Standard Operating Procedure **SOP039**

Title: STORAGE, HANDLING AND DISPOSAL OF WASTE CHEMICALS AND SOLVENTS

Location: CBE Laboratories

1. PURPOSE

This SOP provides standard procedures for the handling, storage and disposal of laboratory hazardous waste chemicals and solvents used in the Centre for Biological Engineering (CBE) Laboratories. However it should be noted that decisions on how to work safely with hazardous chemical substances and associated waste must be derived from risk assessments prior to the commencement of work. The procedures described in this SOP therefore serve as an adjunct to the specific control methods and procedures identified and documented in the individual risk assessments for the work activity.

2. SCOPE

This SOP applies to containment level 2 (CL2) CBE laboratories and personnel, including the CBE Laboratory Unit (located in the Holywell Park) and the CBE Tissue Engineering Laboratory T208B (located in the Wolfson School).This SOP describes procedures for the handling, storage and disposal of hazardous waste chemicals (elements and compounds) and solvents. This covers all chemicals used in the CBE laboratories which fall into the hazardous (or Special) waste category; listed within the Hazardous Waste legislation as: oxidising (Hazard Group Category H2); flammable or highly flammable (H3A/H3B); irritant (H4); harmful (H5); toxic (H6); carcinogenic (H7); corrosive (H8); toxic for reproduction (H10); mutagenic (H11), and which must be disposed via a licensed contractor.

All hazardous chemicals must be subject to a risk assessment, carried out in accordance with the Control of Substances Hazardous to Health Regulations (COSHH), before they can be acquired or purchased or used in CBE Laboratories. The COSHH risk assessment will identify the procedures and exposure control conditions required for the handling, storage and disposal of individual hazardous chemical substances used in each activity. This SOP describes the local procedures for the handling, storage and disposal of hazardous chemical substances and must always be read in conjunction with the relevant COSHH assessments for the individual chemical(s) and work activity.

Authorised laboratory users should consult (1) Annex 3 of the CBE '*Code of Practice for work with Biological Agents and Genetically Modified Organisms*' for further guidelines on the use of chemicals in a biological laboratory, and (2) the CBE 'Code of Practice for Work with Chemical Carcinogens, Mutagens, Substances toxic to reproduction and Cytotoxins; SOP003 ''Disposal of Biological (Healthcare) Waste' ; and SOP029 'Safe handling and Disposal of Trypan Blue', for specific handling, storage and disposal procedures for highly toxic (H6, H7, H10, H11) chemicals.

This SOP does not apply to the disposal of radioactive, biological substances or asbestos which are controlled by other regulations

3. RESPONSIBILITES

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3.1. Each Supervisor must take appropriate measures to ensure that all relevant persons are made aware of any hazards associated with the chemical substances encountered during the course of their work and of the requirements to adopt working procedures designed to keep the risks to their health, and to the health of other persons who might be affected thereby, as low as reasonably achievable. **Decisions on how to work safely with hazardous substances stem from the COSHH risk assessments. It is illegal to carry out a work activity involving hazardous substances without first making such an assessment.**

3.2 B**efore you acquire, attempt to purchase or use any substance, it is the responsibility of all individual researchers to first make their own assessment of the hazards posed by that substance and be sure that the required control methods are available and sufficient to allow working with that substance. All COSHH forms need to be signed by a DSO before Finance will order the chemical.**
A COSHH assessment must be completed and lodged with the appropriate assessor, unless a record already exists. If a record does exist then the data should be studied and a print out attached to your experimental procedure and/or recorded in your training file. These are the starting points in the preparation of the protocol and risk assessment of the procedure. The need for the type of treatment (if applicable) and disposal of waste required must be determined within the risk assessment for the work from whence the waste will arise. The precise method of treatment and the means and route of disposal will therefore be identified prior to the work commencing. A copy of the assessment must be kept in a place accessible to other members of the laboratory, and a copy retained with the practical record, along with a copy on the CBE Learn site.

3.3. It is the responsibility of all research workers to ensure the safe and correct disposal of all wastes produced in the course of their work. Improper and irresponsible disposal of chemical wastes down drains, to the Local Authority refuse collection, or into the atmosphere is forbidden by law. Increasingly strict environmental controls and the escalating costs of disposal, it is essential that the appropriate disposal procedures given below are strictly adhered to. **This SOP has been produced for the guidance of the producers of waste, who are reminded that they remain responsible for that waste even after it has left the premises and until such time as it is finally safely disposed of in accordance with the relevant regulations.**

3.4. The Sustainability team act as the University's Agent for the disposal of waste chemicals and solvents, but this does not in any way relieve individual producers of waste supervisors, Faculties or Departments, from complying with their statutory obligations in accordance with the Health and Safety at Work Act, and other specific regulations, notably the Environmental Protection Act, the Chemicals, Hazard information and Packaging Regulations (CHIP), the Carriage of Dangerous Goods (Classification, Packaging and Labelling), and Use of Transportable Pressure Receptacles Regulations, the Special Waste regulations and the Control of Substances Hazardous to Health Regulations.

It is the responsibility of the producer of such waste to ensure safe packaging, labelling and transport of such waste from the CBE facilities to the central compound.

3.5. The DSO /CBE responsible person will be responsible for co-ordinating hazardous waste collection, storage and disposal on behalf of the CBE in accordance with statutory requirements. He will advise on the definition of "hazardous waste", on laboratory disposal procedures and on packaging and labelling requirements. It is the responsibility of the DSO to monitor the standards which are being achieved, in respect of the physical storage and documentation, in order to ensure that statutory requirements are met and hazards from chemical waste are effectively controlled so far as is reasonably practicable.

3.6. It is the responsibility of Laboratory Manager/Responsible person to maintain an inventory of all hazardous chemicals that are maintained in the laboratory work areas. The hazardous chemicals or products shall be listed by the same name that is on the label and on the MSDS. This form must be updated and available for inspection if required. The Laboratory Manager must keep the inventory form and it shall be readily accessible to employees.

3.7. It is the responsibility of all individual researchers to minimise the types and amounts of waste generated as far as possible by exploring options such as:

- limited stocks of hazardous materials
- modifying processes
- substituting or changing product specifications
- recovery or re-use of material
- De-toxifying or rendering less harmful by chemical, physical or biological treatments utilising safe approved laboratory disposal techniques.

4. EQUIPMENT AND MATERIALS

4.1 Equipment

(i) Chemical Spill kit
(ii) Glass 2.5L Winchester bottles and Winchester carriers
(iii) Chemical Waste labels
(iv) Flammable liquid and acid storage cabinets
(v) Hazard warning tape/stickers

4.2 SPECIAL NOTES: HEALTH & SAFETY

4.2. Compliance with COSHH

The UK Control of Substances Hazardous to Health (COSHH) Regulations requires that wherever possible, exposure to hazardous substances be avoided. Where it is not possible to avoid exposure, the

Regulations require that exposure controls be implemented in a hierarchical order, the first of which is substitution with a substance that is non-hazardous, or less hazardous, before moving further down the hierarchy to mechanical controls and lastly Personal Protective equipment (PPE).

Authorised laboratory users must carry out a risk assessment in accordance with the Control of Substances Hazardous to Health Regulations (COSHH) before acquiring, purchasing or using any hazardous chemical. This risk assessment shall clearly identify the procedures and exposure control conditions for the use of each hazardous chemical(s) utilised in the work activity. The COSHH risk assessment must identify the storage, packaging and labelling requirements of waste products and the waste disposal routes for substances used in each activity. An approved COSHH risk assessment must be in place before commencing any work activity involving a hazardous chemical substance.

4.3. Personal Protective Equipment (PPE) and Safe Working Practices

The actual material, style, and even possibly the make of PPE should be specified as part of the COSHH risk assessment for the specific work activity e.g. type of gloves, eye protection.

The following basic precautions should be taken whenever handling hazardous chemical substances:

(i) Ingestion: To avoid accidental ingestion of chemicals the following rules must be followed:

- Pipetting must be carried out using a pipette bulb or some other mechanical means. Mouth pipetting is not permitted.
- Eating, drinking, smoking and the application of cosmetics are not allowed in the CBE Laboratories or other rooms (e.g. Gas Pods) containing chemicals.
- Hands must be thoroughly washed at the end of a working session.
- Substances must be properly contained (e.g. spill trays) and labelled.

(ii) Inhalation - The inhalation of any volatile or dusty chemicals should be avoided by conducting the work in a 'well ventilated place'. The nature of such a place should be dictated in the assessment. It may demand the use of a fume cupboard (engineering controls), or could be outside or in another relatively open space. Whenever weighing or manipulating fine (dusty) toxic powders, or if regularly handling large amounts of any powder, a face mask or respirator should be worn.

