Reduction of Unintentionally Produced Persistent Organic Pollutants (UPOPs) emissions by improving waste management practices at landfills

Workshop – Overview of HWISFs

GEF Project ID: 5558 – Component 2 - Development and Implementation of a Sustainable Management Mechanism for POPs in the Caribbean

18 November 2021

BCRC CARIBBEAN
Basel Convention Regional Centre for Training and Technology Transfer for the Caribbean

UN environment
United Nations Environment Programme

Resources & Waste Advisory Group

gef

STOCKHOLM CONVENTION

UNIDO

3a. Hazardous Waste Facilities

Overview of design of hazardous waste facilities for project countries

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1

Design considerations

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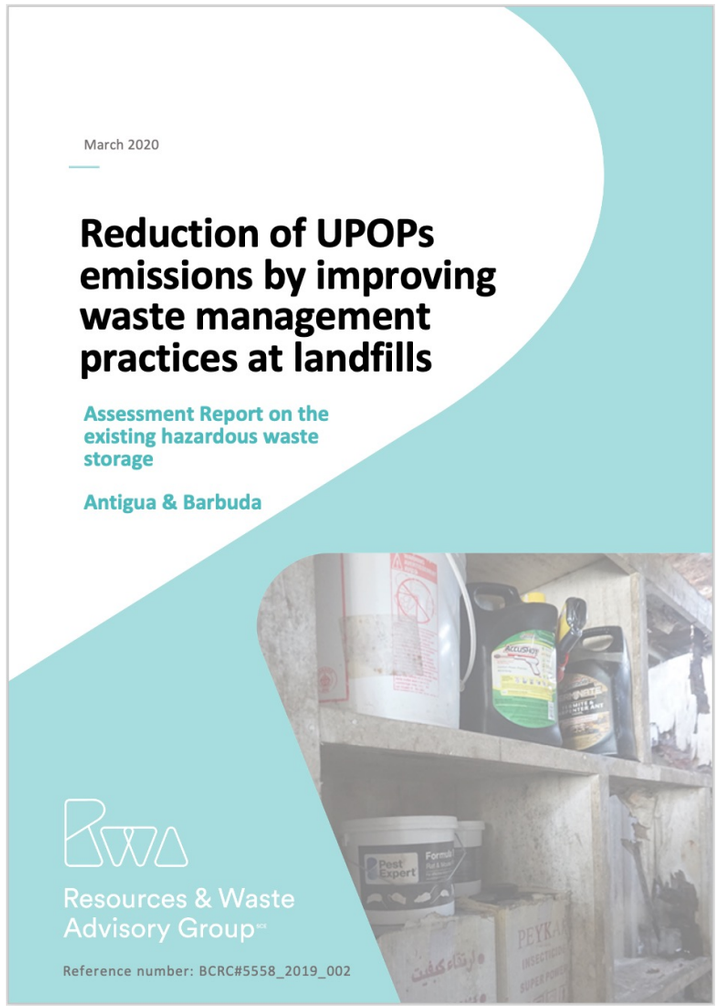
Hazardous Waste Interim Storage Facilities (HWISF)

