embalmers
- Emergency workers.

How is it diagnosed?

A blood test can show if a person has been infected with hepatitis B in the past, and whether a person is chronically infected. Other tests, such as liver function test, can show if any damage has been done to the liver.

How is it treated?

Some people may benefit from special anti-viral treatment. Talk to your doctor about possible treatments. People with chronic hepatitis B infection should take care of their livers and have hepatitis A vaccination if not already immune. Drinking alcohol can make you liver disease worse.

Tetanus

Tetanus is a severe disease that can result in serious illness and death. Tetanus vaccination protects against the disease.

What is tetanus?

Tetanus (sometimes called lock-jaw) is a disease caused by the bacteria *Clostridium tetani*. Toxin made by the bacteria attacks a person's nervous system. Although the disease is fairly uncommon now, it can be fatal.

What are the symptoms?

Early symptoms of tetanus include:

- Painful muscle spasms that begin in the jaw (lock jaw)
- Stiff neck, shoulder and back muscles
- Difficulty swallowing
- Violent generalized muscle spasms
- Convulsions
- Breathing difficulties

A person may have a fever and sometimes develop abnormal heart rhythms. Complications include pneumonia, broken bones (from the muscle spasms), respiratory failure and cardiac arrest.

How is it spread?

- The disease usually occurs after an incubation period of 3 to 21 days (range one day to several months).
- *Clostridium tetani* bacteria are found in dust and animal faeces. Infection may occur after minor injury (sometimes unnoticed punctures to the skin that are contaminated with soil, dust or manure) or after major injuries such as open fractures, dirty or deep penetrating wounds, and burns. Tetanus is not passed on from one person to another.

Who is at risk?

- In poor countries, with lower immunisation rates, newborn children, and young adults are also at risk.
- Injecting drug users may have a greater risk of being infected with the bacteria from contaminated injection sites.

How is it prevented?

- Immunisation protects against tetanus. Tetanus vaccine is given at 2, 4 and 6 months of age, with boosting doses at 4 years, between 15 to 17 years, and at 50 years of age.
- Individuals who received a primary course of 3 doses as adults, should receive booster doses 10 and 20 years after the primary course.

- Adults who have sustained tetanus prone wounds (e.g. open fractures, deep penetrating wounds, contaminated wounds or burns) should disinfect the wound and seek medical attention and receive a boosting dose of tetanus vaccine if more than 5 years have elapsed since their last dose. If there is doubt about prior vaccination history, tetanus toxoid should be given.

How is it diagnosed?

A doctor can diagnose tetanus from the symptoms, and an examination.

How is it treated?

Treatment may include antitoxin, antibiotics, surgical treatment of the infected area and prolonged treatment in the intensive care unit of a hospital.

Typhoid

Typhoid fever is caused by an infection with bacteria called *Salmonella Typhi*. Most typhoid infections are acquired overseas by individuals eating contaminated food or water while visiting friends and relatives in developing countries. Typhoid vaccination is strongly recommended for travellers to developing countries.

What is typhoid and paratyphoid fever?

Typhoid fever is a disease caused by the bacteria *Salmonella Typhi*. Paratyphoid fever is a disease caused by the bacteria *Salmonella Paratyphi*. These diseases cause a similar illness. Paratyphoid infections tend to be less severe and less common than typhoid.

Most typhoid and paratyphoid infections are acquired overseas by individuals eating contaminated food or water in developing countries while visiting friends and relatives or travelling. These infections are different to infection with *Salmonella* which usually causes gastroenteritis.

What are the symptoms?

People with typhoid or paratyphoid fever may experience mild or severe symptoms. The symptoms may include fever, headache, general discomfort and a lack of appetite. Some people have rose spots on the trunk of the body. Constipation or diarrhoea may occur. For typhoid fever, symptoms generally start 8 to 14 days following infection but possibly as early as 3 days or as late as over 60 days after infection. For paratyphoid fever, gastroenteritis may start 1 to 10 days following infection. Some people do not have any symptoms.

How is it spread?

The bacteria that cause typhoid and paratyphoid fever are found in the faeces of infected individuals. Some people (known as carriers) continue to carry the bacteria even after symptoms have resolved. Transmission usually occurs when faecally-contaminated food and water are ingested. Therefore, typhoid fever is more common in less developed countries with poor sanitation, poor hand hygiene and food handling standards, and untreated drinking water. Raw fruits and vegetables and shellfish are the types of foods most often associated with illness. Flies may transfer the bacteria to food.

Who is at risk?

Typhoid fever is widespread in most parts of the world except for the developed regions.

Immigrants who return to developing countries (in particular India, Pakistan and Bangladesh) to visit friends and relatives are at greatest risk of acquiring the disease.

People who have travelled or live with an infected person will be screened for typhoid fever by their local public health unit.

Household contacts, or people who have travelled with a person infected with typhoid, will be screened for typhoid by their local public health unit. Contacts should be aware of the symptoms of typhoid and should see their general practitioner if they develop symptoms.

How is it prevented?

People travelling to countries where typhoid and paratyphoid fever are common should:

- receive the typhoid vaccine two weeks prior to travel (for those ≥ 2 years). Typhoid vaccination is required every three years to protect from infection.
- wash hands thoroughly with soap and water after going to the toilet and before eating
- avoid uncooked foods, including fruit and vegetables unless you are able to peel them yourself
- drink bottled or boiled water
- not drink untreated water, including ice and drinks mixed with water
- avoid eating from street stalls
- ensure hot food is thoroughly cooked and eaten whilst hot.

People infected with typhoid or paratyphoid fever, or who share a house with someone infected with typhoid, **MUST NOT** work if their work involves food handling or caring for children, patients or the elderly, and should not prepare food for others until stool samples have shown that they are not infectious. A number of stool tests will be required to assess when you are no longer infected. Your local public health unit will advise you when are able to return to work.

How is it diagnosed?

To diagnose typhoid and paratyphoid fever, your general practitioner or local hospital will send a blood or stool sample to a laboratory for testing.

How is it treated?

Typhoid or paratyphoid fever is treated with antibiotics. Some people may never have symptoms but may be carriers of typhoid or paratyphoid. Antibiotic treatment is required to treat carriers also.