(iii) Direct Contact - Laboratory coats must always be worn when working in the CBE Laboratories and removed on leaving. Open-toed or open-topped shoes must not be worn since they offer little protection from spilled chemicals. Where chemicals could possibly be splashed into the eyes, eye protection must be worn. This applies to anyone entering a laboratory where hazardous chemicals may be used, whether or not the persons are directly dealing with such materials.

When using more hazardous materials, goggles and/or a face shield should be employed. This would normally be only for periods of short duration, as they are relatively cumbersome and

uncomfortable. For substances that could attack the skin, gloves and safety glasses and/or a face mask must be worn. The wearing of masks is not generally routine practice and hence activities requiring such protective equipment should be specifically assessed.

4.4 General Precautions for Handling Chemicals (refer also to SOP042)

(i) Great care should always be taken in the handling of chemicals. If in doubt, seek advice from the DSO.

(ii) Open containers away from the face. **CAUTION:** Pressure may have built up inside. Wear eye protection where chemicals are being handled in open vessels.

(iii) Avoid splashing when pouring liquids from bottles to avoid splashing. Ensure adequate ventilation if dangerous fumes are likely to be emitted during the process.

(iv) Prevent inhalation of gases and dusts. **CAUTION:** Liquids and solids may present an inhalation hazard.

(v) Prevent contact with the skin; always use protective gloves of the appropriate type. **CAUTION:** handling glassware with wet gloves is hazardous.

(vi) Do not handle bottles, switches and door handles etc with contaminated gloves.

(vii) Ensure that eye wash facilities and emergency equipment are available in or close to the work area.

(viii) At any sign of illness, refer immediately to the COSHH risk assessment for first aid instruction.

4.5. Specific Precautions for Handling Hazardous Substances

Under COSHH, the routine use of the following categories of hazardous chemicals (but not limited to) is discouraged and should only be used where product evaluation and risk assessment have concluded that there is no viable safer alternative. Should the latter be the case serious consideration should be given to acquiring or purchasing ONLY ready-made solutions so as to avoid the higher-risk hazards created by using these chemical in their powdered form, for example.

The CBE 'Code of Practice for work with chemical carcinogens, mutagens, substance toxic for reproduction and cytotoxins, must be consulted before using toxic chemicals in the CBE Laboratories.

4.5.1 Toxic Chemicals

Toxic chemicals may act quickly, be cumulative poisons, or their action may be very slow and insidious (e.g. carcinogens, mutagens etc).

(i) Effects may vary from individual to individual and workers who know they are suffering from any abnormal skin condition, respiratory trouble or allergy must take special precautions.

(ii) Experimental protocols must address the particular toxic hazards associated with the chemicals.

(iii) If applicable, it is important to have suitable antidotes or drugs available in the laboratory, for use by suitably trained staff. Appropriate reagents should be to hand to neutralise any toxic residues left after the experiment.

4.5.2 Dermatitic Chemicals

(i) Substances causing dermatitis fall into two groups and the resulting skin reaction will depend upon the type of irritant contacted.

- **Primary irritants.** These substances produce inflammation in the area of contact.
- **Secondary irritants**. These substances do not produce immediate reaction and the effects will differ with individuals.

(ii) The dermatitis that develops may well be on parts of the body other than those where actual contact with the irritant has occurred. Once a worker has been sensitised to a particular substance, they may react to a minimal exposure and may even become sensitised to other substances at the same time.

- Use protective clothing such as gloves, visors and aprons to minimise the risk i.e. the most obvious method of prevention of dermatitis is to avoid contact between the irritant and the skin.
- Wear a fastened laboratory coat as this helps minimise contact with hazardous chemicals.
- Before leaving the laboratory remove laboratory coat and ensure all possible irritants and contaminants are removed from the skin and under the nails.

4.5.3 Carcinogenic Chemicals

Generally the effect of a carcinogenic chemical may not be seen until many years after exposure has ceased. The carcinomatous process, once commenced, is irreversible. Effective protection is your only defence. The following procedures for laboratory workers (recommended by the Institute of Cancer Research) should be adhered to:

(i) Label carcinogenic substances as “Carcinogenic” and mark “Not to be handled without proper precautions”.

(ii) Keep substances in a closed container.

(iii) All persons who have to use these substances must be made aware, by their supervisor, of the risk of all possible routes of absorption.

(iv) Wear appropriate protective gloves for experiments involving these chemicals. If there is accidental skin contact, wash the affected parts in COLD running water for a minimum of 5 minutes.

(v) Carry out operations involving the risk of vapour or dust formation in an efficient fume cupboard.

(vi) Wash contaminated apparatus, gloves, bench surface, etc with COLD water.

(vii) Impervious working bench surfaces are essential for operation with these materials. Work on a tray to contain operational hazards. The tray should be decontaminated by an appropriate method.

(viii) Trypan Blue is a known carcinogen. Disposal of Trypan blue should be through the cytotoxic waste route. Refer to SOP029 & SOP003 for more details.

NOTE: At the time of writing this SOP, there are two available fume hoods for the CBE.

a. The CBE fume hood is a non-ducted fume hood for light usage only as per SOP026, Use and Maintenance of the Captair M321 Fume Cupboard.
b. The second fume hood is found in H27. You will need to check it fills teh requirements before this fume hood is used.

4.5.4 Unstable or Explosive Chemicals

There are many dangerously unstable substances which may cause very serious laboratory accidents, e.g. picric acid, diazonium salts, aromatic nitro compounds, per-chlorate salts. When working with such materials the following general precautions should be observed:

(i) Keep quantities used to an absolute minimum.

(ii) Use safety screens, goggles and gloves.

(iii) Do not store in bottles with glass stoppers.

(iv) Store stocks of explosive compounds away from other materials.

4.5.5 Flammable Chemicals

(i) Quantities of flammable solvents exceeding 500 ml must be stored in the metal solvent storage cabinets (located in Gas Pod 1 or T208B Laboratory).

(ii) The total quantity of flammable material stored in a laboratory must be kept to a minimum. Stock quantities of solvents must be kept in designated CBE solvent store located outside the CBE Laboratory Unit in Gas Pod 1.

(iii) Care should be taken with liquids that may form a dense vapour (e.g. ether). The vapour may creep along bench tops or floors for considerable distances and if ignited can explode and/or flash back to the original source of the vapour. The amount of electrical energy necessary to ignite a flammable vapour-air mixture is very small.

(iv) Many inorganic substances present special fire hazards, e.g. phosphorus. Metals in finely divided form such as aluminium, magnesium, zinc, noble metal catalysts etc, are readily ignited and some may be spontaneously flammable and should only be used under constant supervision.

(v) If using these materials, ensure that sand or dry-powder extinguishers are available for dealing with small fires that may be produced by such materials.

(vi) Conduct reactions involving flammable gases in a fume cupboard so that any resulting fire can be easily confined and extinguished.

4.5.6 Fine Powder Hazard

Silica Gel and Cellulose are regularly used in chromatography and these present a low toxic hazard. The extremely small particle size does present a hazard to health on chronic exposure to the dust generated when handling the dry powder.

- Use suitable precautions such as the use of a fume-hood when handling the dry powder.

5. PROCEDURE

This section provides general guidelines for storage of hazardous chemicals and the collection, labelling, packaging, segregation and monitoring of the disposal of associated hazardous chemical waste.

5.1. Safe Storage of Hazardous Chemical Substances

5.1.1. Principles for Safe Storage

There is a range of storage facilities suitable for hazardous chemicals in the CBE. Several of these are specially designed for the safe storage of different types of hazardous substances. It is important to understand what substances can be safely stored in which storage container.

(i) **The first principle of safe storage:** Store like materials with like. It is essential to segregate antagonistic substances to prevent dangerous interactions. All hazardous materials should have a label on them identifying their hazard category. (Corrosive, flammable, oxidising, toxic etc.).

- The reception, storage and distribution of hazardous chemicals must be the responsibility of authorised persons only. Regulations governing the storage and labelling of toxic and other hazardous materials must always be observed. Very toxic chemicals, including chemicals with emotive names such as potassium cyanide, etc., must always be kept in secure storage, access to which is available only to nominated key holders. Accurate records of chemicals issued from secure store must be kept by a nominated person.
- Flammable reagents and solvents must never be stored in a refrigerator or freezer unless the internal light has been disconnected and removed and the thermostat control circuit has been modified to be spark proof. Warning notices must be placed on all refrigerators which are not suitable for storing flammable materials.

(ii) **The second principle of safe storage:** Store the minimum stock levels of hazardous materials in the laboratory.