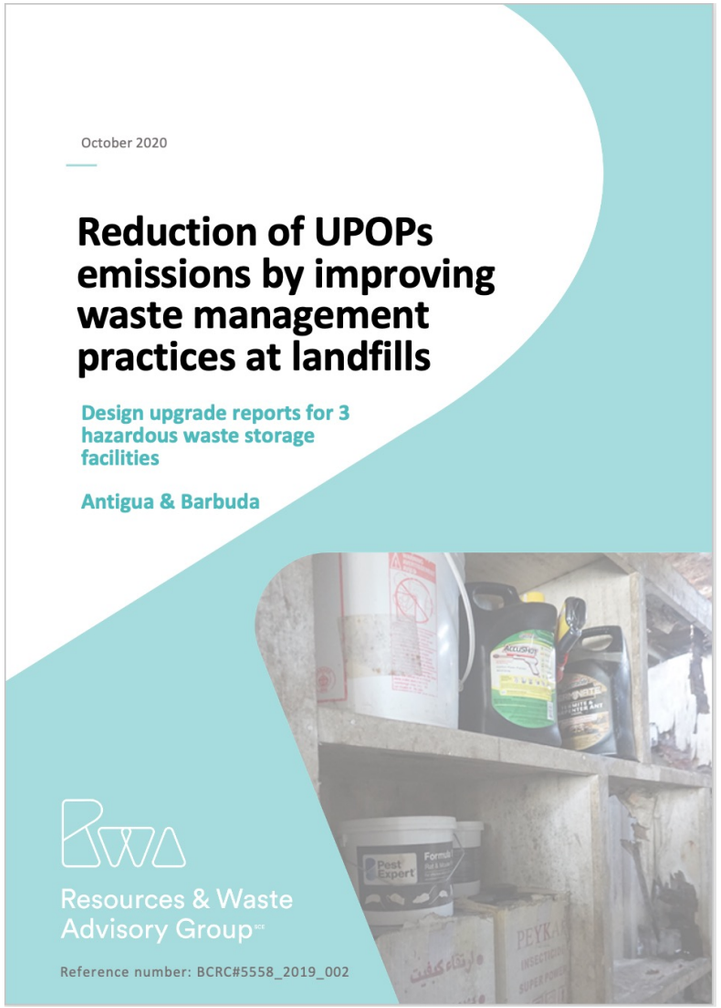
D8: Assessment Report on the existing hazardous waste storage