- Chemicals should, in general, be stored some distance from the working area, correctly segregated and in a quantity sufficient only for the work in progress. Over-ordering of chemicals must be avoided, in order to obviate the accumulation of unwanted chemicals which subsequently become waste for disposal during and after the implementation of research programmes. Individual workers should not retain chemicals superfluous to current needs and should return these to the chemical store or, if the materials cannot be used again, make arrangements for their safe disposal.
- In order to minimise the risk of a serious fire, the maximum amount of flammable reagents and solvents etc., stored in Gas Pod 1 or T208B should not exceed fifty litres or less dependent on the containment volume of the spill bund within the cabinet. They must be kept in suitable closed vessels, in fire resistant cupboards, cabinets or bins, which may be constructed either of wood or steel. Stores for flammable solvents must be properly labelled and should not be sited adjacent to doors or other means of escape from the Gas Pod or T208B.
- Containers of flammable solvents should be returned to the designated storage cupboard, cabinet or bin in Gas Pod 1 or T208B as soon as possible after use. With the exception of 70% IMS and 1% Virkon stock solutions (which may be stored in 5-10 litre plastic containers provided in designated laboratories), reasonable quantities of hazardous chemicals (including, but not limited to flammables and corrosives) may be kept in the open CBE Laboratories in suitable closed vessels of volumes not greater than 500ml. Stock solutions of chemicals (>500 ml) should be stored in Gas Pod 1 (Annex III) or T208B in the appropriate segregated holding area or cabinet.

(iii) **The third principle of safe storage:** Store chemical containers, particularly of liquids, below shoulder height. Storage of other materials e.g. plastic containers, above this height is acceptable provided that there is a safe means of access to the storage location.

5.1.2. Segregation of Hazardous Chemical Substances by Type

Many chemicals used in the CBE may react adversely when combined, whether during an experimental protocol, accidentally when spilled, or when waste mixtures are improperly consolidated for disposal. It is recommended that incompatible chemicals are stored in separate areas, when in the CBE Laboratories (i.e. when in use), the Storage Areas (eg Gas Pod 1 – Annex III) or Waste Areas (eg Gas Pod 2 – Annex IV), when feasible.

Authorised personnel should refer to the relevant COSHH risk assessment and Material Safety Data Sheets (MSDS) for information on specific chemical incompatibilities. The DSO should be consulted for advice on specific storage issues.

It is not possible to cover all reaction hazards in this document, but general recommendations are described below;

(1) Acids

Small quantities can be stored safely inside a vented cabinet or even in a wooden cupboard so long as they are in a containment tray to contain any spillages. Exceptions: - a wooden cupboard cannot be used to store oxidising acids such as nitric or perchloric acids (see Oxidisers). Consideration must also be given to the effects of any acid fumes on any metal in the fittings and construction of the container. Acid chlorides and other materials which liberate acid fumes can also be stored in a similar way. Alkalis are incompatible materials which must be stored separately.

Separate acids from the following substances:

- Bases (possible violent exothermic reaction)
- Most metals (production of flammable hydrogen gas)
- Cyanides (forms toxic and flammable hydrogen cyanide gas)
- Sulphides (forms toxic and flammable hydrogen sulfide gas)
- Azides (may form explosive hydrazoic acid)
- Phosphides (may form toxic and flammable phosphene gas)
- Oxidizers (may form toxic and/or explosive compounds)

(2) Alkalis

Even though these materials are marked with a corrosive label, as are acids, they must be stored separately from acids. Since any accidental mixing of the concentrated materials will generate large quantities of heat and fumes.

(3) Chlorinated solvents

Should be stored in well ventilated cabinets and separate from flammable solvents. This is due to possible violent reactions when certain flammable solvents and chlorinated solvents are allowed to mix. Also, when chlorinated solvents are involved in a fire they can generate toxic gases such as phosgene. They should not be stored with alkali metals such as lithium, potassium or sodium, since any mixing may cause an explosion. They can be stored in metal bins if ventilated storage is not available.

(4) Dangerous drugs and medicines

Should be stored in locked cupboards. If it is necessary to store them at low temperatures, the fridge or freezer used should be fitted with a lock or otherwise made secure from unauthorised access.

(5) Flammable solvents

Should only be stored in specialised flammable solvent storage units. These are available commercially and consist of a cupboard or bin with containment for any spilled solvent. The construction should have

at least half hour fire resistance. They should be properly labelled e.g. "Highly flammable no naked flames".

Chlorinated solvents should not be stored in a flammable solvent container. Oxidising agents (such as peroxides, per-chlorates and nitrates) must never be stored with flammable solvents since fires and explosions can result after any spillage, even without a naked flame or heat. The cabinet or bin must be kept securely closed at all times to prevent spread of fire. The amount of flammable solvent, including waste flammable solvent stored in a lab area should not exceed 50 litres in total.

Flammable solvents must not be stored in fume cupboards or ventilated cabinets, since the airflow will fan any fire and may also spread the fire to other parts of the building via the ventilation ducting. The ventilation openings in a ventilated cabinet would also allow a fire in the laboratory to be drawn into the cabinet.

(6) Noxious chemicals

Ventilated cabinets are designed to safely hold chemicals which give off noxious fumes and smells. These fumes are sucked away by forced ventilation. Often these are located under fume cupboards and use the same extract system as the fume cupboard. However, free-standing units are also available with their own ventilation system. These should be used to store materials such as mercaptans and amines which have a strong smell. They can also be used to store lachrymators. If you do not have ventilated cabinet, containers of these noxious materials can be stored in sealed secondary containers which should only be opened in a fume cupboard.

(7) Oxidisers

Should be stored separately from other materials. Ideally, they should be stored in a bin or cabinet made from metal or other non-organic material. They should not be stored where they can come in contact with wooden shelves or paper. Perchloric acid is especially hazardous and is best stored standing in a tray filled with sand within a cabinet or bin.

Separate oxidizers from the following substances:

- Acids (may form toxic and/or explosive compounds) (For example: concentrated sulfuric acid mixed with chlorates or perchlorates forms explosive compounds)
- Organic materials (especially when mixed with flammables, may ignite)
- Metals (may form explosive compounds)
- Reducing agents (for example: boranes, hydrides, sodium hydrosulfite, etc.)
- Ammonia (anhydrous or aqueous)

(8) Poisons

Section 7 of the Poisons Act (1972) lists toxic substances known as Schedule 1 Poisons. This list includes most of the well known poisons such as arsenic, cyanide, strychnine. They must be stored in a locked cupboard and a list kept of the contents. Any poison removed must be signed for. It would be good laboratory practice to take the same care in the storage of other highly toxic substances even although they do not appear on Schedule 1. Chemical suppliers should indicate whether a substance is a Schedule 1 poison at the time of purchase and will normally have a special order procedure for such materials.

(9) Water-reactive chemicals

Should be separated from aqueous solutions and in many cases just the moisture in the air (for example: metal hydrides, alkali metals and certain metal dusts in moist air will form hydrogen gas and ignite; halosilanes and acid halides will react with water to form toxic acid gases)

(10) Other materials

Can be kept in normal cupboards or in ventilated cabinets and fridges according to their properties.

5.2. Assessment and Classification of Hazardous Chemical Waste

Hazardous Waste is defined by reference to the European Waste Catalogue (EWC). Hazardous waste is subject to additional controls under several regulatory regimes, including IPPC, the Landfill Regulations, the Incineration Regulations and the Transfrontier Shipment Regulations. In England, the EU definition of hazardous waste has been brought into force by the List of Wastes (England) Regulations 2005 (SI 2005 No. 895), as amended by SI 2005 No. 1673 and Hazardous Waste (England and Wales) Regulations 2005 (SI 2005 No. 894).

These Regulations require that Hazardous (or Special) Waste be identified, labelled, segregated from other (non-hazardous) waste types and disposed of in an appropriate and authorised manner. The hazardous (or Special) nature of a waste is determined using Hazard statements (available through the Approved Supplier List or Material Safety Data Sheets) and where necessary, by assessing the concentration of the hazardous component within that waste. Only waste containing chemical components above the hazardous threshold are classified as a Hazardous (or Special) Waste. Where this is the case, the waste MUST be consigned to an authorised contractor for treatment in an appropriate facility.

All chemicals must be assessed as to whether they are hazardous (inherently dangerous) and if so their "category of danger" must be identified and a description provided of the hazard (the hazard statement). The types of hazard, hazard statements and precautionary statements associated with hazardous chemicals,these can be found at can be found at the following websites: http://www.hse.gov.uk/ and https://www.lboro.ac.uk/services/health-safety/topics/hazardous-clinical-waste/

Guidance on the assessment and classification of hazardous waste can be viewed in the Environment Agency's official guidance document, '*Hazardous Waste: Interpretation of the Definition and Classification of Hazardous Waste (Technical Guidance WM2)*'.A summary is given below.

5.2.1. Assessment of Hazardous Properties

Follow the six steps outlined below. **CAUTION:** it is **illegal** to dispose of hazardous (or Special) waste other than via an authorised contractor to an authorised facility. Hazardous (or Special) waste must **never** be disposed of to drain or sewer.