March 2020



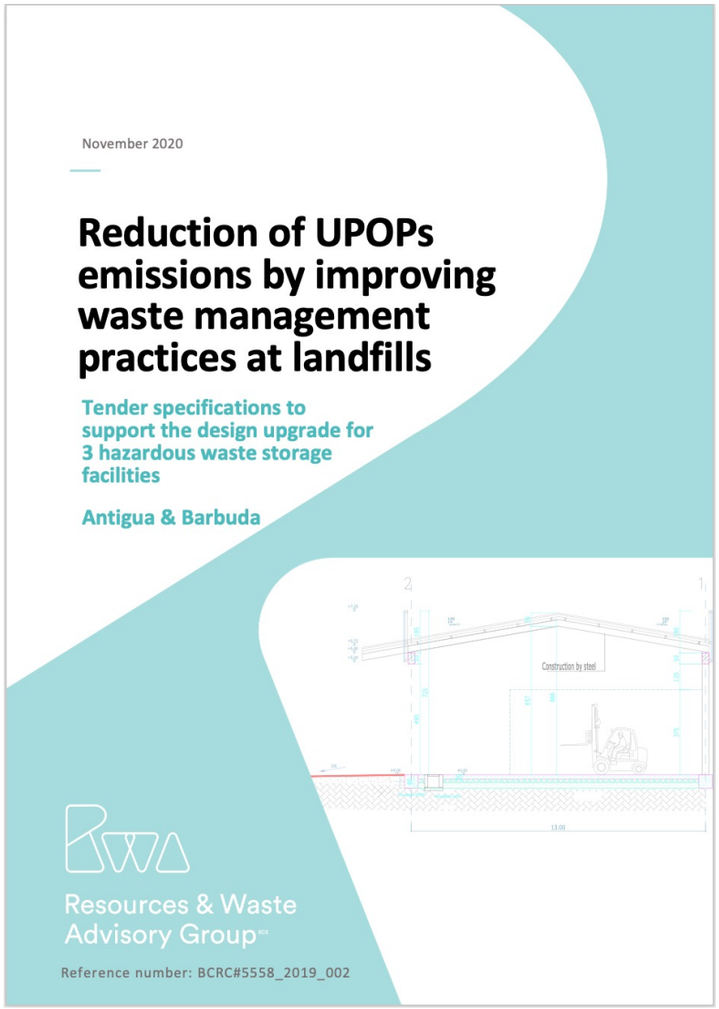
D9: HWISF – Design Upgrade Report

October 2020



D10-HWISF Tender Specs

November 2020



Assessment of Existing Conditions
Hazardous Waste - Storage Problems

Existing facilities

- **Antigua and Barbuda –** Existing facility is a shipping container in a dilapidated condition
- **Barbados –** HWISF was constructed at SBRC but currently used for compost bagging and was did not meet minimum design standards
- **Saint Lucia –** No facility available

Health & Safety

- **No designated or poor storage conditions**
- **Spillages or leaks**
- **Bulging/corroding containers**

Identification

- **Improperly marked/ labels**
- **Missing or lost labels**
- **Shortage of skilled trained staff & laboratories**

Example of poor storage - 1

Example of poor storage - 2

Example of poor storage - 3

The need for HWISF

- Interim storage and export of hazardous wastes provides for environmentally sound HW management
- Facilitate bulking, regrouping, repackaging and labelling of hazardous wastes for storage and subsequent shipment to licensed facilities for recovery/treatment/disposal
- Storage of hazardous wastes safely before shipment to licensed recovery/treatment/disposal facilities
- Rationalise logistical costs through the collection, storage and shipment of the maximum quantity of hazardous wastes
- Located away from sources of heat or fire
- Not located in areas that has the potential to be flooded or close to the edge of hill or slope

HWISF Design and Operational Requirements

Above all else, a sustainable operator model with competent operator.
Proper design
Adequate storage capacity
Proper operating procedures and appropriate containers
Good storage practices and packaging
Adequate testing equipment

Main Hazardous Wastes being generated

- Reactive and inorganic chemicals, organic solvents arising from laboratories;
- Acids (e.g. from ULABS);
- Used oil sludge and oily wastes (rags, filters, contaminated absorbent material, etc - with regards to used oil filters the oil will have to be removed by crushing and metal housing recycled or disposed to landfill);
- Plastic (PVC, BFR) housings of electronic wastes;
- Cathode Ray Tubes (CRT);
- Mercury and mercury lamps
- Packaging containers for pesticides and hazardous chemicals

Storage Capacity

- Must accommodate irregular generation volume and delays from collection contractors
- Provide extra storage capacity of the actual maximum amount of waste generated (e.g. 25% reserve)
- Capacity should comfortably exceed the normal collection interval
- Should have adequate space for segregation of incompatible and high-risk waste

Inventory and prediction of quantities made (ANU)

Hazardous waste	Description	Annual amount requiring storage in kilogram or litres				
Year		2020	2021	2022	2023	2024
Chemical wastes/ pesticides residues in empty containers *	Inorganic wastes, wastes organic solvents (may contain halogenated solvents) - Solutions containing heavy metals	51 00	5 202	6 367	7 577	8 832
Used oil Sludge	Organic solid	86 700	88 434	108 243	129 080	150 144
Acids	Inorganic liquid	4590	4681	5730	6819	7948
Total Storage requirements		124 440	126 928	155 360	185 149	215 503

Year wastes collected in	Amount solids, tonnes	Amount liquids, Cubic metres	Total amount of solids and liquids	Approximate number of 210 litre drums
2020	119.3	5.1	124.4	593
2021	121.7	5.2	126.9	605
2022	148.9	6.4	155.3	740
2023	177.5	7.6	185.1	882
2024	207.2	8.8	216.0	1029

HWISF Design Requirements

Designed to allow for the storage of wastes with the following characteristics, based on the classification according to National Legislation and Basel Convention, Annex III, which includes:

- Flammable liquids and solids;
- Wastes liable to spontaneous combustion
- Oxidizing waste
- Poisonous waste
- Corrosive waste
- Toxic and Eco-toxic waste