Step 1:- Identify the composition

The first step is to identify whether your waste has, or is likely to have, hazardous properties. If you know that your waste is hazardous then you do not need to carry out Steps 2 to 5 of this assessment, just go straight to **Step 6**.

How to identify the composition

Identify the composition of the waste by referring to Appendix A of WM2 - find the waste category in the European Waste Catalogue (EWC).

Is your waste hazardous?

If Waste is marked with an asterisk **(*)** the waste is hazardous. If there are mirror entries, you must ascertain whether the waste possesses one of the 14 hazardous properties (Annex II). If your waste is identified as being hazardous or potentially hazardous, continue to **Step 2**.

Step 2:- Identify the Hazard Statements

If you have established that your waste is hazardous or may be hazardous, the next step is to identify the "Hazard Statements" that apply to each component in the waste.

Why use Hazard Statements?

With the introduction of the CHIP Regulations, all chemicals should have EC regulated Hazard ('H)) and Precautionary ('P') numbers or "phrases" associated with them. These refer to standard phrases which should always be identified and used on risk assessment forms in order to assess whether the substance or preparation will be hazardous at the point of disposal. More information on CHIP is available on the

HSE's website (http://www.hse.gov.uk/), including free publications about how to read a chemical label, where to obtain MSDS information, etc.

By using these methods of classification, you are aiming to clarify the following:

- Categories of danger exhibited by the substance (Hazard Groups)
- Precautionary / Phrases of the substance, which describe the nature of the hazards.

How to identify Hazard statements

(i) Look up the potentially dangerous constituents of the waste on the Approved Suppliers List (ASL). This shows hazard information and classification for many common chemicals (see below for more information on this). If the waste contains substances on the ASL, this classification should be used in preference;

(ii) Use the methodology given in the Approved classification and labelling guide (available from HSE books) with data for the substance obtained from peer reviewed sources.

(iii) Use information from material safety data sheets (MSDS) or other data sources to find out whether the waste contains dangerous substances.

If none of the substances in the waste are classified as “dangerous substances”, the waste will not be hazardous and the normal method for disposing of non-hazardous waste of that type should be used. If you are in any doubt, contact the DSO.

Step 3:- Identify the relevant hazards and threshold concentrations

The next step is to determine what your hazard categories and risk phrase(s) mean and whether there is a threshold concentration attached to them. This can be determined either from the risk phrases table below.

Hazard groups

There are 15 hazard groups used within hazardous waste legislation. These can be found on the HSE website.

Hazard Statements

The definitions and hazardous thresholds for each of the key Risk Phrases are contained within the Hazardous Waste Technical Guidance WM2 available at http://www.ni-environment.gov.uk/tgn_part1.pdf. Further detail to be found within the waste assessment framework provided in the technical guidance WM2, introduction, if you need it. In most cases, the information provided here will be sufficient.

If the Hazard statements(s) associated with your substance or preparation have or has hazardous waste threshold limit(s), go to the **Step 4**.

If you need further information on the assessment of thresholds for risk phrases within each hazard groups or on testing your substance further (e.g. for hazard groups H1, H2, H3, H12, H13), you will need to refer to the technical guidance WM2, Appendix C.

Step 4:- Record

Record the hazards and threshold concentrations for each component on your COSHH risk assessment form.
This can be found on the Loughborough Website. https://www.lboro.ac.uk/media/wwwlboroacuk/content/healthandsafety/downloads/COSHH%20Risk%20Assessment%20Safety%20Documentation.pdf

Step 5:- Determine whether the threshold concentrations recorded are exceeded

If they are, the whole consignment will be hazardous. It should be noted that for some hazards, concentrations of components in the waste must be added together to calculate the total concentration of the substances with that hazard. See Appendix C of WM2 for specific instances where this procedure applies.

Is the substance above or below the threshold?

1. Determine the concentration of the hazardous component within your substance /preparation

In order to assess whether your substance or preparation is above or below the threshold level(s) associated with it, you must know what the concentration (percent by mass) is within your waste of each hazardous substance(s). Once you have determined the concentration(s), go to **Step 4**.

2. Work out if the substance(s) is present at a concentration at or above the Threshold

This must be done at the point of disposal. If the concentration of the substance is at or above the threshold concentration for any relevant Hazard statements, your waste will be hazardous (special) waste. If there is more than one Hazard statement associated with your waste then start with the lowest threshold.

Step 6:- Consign your waste

If this procedure identifies your waste to be hazardous, then it must be consigned as hazardous (special) waste and sent to an appropriate licensed facility for disposal. Arrangements for this shall be made by the DSO. The flow chart in Annex I summarises the chemical waste disposal options.

5.3. Assembly, Segregation and Collection of Hazardous Chemical Waste for Disposal

The majority of chemicals used in the CBE facility will need to be disposed of as hazardous waste. All chemicals that cannot be disposed of on-site within the CBE laboratories (e.g. includes most of the

common solvents) have to be dealt with by the University's waste system. To use this service, the collection of the waste (or surplus chemicals) should be co-ordinated with the DSO.

NOTE: Waste disposal begins with the generator (laboratory) personnel who first decide if the chemicals are still needed. Chemicals which are no longer of use should not be considered waste until other alternatives such as redistribution or recovery have been considered.

5.3.1. Segregation of Hazardous Chemical Waste

Proper segregation of laboratory waste is essential to good chemical hygiene and a safe workplace environment. The guidelines for temporary storage of chemical wastes in the CBE Laboratories and/or the Storage Areas in the Gas Pods or in T208B are no different to those that are used for the storage of your usual laboratory chemicals (**refer to Section 5.1**).

Proper segregation of wastes involves making sure that wastes within a bottle are compatible. Only chemically compatible waste can be mixed together and placed in a common container for disposal.

The relevant COSHH risk assessment MUST be consulted to confirm chemical compatibility and the appropriate waste disposal route.

1. **Waste category examples of Compatibility – *ie waste chemicals that <u>can</u> put in the same waste container bottle for disposal***

    - Flammable solvents acetone, methanol, ethanol, toluene, xylene, acetonitrile, benzene etc (can all be put in the same disposal container)
    - Halogenated solvents halothane, methylene chloride, chloroform, carbon tetrachloride, trichloroethane, trichloroethylene (can all be put in the same disposal container)
    - Organic acids formic acid, acetic acid, propionic acid (can all be put in the same disposal container)

2. **Waste category examples of Incompatibility – *ie waste chemicals that cannot put in the same container bottle for disposal***

    - Heavy metal solutions aqueous solutions containing arsenic, barium, cadmium, chromium, copper, lead, mercury, osmium, selenium, silver etc.(do not mix together, keep each type separate)
    - Mineral acids hydrochloric acid, nitric acid, sulphuric acid, perchloric acid (do not mix together, keep each type of acid in separate container)
    - Inorganic Bases sodium hydroxide, potassium hydroxide, ammonia (do not mix together, keep each type in separate container)

- Oxidizers potassium nitrate, hydrogen peroxide, potassium permanganate, bleach (do not mix together, keep all in separate containers)

- Reactive wastes phosphorus pentoxide, sodium hydride, sodium methoxide, dry picric acid, (do not mix together, keep all in separate containers)

NEVER store the following types of wastes near each other:

- Acids and bases.
- Organics and acids.
- Cyanide, sulfide or arsenic compounds and acids.
- Alkali or alkali earth metals, alkyllithiums etc. and aqueous waste.
- Powdered or reactive metals and combustible materials.
- Mercury or silver and ammonium containing compounds.

CAUTION: If a bottle gets broken inside a waste storage area where incompatibles were present, the results could be disastrous. Remember: incompatible bottles of wastes should be stored in separate cabinets, preferably as far apart as possible!

5.3.2. Safe Use of Containers for the Collection of Waste

(i) Seal waste collection bottles and other containers so that contents cannot escape or leak. Pack all corrosives in leak-proof containers and in secondary plastic Safe Packs.

(ii) Store the 'in-use' collection bottles/containers in a safe and appropriate location in Gas Pod 1 or T208B i.e. flammable liquid or acid storage cabinets; away from incompatible chemicals etc. **CAUTION:** Do not store flammable waste containers on the bench or floor; Do not store waste bottles in or near a sink or floor drain – this could allow toxic chemicals to enter the sewer.

(iii) DO NOT allow hazardous chemical waste collection bottles or out-dated chemicals to accumulate in Gas Pod 1 / 2 or the CBE Laboratories. **CAUTION:** Research groups should check chemical stocks regularly and dispose of any chemicals no longer required. Unwanted chemical stocks should not be allowed to accumulate

(iv) Ensure that collection bottles and lids are compatible with the chemicals stored in them. **CAUTION:** Do not use metal cans for waste; even near neutral pH, solids and liquids can easily corrode through metal cans in a surprisingly short period of time. Use ONLY glass or polyethylene containers for waste.