HWISF Design Requirements - compartments

Best practice dictates that the storage should be partitioned by fire resistant walls into three sections for safe keeping of:

- Highly flammable chemicals in section one,
- Other chemical waste in section two, and
- All remaining types of waste intended for storage in the third compartment.
- A fourth compartment required for sorting and inventorying materials, but fire wall was not an essential requirement in this section

Design

- Can be Modular type - modules to allow interim storage buildings be added in accordance with the actual waste amounts and types collected

- International standards for storage of organic waste require a safety distance between each storage building of up to 15 metres

Design

- Gravity drainage wherever possible
- Buildings designed for cyclone loading
- Restricted access to site
- Robust fire fighting system

HWISF Design Requirements – service needs

For the design of the storage and the required equipment the following aspects were considered:

- Required storage capacity and equipment;
- Type of storage containers;
- Design of the storage building and manoeuvring area;
- Ventilation;
- Building services (water and electricity supply, wastewater discharge);
- Fire prevention and firefighting equipment (fire extinguishers);
- Technical safety equipment for personnel.

HWISF Design Requirements – Equipment

The HWISF will be equipped with the following installations to assure an effective and environmental sound operation of the facility:

- Shelves with drain pans
- Collection systems for spillage
- Separate rainwater and deviation system
- Manoeuvring area for delivery and transport trucks
- Fence and lockable gate
- Interior and exterior lightning
- Signage to ensure clear separation and containment of wastes
- Firefighting equipment
- Emergency shower
- Waste registration and sorting area
- Weighbridge and facilities for the staff (social rooms) can be used from the nearby landfill

Testing Equipment

- UV-Vis spectrophotometer for chlorine
- pH/EC meter
- Calorimeter for determining calorific value
- AAS
- Total Organic Carbon (TOC) analyser
- Ion chromatography equipment for determination of anions
- Flash point tester
- Muffle Furnace (1100oC) for volatiles

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Operation

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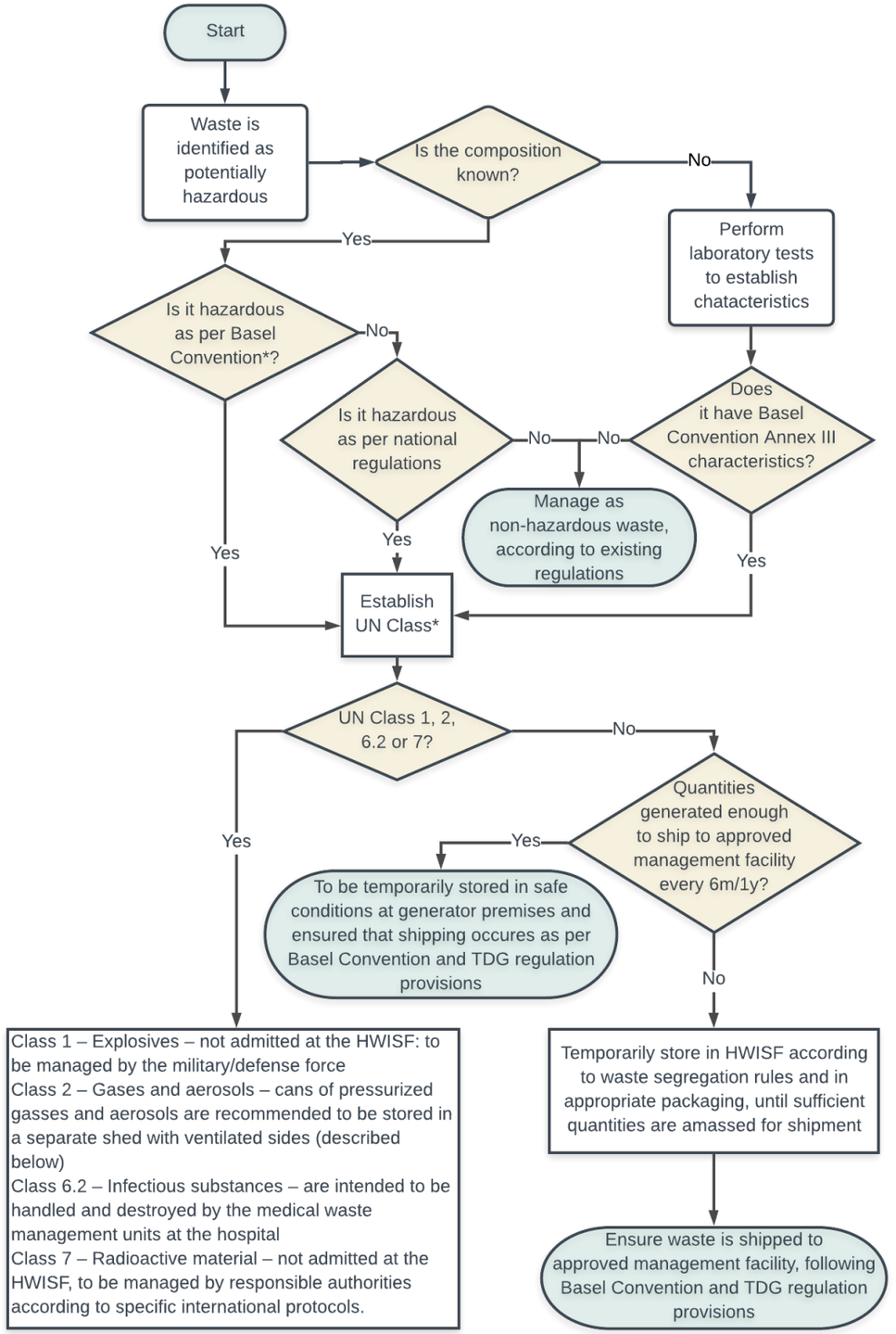
Operations process