(v) DO NOT store collection containers with an open bung or a funnel in them. Leaving a funnel in the waste bottle is unacceptable. A funnel can too easily be moved to an adjacent (incompatible) waste bottle and result in a fire or explosion.

(vi) DO NOT leave the cap off an organic waste bottle. **CAUTION:** The only time a cap should be off a waste bottle is when you are actually putting waste into it. If you are afraid of a pressure buildup in the bottle, simply cap it loosely.

(vii) DO NOT fill containers to capacity. Replace/empty when approximately ¾ full and remove to the appropriate bulk storage area in Gas Pod 2.

(viii) Re-use empty Winchester bottles e.g. for the disposal of waste solvents. If they have contained a corrosive or harmful chemical e.g. concentrated acid or ammonia, wash out with water before use

5.3.3. Labelling of Waste Containers/Collection bottles

(i) Correctly label all bottles and containers. Use approved labels for solvent waste . **CAUTION:** If the contents of the bottle are not listed, the next person to use the bottle could accidentally combine incompatible chemicals causing a fire and explosion egg mixing nitric acid and ethanol can form an explosive mixture.

(ii) Place large chemical waste label over any existing labels onto Winchester bottles which are to be re-used for the collection of chemical wastes, or the outside of a box containing a number of identical chemicals. Remove or obliterate all manufacturer's labels from the waste collection bottles.

(iii) Remove or paint out old labels or incorrect markings on boxes and bottles. Affix the appropriate correct labels (see below). **NOTE:** Scratching out the former contents of the label on the bottle and writing "Waste" on it, is unacceptable. You must remove or totally deface the old label so there is no confusion over the contents.

(iv) Use small chemical waste labels for any other size bottles/containers

(v) Complete the labels in pencil or indelible ink by providing the following information:

- Contents: brief description of the contents e.g. "Halogenated Solvents" or "Non-Halogenated" and principal hazard i.e. flammable, corrosive etc, preferably using appropriate hazard warning tape or stickers. List all disposals in the bottle on the waste disposal form (Section 8). The bottles should be labeled with "CBE - <Type> SOLVENT WASTE" and also indicate:
- Waste producer: Put your name if you have produced the waste yourself - or if it consolidated laboratory wastes, put the name of your supervisor or the laboratory manager. This is so that if there is a spillage or incident involving this chemical, the producer can be contacted for further information.
- The amount of each chemical component needs to be included, as the % of each component needs to be calculated for the waste disposal company

5.4. Packaging, Storage and Transport of Hazardous Chemical Waste

Once the chemical waste bottles have been properly labelled, package the waste for transportation by carrying out the following procedures: Laboratory Chemicals in containers of less than 5 litres are normally termed lab smalls" If possible these lab smalls should be stored in dedicated waste chemical stores whilst awaiting collection in Gas pod 1.

5.4.1. CBE Laboratory Unit

(i) In the fume hood, decant waste liquids into the containers provided using the appropriate equipment and PPE. **CAUTION:** Before disposing of liquids into waste bottles, be aware that incompatibilities between chemicals can occur. **Check the relevant COSHH risk assessment and MSDS or seek the advice of the DSO before disposal.**

(ii) Clean the fume hood and put away any equipment used.

(iii) When containers are approximately ¾ full, take the suitably labelled bottle (using a Winchester or solvent carrier or other appropriate secondary container) to one of storage areas reserved for waste chemical liquids in Gas pod 1.

(iv) A Disposal is arranged, by completing the Chemical Waste sheet, which is then emailed to Nik Hunt who arranges for the University's chemcial waste disposal. This form can be found on the university website.

(v) There are various dates throughout the year when the waste is collected. If there is a large amount of waste to be disposed off he can also arrange a special pick up.

(vi) On Chemical Waste Collection day, Biffa come to the CBE, and will pack the chemical waste, and will then collect it the same or next day.

The Chemical Waste sheet can be found on the university website. Occassionally, Biffa will ask for more details regarding items of chemical waste. This includes sending copies of the MSDS's.

Check for updates on teh website for any changes to Chemical Waste disposal.

5.4.2. CBE Tissue Engineering Laboratory (T208B)

(i) Decant waste liquids into the containers provided using the appropriate equipment and PPE. CAUTION: Before disposing of liquids into waste bottles, be aware that incompatibilities between chemicals can occur. Check the relevant COSHH risk assessment and MSDS or seek the advice of the DSO before disposal.(ii) Clean the bench and put away any equipment used.(iii)When containers are approximately ¾ full, arrange disposal by contacting the Laboratory Manager and/or DSO. If you are producing large amounts of any individual liquid waste other than halogenated or non-halogenated waste eg acid waste, it may help to dedicate waste bottles to these liquids. (iv) Follow the instructions for packaging, detailed in Section 5.4.1 (steps iv to ix), as appropriate.

5.5. Disposal of low or non-hazardous aqueous waste on-site (within the CBE facilities)

Some low-hazard waste can be safely disposed of in the laboratory via the drains providing they are water soluble and are not “heavy metal” salts or organic materials and are WELL DILUTED. A flow chart summarising the waste disposal routes is shown in Annex I.

Dilution to the sewer can be the most appropriate method for disposal of a wide range of materials. Advice should be sought from the DSO as to whether disposal to drain is appropriate. **Do not put any chemical down the sink without first consulting the DSO.**

The following materials may be disposed of down the sinks but must first be massively diluted and followed by copious amounts of water.

- Common, harmless inorganic salts *(including all drying agents such as $CaCl_2$, $MgSO_4$, Na_2SO_4, P_2O_5)*
- Buffers
- Dilute acids or alkalis (these should be neutralised prior to disposal)
- Any non-toxic water soluble chemicals
- Some water soluble solvents*

Hazardous, toxic, carcinogenic and water immiscible solvents CANNOT be disposed of in this way (and that includes most of the common solvents*), these have to be dealt with by the University’s waste system.

5.6. Disposal of Hazardous Chemical Waste through the University Waste System

A flow chart summarising the waste disposal routes is shown in Annex I.

Flammable reagents, solvents and materials on the following list must NEVER be poured down drains. This list includes, but not limited to, compounds of the following elements:-
•Antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, tellurium, thallium, tin, titanium, uranium, vanadium and zinc.
•Organohalogen, organophosphorus or organonitrogen pesticides, triazine herbicides, any other biocides.
•Cyanides
•mineral oils and hydrocarbons•poisonous organosilicon compounds, metal phosphides and phosphorus element •fluorides and nitrites

CAUTION: Acetone MUST NOT be disposed of to drain. Acetone vapour accumulating in the drainage system can cause explosions.

CAUTION: Acetone and chloroform MUST NOT be mixed because the mixture can result in an exothermic reaction

5.6.1. Disposal of Organic Solvent Waste

Organic solvent waste is segregated into 'HALOGENATED' (chlorinated) (**yellow-labelled**) and 'NON-HALOGENATED' (non-chlorinated) (**red-labelled**) bottles. Labelled 2.5 litre glass Winchester bottles are provided.
CAUTION: Check the relevant COSHH risk assessment and MSDS to identify which category generated waste falls into (refer to http://www.msds.com/**). If in doubt, seek the advice of the DSO before disposal to ensure the waste solvent is compatible with the contents of the waste collection bottle.**

CAUTION: NEVER MIX HALOGENATED WITH NON–HALOGENATED WASTE

(i) HALOGENATED ORGANIC WASTE; e.g. CHLORO, BROMO, FLUORO AND IODO SOLVENTS.

This includes, but not limited to, solvents such as:

- Chloroform
- Dichloromethane
- Bromoethane
- 2-Iodopropane
- 1,1,1-Trifluoroacetone

(ii) NON-HALOGENATED WASTE; e.g. ALCOHOLS, ALKANALS, ALKANONES, ETHERS.

This includes, but not limited to, solvents such as:
•Chloroform
•Dichloromethane
•Bromoethane
•2-Iodopropane
•1,1,1-Trifluoroacetone

(ii) NON-HALOGENATED WASTE; e.g. ALCOHOLS, ALKANALS, ALKANONES, ETHERS.

This includes, but not limited to, solvents such as:

- Methanol, Ethanol, Propan-2-ol
- Propanol, Butanol(note not formaldehyde)
- Acetone, Propanone
- Diethyl Ether, Petroleum Ether
- Acetonitrile
- Other toxic substances such as trypan blue

NOTE: Other solvents may be acceptable, please check with the DSO first.

The following procedures should be carried out to ensure proper labelling; safe handling and collection of solvents (refer to Table 1):

(i) Decant all toxic or volatile waste within a fume hood or other suitably ventilated area (ie Gas Pod 1). **CAUTION:** DO NOT USE RECIRCULATING BIOLOGICAL SAFETY CABINETS. Separate containers for the halogenated and non-halogenated solvents should ideally be kept in a fume-hood or in a well ventilated area ie Gas Pod 1 (refer to Section 5.4).