- Pre-acceptance Procedures
- Transportation of Hazardous Wastes to Facility
- Receipt of Hazardous Wastes at the Facility
- Confirmatory Testing and Acceptance of Hazardous Wastes
- Sorting, Transferring, Bulking, Regrouping, Reconditioning
- Repackaging and Labelling of Hazardous Wastes
- Storage of Hazardous Wastes at the Facility
- Exportation of Hazardous Wastes to Licensed Recovery/Treatment/Disposal Facilities

Operations process



Sorting (purpose)

- ❑ Minimize production of hazardous wastes
- ❑ Enable some wastes to be sent for recovery
- ❑ Reduce hazards by segregating incompatible and high-risk wastes
- ❑ Reduce quantities for treatment/disposal
- ❑ Enable different waste types to be directed to the appropriate destination

Segregation

Incompatible wastes

- Placement in an unsuitable container which may cause corrosion or decay of the container or its liner
- Mixing with another waste which would produce hazardous situations such as: violent reaction, heat generation, flammable gases (e.g. H_2), toxic gases (e.g. H_2S, HCN)
- Incompatible wastes need to be stored in separate containers, and such containers shall be placed in separate containment areas.

High risk wastes

- Potential risk of fire or explosion, for the release of toxic substances in case of fire
- Waste containing PCBs or other highly toxic organic materials
- Infectious wastes
- Mercury wastes

SEGREGATION OF CHEMICALS ACCORDING TO CHEMICAL COMPATBILITY

To help with segregation decisions, dangerous goods with similar chemical properties have been grouped together in **Segregation Groups**:

1. Acids	10. Liquid halogenated hydrocarbons
2. Ammonium compounds	11. Mercury and mercury compounds
3. Bromates	12. Nitrites and their mixtures
4. Chlorates	13. Perchlorates
5. Chlorites	14. Permanganates
6. Cyanides	15. Powdered metals
7. Heavy metals and their salts	16. Peroxides
8. Hypochlorites	17. Azides
9. Lead and its compounds	18. Alkalis