(ii) Attach the label to the container as soon as the bottle is used as a collection container. Record the starting date on the label. The container must be uniquely numbered and accurately labelled as Halogenated or Non-halogenated. **Under no circumstances** may this label be altered by laboratory users: - the Chemistry Department will not accept containers where the label has been altered.

(iii) As ingredients are added to the container, maintain a separate list recording the ingredients and amounts added (Section 8). Log the constituents of the waste and volume you have disposed into the Winchester container e.g. Ethanol with 0.1% trypan blue, 50ml, and your name and the date on the waste disposal form FSOP039.2 provided (Section 8).

(iv) Retain the list next to/near the container.

(v) Keep containers in the process of being filled closed and stored in a safe location in Gas Pod 1 or T208B. **NOTE:** the storage location should be selected based on the characteristics of the contents.

(iv) When the waste Winchester container is 75% full, transfer to a secondary safety container, and take to the temporary holding area in Gas Pod 2, using an appropriate solvent carrier, to await collection OR arrange disposal by contacting the Laboratory Manager and/or DSO.

(vi) Obtain a fresh Winchester and start new FSOP039.2 form. Notify the laboratory manager.

Table 1: Non-halogenated and Halogenated Solvent Waste Segregation

LIQUID WASTE	EXAMPLES	CONTAINER	LABEL	DISPOSAL ROUTE

Non-halogenated solvents	Acetone Alcohol Hexane Acetonitrile Acetic acid	2.5 litre Glass Winchester bottle	Red label CHEMICAL WASTE – Non-halogenated waste (List primary components)	All these disposals are completed by the University Waste Disposal Route. Contact DSO
Halogenated Solvents	Chloroform Methylene chloride 1,1,1-trichloroethane	2.5 litre glass Winchester bottle	Yellow label CHEMICAL WASTE – Halogenated waste (List primary components)	

5.7. Disposal of unused or outdated chemicals

Unused or outdated chemicals that are in their original containers, with labels identifying the contents, are suitable for waste collection. If the label appears faded or illegible, affix a new label to the bottle.

Unused or outdated chemicals waste should be entered on a waste disposal form (Section 8).

5.8. Disposal of Empty Chemical Bottles and Glass Waste

Empty chemical containers, both glass and plastic may be disposed of in the waste containers provided in the CBE Laboratories. Ensure that these have been thoroughly rinsed and the outside of the containers cleaned BEFORE disposing. Bottles that cannot be washed out (e.g. hydrofluoric acid bottles) or bottles that stubbornly resist cleaning must be treated as hazardous waste and be disposed of via the DSO.
Cardboard boxes for the disposal of glass waste, for example, broken laboratory glassware etc are provided in the CBE Laboratories. The boxes should be lined with a plastic bag. All glass must be clean or cleaned prior to being placed in the boxes. When the boxes are ready for disposal, they should be sealed (with tape), **clearly** marked as containing broken glass, and then placed in the holding area for collection.

Contaminated glass waste should be considered as hazardous waste, unless it can be cleaned, and dealt with in the appropriate manner. If the contaminated glass is broken, or otherwise has sharp or jagged edges, it is your responsibility to ensure it is packaged safely and labelled with full details of what is contained within the packaging and what the contaminant(s) is/are. Inappropriately packaged and/or labelled contaminated glass will not be accepted for disposal.

5.9. Dealing with Chemical Spills

5.9.1. Preventing Spills

The majority of chemical spills can be prevented or minimised by:

(i) Maintaining a neat and organized work area

(ii) Performing a laboratory procedure review prior to conducting new experimental procedures

(iii) The use of containment trays and/or Benchcote

(iv) Storing liquid chemicals in secondary containment bins

(v) Keeping reagent chemical containers sealed or closed at all times, except when removing contents

(vi) Ordering reagent chemicals in plastic or plastic coated glass containers whenever possible

(vii) Using secondary containment to store and move chemicals.

(viii) Making the materials for dealing with a spillage (materials for containment, absorbents, neutralisers etc.) available in the vicinity of the work so that no delay occurs before tackling and controlling the spill.

5.9.2. Spill Response Advice

(1) GET AWAY: If you see or smell a hazard move away to a safe distance, turn off any sources of ignition if you are not taking any personal risk in doing so. If you do not know how to properly deal with the spill, stay away and get someone with more experience.

(2) IDENTIFY THE SPILL: Do not go back to a spill. Did it have a label? Was it foaming or fuming? Was there a fire? What colour was it? Did it have a characteristic smell?

(3) GET HELP: Do not attempt to clear up a major spill on your own. Get assistance and when ever possible, a trained emergency spill team. In some cases the emergency services are required.

(4) SEAL OFF THE AREA: Keep other people away from the hazard. Warn people of the hazard.

(5) LOOK FOR INJURIES: If you find someone injured get them to fresh air as soon as safely possible. Keep them warm and quiet. Seek medical help. If the victim is not breathing perform artificial respiration if it is safe to do so, remember they may have contacted something poisonous. Remove any contaminated clothes and if the hazardous material has come into contact with the skin flush with running water for no less than 15 minutes. DO NOT BECOME A CASUALTY YOURSELF. If you do not have the right protective equipment, do not retrieve a casualty from a spill area. Where casualties are involved first aid and or medical personnel should be called to attend.

(6) IDENTIFY THE HAZARD: Identify what chemical(s) are involved in the incident; evaluate what the potential dangers are by consulting the MSDS (MATERIAL SAFETY DATA SHEET), COSHH assessment form or SIGNS AND LABELS.

There are several factors which affect the risks caused and the remedial action to be taken. The following should be considered:

(i) Nature of the Hazard - determines what personal protective equipment needs to be used when making the area safe; determines what other precautions need to be taken to minimise

the risks. e.g. on spillage of an acid the first action would normally be to dilute the spillage with water, whereas the first actions on spillage of a flammable solvent would be to extinguish all ignition sources and to prevent the solvent getting to a drain.

(ii) Physical State of material - can increase risks and the difficulty in decontaminating the area of the spillage. Solid materials are usually the easiest to control, but fine dusts (like gases) are difficult to control. The use of ventilation and a suitable respirator will probably be necessary while decontaminating a major spillage of hazardous fine dust.

Liquids are often volatile or generate fumes and aerosols after a spillage; in these cases ventilation of the spillage area and use of a suitable respirator will probably be required when decontaminating the affected area. Spilled liquids should be contained, absorbed, diluted or neutralised. The use of containment is to prevent the spillage from spreading to a larger area and can be accomplished with commercial spill kits or improvised barriers of towels, sand or other available materials. Spillages of flammable solvents should be contained to prevent them from entering the drainage system. Liquids can be absorbed into a solid such as paper tissues Spilldri, cat litter or sand which can swept up and placed in a closed container for future treatment. Dilution is used to lower the risk from the liquid e.g. spilled liquid acids should be diluted with water and then neutralised with a carbonate such as sodium carbonate or bicarbonate and then absorbed or mopped up. If the liquid is flammable and water immiscible do not try to dilute this with water since the solvent will float on the surface and be spread over a wider area thus increasing the risk of fire.

Some substances on their own or in contact with the air or water can generate hazardous gases or vapours. Being gases these are difficult to control and often require the use of appropriate respirators and ventilation of the area where the spillage occurred. Examples of this kind of spillage are diethyl ether and thionyl chloride. Both of these give off vapours. The flammable vapour from diethyl ether is dense and can run along surfaces and floors for long distances before being ignited by an ignition source causing a sheet of flame to flash back to the source of the spillage. The vapour from thionyl chloride in contrast is irritating to the eyes and respiratory system. In contact with water or moist air toxic sulphur dioxide and hydrogen chloride are liberated.

(iii) Scale of a Spillage - the larger the spillage the greater the risk and the more likely that the Emergency Services will be needed. The risk of major incidents following large volume spillages of flammable solvents, volatile toxic substances or corrosive substances is high.

(iv) The number of people who can be affected by exposure to the Spillage. - the more people who can be exposed to the hazardous substance the greater the risk. Therefore all personnel not involved in the cleaning up of the spillage should be evacuated to a safe area until the spillage is declared safe.

(v) Location of the Spillage - the risks arising from a spillage vary widely from one location to another. The spillage of a Winchester of hazardous substance in a laboratory creates a large risk but the same spillage in a main corridor or outside the laboratory creates a risk of a

significantly higher magnitude. Therefore, when transporting hazardous materials through public areas or outside of buildings special precautions should be observed. Transportation of hazardous materials outside laboratory areas should ideally be in unbreakable sealed containers, within secondary containment. Also, the existence of other factors in the location of the spillage will affect the risk created e.g. ignition sources next to a spillage of flammable solvent. The liberation of heavy vapours or gases in or near basements or other low areas can produce a range of particular risks. These gases collect in low areas potentially leading to asphyxiation from displacement of oxygen. Further risk of a major explosion could also occur if a dense flammable gas such as diethyl ether vapour was allowed to collect in a low, unventilated area.