Segregation groups

these… +	Away from these… ➔Keep	Or you may get these…
Acids	Bases	Heat violent reaction
Acids or bases	Reactive metals (aluminum, beryllium, calcium, lithium, potassium, magnesium, sodium, zinc powder) metal hydrides	Fire Explosion Hydrogen gas
Water or alcohols	Concentrated acids or bases calcium, lithium, potassium, metal hydrides, other waste reactions	Heat / Fire / Explosion Flammable and toxic gases
Reactive organic compounds or solvents (alcohols, aldehydes, nitrated hydrocarbons)	Concentrated acids or bases, reactive metals and metal hydrides	Fire Explosion

Good Storage Practices

- Stacking
  - maximum of 3 tier high for drum storage
  - drums should be stacked vertically and not horizontally for stability
  - maximum of 6 drums per standard pallet
  - 3 tiers for crate storage
  - in rows two pallets wide

- No containers within 1.5 meters of perimeter bund
- Containers must not obstruct exits
- Equip with ventilation system for volatile wastes
- First In First Out (FIFO) system

Adequate containers

Hazardous wastes are generally stored in the following containers:

- Bunghole drum (steel/plastic) - for Inorganic or organic liquid waste, Steel drums should not be used for corrosive wastes such as acids or alkalis
- Open top drum (steel/plastic) with cover and clamp - used for solids and sludge, e-waste, pharmaceutical waste, laboratory waste, contaminated gloves
- Intermediate bulk container - used for a broad range of waste streams such as oils, solvents and acids
- Flexible Intermediate Bulk Containers (FIBCs) /Jumbo Bags / Bulk Bags / Polypropylene Big Bags - used for dry solid waste with no free-flow liquid e.g. dust, slag, ash, clinker, e-waste, dry sludge, contaminated rags

Typical storage of drums

Proper Packaging

UN 4G / X 3 / S / 16 / USA / LM0000

UN 1A1 / X 1.5 / 250 / 16 / USA / LM0000

- UN approved packaging - built, tested, and certified to carry liquid or solid dangerous materials. This is a unified means to ensure dangerous materials are transported safely.
- UN Rating is a series of number and letter codes that show what a container is regulated to handle. They determine this through a series of tests that all containers must undergo if they are to be UN Rated.