5.9.3. General Guidelines for Chemical Spillage Clean Up

Most spillages are small and create minimal or no risk. If the material involved is not hazardous, it simply can be cleaned up by normal operations such as brushing or mopping up the spill. However, on some occasions the spill may be on a larger scale and may involve a hazardous material. It is important to know what to do before the spillage happens so that remedial action can be prompt and harmful effects minimised. If a hazardous substance is being used, a COSHH risk assessment will be available and it should include a plan for dealing with any spillage. This in turn should mean that the materials required for dealing with the spillage should be readily available.

1. Having followed steps 1 to 6 in Section 5.9.2., notify the DSO if this has not already been done, and then;

If the spill can be dealt with at a laboratory level i.e. if the material is not particularly volatile, nor toxic, and poses no fire hazard, **proceed as follows:**

(i) Make sure you have the correct personal protective equipment to deal with the spilled material.

(ii) Take the spillage kit to the site of the spill.

(iii) Liberally spread the absorbent material in the spill kit over the liquid spill. NOTE: Liquid can be cleaned up by using an absorbent material which neutralizes them, for example, sodium bicarbonate solution or powder for acids, or sodium thiosulfate solution for bromine etc – **Check MSDS for advice.**

(iv) Using the dustpan and brush shovel and sweep up the absorbent and place it in the disposal bag (do not overfill the bag). Label the bag appropriately (for example; methanol on spillage absorbent) and contact the DSO for waste disposal.

(v) Record all significant spills in the Spill Record Log (a template can be found in section 8.3). Report accidental spillage of chemicals to the Laboratory Manager or DSO who will advise on the appropriate forms to complete.

For Solid Spills use the following procedure:

- Use the plastic shovel to place the spilled material into a disposal bag. Care should be taken so as not to create dust or cause the contaminated powder to become airborne.
- After the bulk of the material is cleaned up, wet a spill pad and wipe the area down.
- Place the pads into the disposal bag.
- Wipe the area down with a wet paper towel. Dispose of paper towel with the waste generated from the spill clean-up. Seal bag with tape.
- Record all significant spills in the Spill Record Log (a template can be found in section 8.3). Report accidental spillage of chemicals to the Laboratory Manager or DSO who will advise on the appropriate forms to complete.

2. Laboratory personnel can clean up the majority of chemical spills that occur in the CBE Laboratories. However, due to the hazardous properties of certain chemicals or size of the spill, assistance from the DSO may be necessary when a spill occurs. The following contains a list of chemical classes with examples that might require assistance from the DSO:

- Strong Acids - Any acid that is concentrated enough to fume or emit acid gases i.e. Fuming Sulphuric Acid, Red Nitric Acid, Hydrofluoric Acid, Perchloric Acid
- Strong Bases - Any base that is concentrated enough to emit vapours i.e. Ammonium Hydroxide
- Poison by Inhalation - Any chemical that readily emits vapours / gases at normal temperature and pressure that are extremely toxic by inhalation i.e. Phosphorous Oxychloride, Titanium Tetrachloride, Formates, Isocyanates
- Reactive - Any chemical that is sensitive to air, water, shock, friction and/or temperature i.e. Dry Picric Acid, Lithium Aluminium hydride, Sodium Borohydride, Phosphorus Metal, Organic Peroxides
- Mercury - Any mercury compound i.e. Metallic Mercury, Mercury Salts, Aqueous Mercury Solutions. **NOTE:** ALL spillages of mercury MUST be reported, irrespective of size, to the DSO.
- Extremely Toxic - Any chemical that is readily absorbed through the skin and is extremely toxic at small concentrations i.e. Benzene, Sodium Cyanide,

Having followed steps 1 to 6 in Section 5.9.2., i**f the material is particularly volatile, flammable or toxic, proceed as follows:**

(i) ALERT everyone in the laboratory to extinguish flames or sources of ignition, disconnect spark-producing equipment, shut down all experiments, and evacuate the laboratory.

(ii) Contact the DSO immediately

5.10 Emergency Action for Accidents Involving Hazardous Chemicals

For accidents where chemicals are involved, prompt action is essential and **must not** be delayed until medical help arrives. **In the first instance, consult the appropriate COSHH risk assessments - these should contain possible adverse health effects and detail what immediate action should be taken.**

Some general principles that should be observed in the case of a serious or potentially serious accident are outlined below:

(i) In the case of eye injury where splashes of chemicals have entered the eye,

- Commence irrigation with running clean, cool water. Mains water supply is adequate for this purpose but if not immediately available, eye wash bottles should be used.
- Do not attempt to touch the eye or remove particulate matter, this requires expert medical attention.
- Continue the irrigation for at least 15 minutes.
- If irritation still remains after the flushing period, or returns later, then medical help should be sought.

(ii) In the case of skin contamination with corrosive chemicals

- Remove contaminated clothing not stuck to the skin and flush with plenty of water for 10-15 minutes.
- Apply a sterilised dressing to the exposed, damaged skin and send to hospital.
- **NOTE:** Specific materials may require specialised treatment e.g. contamination by material containing hydrogen fluoride, these should be highlighted on the risk assessment form, and the emergency response put in place accordingly.

(iii) In the case of Chemical Hazard Ingestion and Inhalation

- Inhalation: Use suitable protective equipment to move the casualty into the fresh air.
- If the symptoms persist, or the assessment dictates, send or take the casualty to hospital with full details, as available, of the chemical involved.
- Mouth: If the chemical has been confined to the mouth, give copious amounts of water as a mouth wash, ensuring that the mouth wash is not swallowed.
- If the chemical has been swallowed and the patient is conscious, give him/her a pint of water to drink immediately and send to hospital with details of the chemical swallowed.

(iv) In the event of a serious injury requiring medical attention, individuals should attend the Accident and Emergency Department/Minor Injuries Unit of the local hospital.

(v) If First Aid is required at the site of an incident, locate the nearest First Aider. Where a qualified first aider administers treatment and decides a referral to an A & E department or walk in centre is called for, but that the condition is not life threatening so an ambulance is not required, a First Aid Taxi Service is available. The procedure for using this service can be found by clicking on the First Aid Taxi Service Guidance Notes; http://www.lboro.ac.uk/admin/hse/accidents.html).

(vi) Out of normal working hours, contact the Accident and Emergency Department/Minor Injuries Unit of the local hospital.

5.11. Reporting and Recording Accidental Chemical Spillage

(i) Record all spills in the Spill Record Log (a template can be found in section 8). Report accidental spillage of chemicals to the Laboratory Manager or DSO who will advise on the appropriate forms to complete.

(ii) In the event of any accident or incident where exposure to a chemical may have occurred, inform the University Health and Safety Department and the Occupational Health Unit immediately.

(iii) Report all accidents and instances of occupational ill health (illness reliably attributed to a work activity) to the University Health and Safety Department as soon as possible after the incident has occurred, so that the requirements of the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations may be met. Any reporting required under these Regulations will be undertaken by the Health and Safety Department.

NOTE: No accident should be considered too trivial to report. Near misses that could have had serious consequences should also be reported. Details of the accident reporting system in the University are available on the Health and Safety Department website.

NOTE: For guidelines on how to complete an accident report form, please consult Guidance Note, "Reporting of Accidents, Dangerous Occurrences and Occupational Ill Health - Staff, Students, Contractors and Visitors" (Available at http://www.lboro.ac.uk/admin/hse/accidents.html.

(iv) Forward copies of accident and near misses records involving potentially hazardous biological material to the DSO

(v) Any serious injury will be investigated by the CBE Laboratory Management Committee (and potentially by the University Safety Office). In the event of an investigation, you will be required to produce signed risk assessments, protocols and laboratory books within 24 hours of the incident being reported.

(vi) In the event of an Emergency First Aid incident dial 999 from the nearest telephone. Once you have spoken to the ambulance controller please inform University Security (see emergency contact displayed on the laboratory wall)

5. DOCUMENTATION

The following records are outputs of this SOP:

FSOP039.3 Spill Record

These records shall be filed and stored in the CBE Office or otherwise archived for future review or retrieval.

NOTE: Chemical Inventory Instructions and COSHH Spreadsheet.

All hazardous chemicals that are maintained in the laboratory must be lincluded on the Chemical Audit and also the COSHH spreadsheet or Non-hazardous spreadsheet. The hazardous chemicals or products shall be listed by the same name that is on the label and on the MSDS. This form must be updated and available for inspection if required. The Laboratory Manager must keep the inventory form and it shall be readily accessible to employees.

Place all appropriate information on the form in the space provided.

Identity- Place in this column the name of the material as it appears on the container's label and/or MSDS

Chemical Contents- If you are reporting a mixture of chemicals, place as many of the chemical names (shown in the MSDS) as you can in the space provided. When reporting a mixture with a generic name the individual ingredients do not have to be listed. If the product you are reporting has a trade secret formula, the generic name (provided on the MSDS) may be used. If the MSDS does not provide a generic chemical name, the words "Trade Secret" may be used.

COSHH Assessment Number- Place the COSHH Number of the substance in this column.

Container Type- Use on or more of the following letters in this column to describe the storage container for the hazardous chemical:

A. Steel drum
B Plastic/non-metallic drum
C. Can
D. Carboy
E. Bag
F. Box
G. Glass bottles
H. Plastic bottles
I. Other

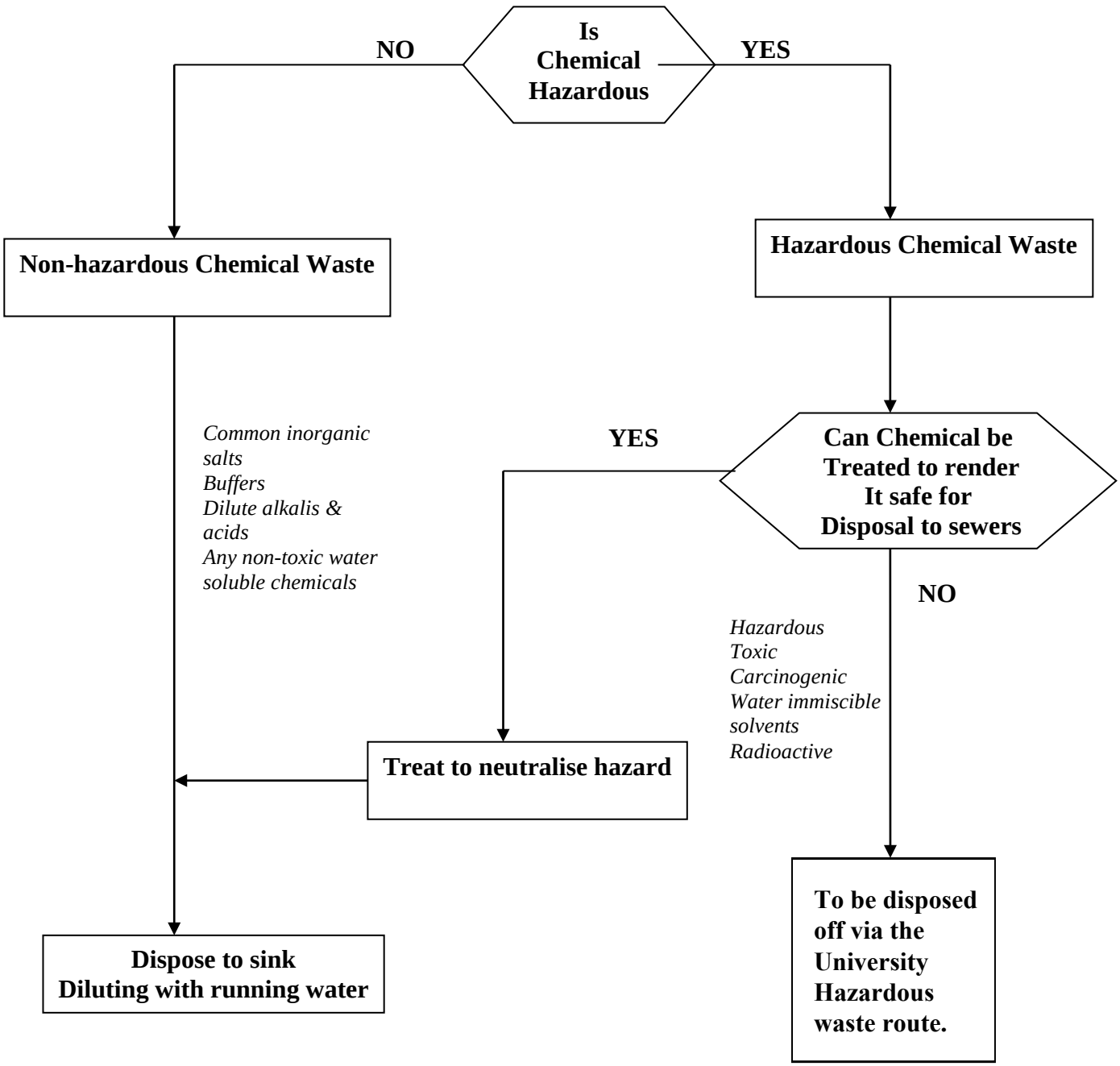
Quantity or Amount - Place in this column the maximum amount (in grams or mls/bottle) of each hazardous chemical stored on any one day during the year. Include the number of bottles and concentration if available.

Standard Operating Procedure **SOP039**

Title: STORAGE, HANDLING AND DISPOSAL OF WASTE CHEMICALS AND SOLVENTS

Location: CBE Laboratories

Annex I: Flow chart summarising the chemical disposal route.



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Annex II: List of symbols, abbreviations, risk and safety phrases

Note: these symbols, abbreviations, risk and safety phrases relate only to the Chemicals (Hazard Information and Packaging for Supply) Regulations 2009 – known as CHIP 4 or CHIP).

AII-A: Symbol, abbreviation and description of hazard

Symbol	Abbreviation	Hazard	Description of hazard
(Physicochemical)			
	E	explosive	Chemicals that explode.
	O	oxidising	Chemicals that react exothermically with other chemicals.
	F+	extremely flammable	Chemicals that have an extremely low flash point and boiling point, and gases that catch fire in contact with air.
	F	highly flammable	Chemicals that may catch fire in contact with air, only need brief contact with an ignition source, have a very low flash point or evolve highly flammable gases in contact with water.
(Health)			
	T+	very toxic	Chemicals that at very low levels cause damage to health.
	T	toxic	Chemicals that at low levels cause damage to health.
	Carc Cat 1	category 1 carcinogens	Chemicals that may cause cancer or increase its incidence.
	Carc Cat 2	category 2 carcinogens	
	Carc Cat 3	category 3 carcinogens	
	Muta Cat 1	category 1 mutagens	Chemicals that induce heritable genetic defects or increase their incidence.
	Muta Cat 2	category 2 mutagens	
	Muta Cat 3	category 3 mutagens	
	Repr Cat 1	category 1 reproductive	Chemicals that produce or increase the incidence of non-heritable effects in progeny and/or impairment in reproductive functions or

		toxins	capacity.
	Repr Cat 2	category 2 reproductive toxins	
	Repr Cat 3	category 3 reproductive toxins	
	Xn	harmful	Chemicals that may cause damage to health.
	C	corrosive	Chemicals that may destroy living tissue on contact.
	Xi	irritant	Chemicals that may cause inflammation to the skin or other mucous membranes.
(Environmental)			
	N	dangerous for the environment	Chemicals that may present an immediate or delayed danger to one or more components of the environment

Standard Operating Procedure **SOP039**

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SOP Version History

Version Reviewed	Date Revised/ Reviewed	Revision Summary	New Version Number
1.0	25.03.10 Reviewed & revised by P.Hourd	1. Revised the 'Purpose' statement to emphasis the link to COSHH risk assessments 2. Revised 'Scope' to emphasize link to COSHH and local Codes of Practice 3. Section 4: Added COSHH Compliance section (4.1) 4. Section 7: Added 'Principles for Safe Storage' section (7.1.1) 5. Section 7: Revised storage guidelines - added guidelines for segregation of specific types of hazardous chemicals. 6. Section 7: Revised waste storage guidelines - added guidelines for segregation of hazardous chemical waste. 7. Revised the 'Classification' section – added a 6-step procedure for assessment of waste 8. Revised 'Spill' section to improve clarity on the use of COSHH risk assessments. Added guidelines for assessing factors that affect risks caused and remedial action to be taken 9. Revised 'Emergency' section to improve clarity on the use of COSHH risk assessments 10. Section 8.1: Revised description of 'Quantity' to include requirement for 'quantity per bottle', number of bottles and concentration	2.0
2.0	16.06.10 Reviewed by C.Kavanagh	1)Section 4.4.3 (viii) Added a statement to say that Trypan Blue is a known carcinogen . Disposal of Trypan blue should be through the cytotoxic waste route. Refer to SOP029 & SOP003 for more details.	3.0
3.0	23/02/2011 P.Hourd	Revised scope to include CBE Tissue Engineering Laboratory (T208B), located in the Wolfson School. Added Section 7.4.2. for packaging, storage and transport of waste in T208B	4.0
4.0	17 October 2012 A. Chandra	Revised to move to the new SOP format. 1. Included the use of the fume hood for light usage. 2. Revised the layout of the Gas Pod and included usage of the fume hood for decanting material.	5.0
5.0	04/08/21 J,Bowdrey	Revised and updated to the current University guidelines and also to the current Hazard and Precautionary Statements	6.0