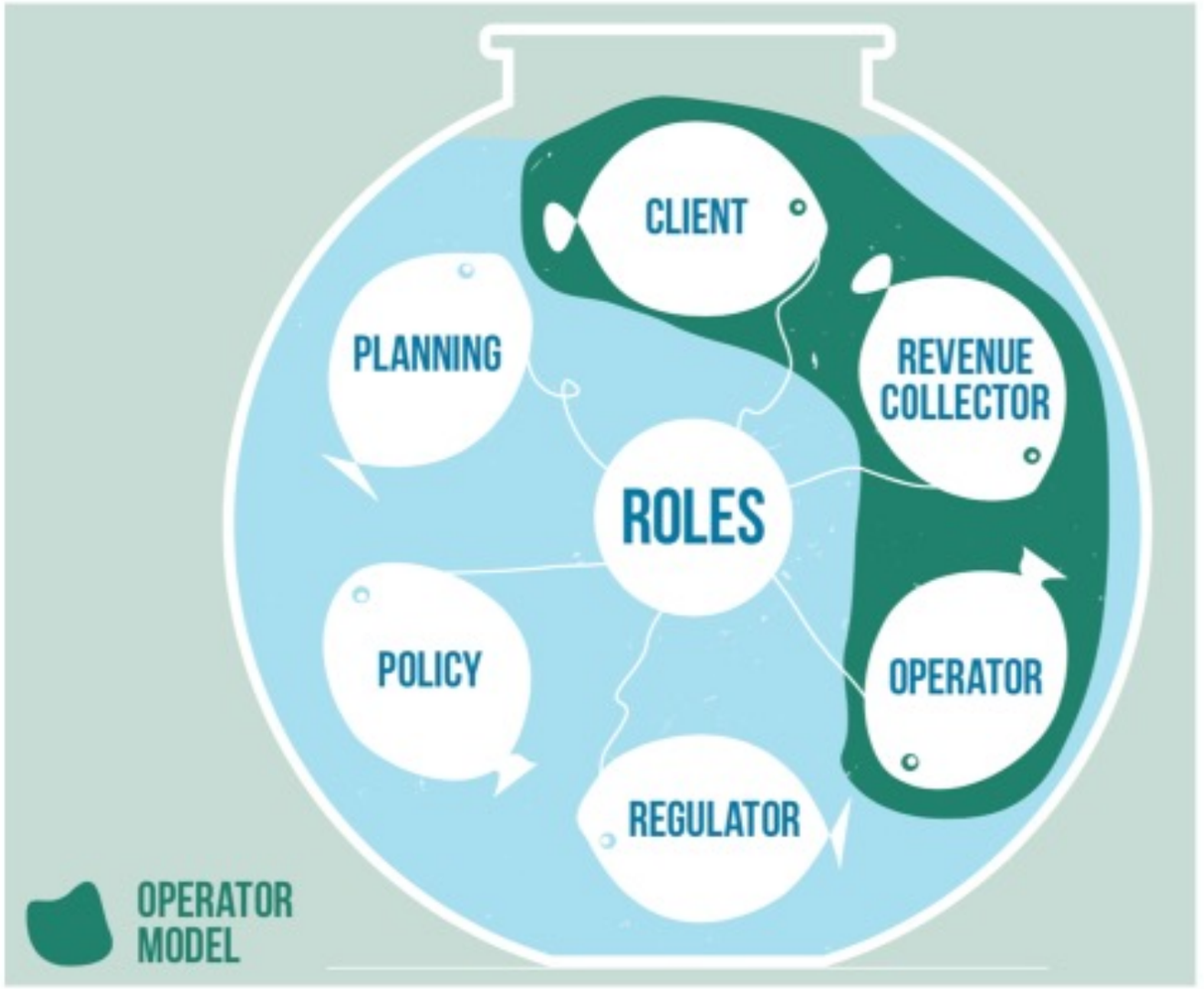
Storage of packed wastes

- Before storing the packed waste, HDPE liner should be placed to prevent potential ground contamination

- Packaging containing waste should be placed on new clean pallets and start placing them on the HDPE liner with the help of a forklift

- Adequate space between containers for easy access on loading/unloading operations and in case of an accident

Operator Model as important as facility design!



Operator Models. Respecting Diversity
Guidance Paper for Solid Waste Management Practitioners (GIZ)

3

Case study - Mauritius

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Case Study – Mauritius Hazardous Waste Interim Storage Facility

- The facility has been designed to receive hazardous wastes such as laboratory and industrial chemical wastes (acids, alkalis, heavy metals, spent organic solvents, organic sludges), paint wastes, obsolete pesticides, pharmaceutical wastes, waste gas cylinders and waste aerosols, amongst others, which cannot be disposed of locally.

- The contract for the construction of the facility was awarded to Local Civil Engineering Company in March 2015 for the sum of 6.5 million US Dollars. Construction works started in March 2015 and were substantially completed in June 2016

Case Study – Mauritius Hazardous Waste Interim Storage Facility

The interim hazardous storage facility has been developed over a portion of land of extent of 4.5 Ha and comprises the following:

(a) 3 no. storage building for hazardous wastes and one quarantine and packaging building, made of reinforced concrete and zinc/aluminum pre-painted profiled steel cladding and roofing

(b) One administration and laboratory block

(c) One workshop and consumable stores

(d) Concrete platform of an approximate area of 300 m² installation of a maximum of 7 No. containers for hazardous waste export

(e) Weighbridge

(f) Contaminated, surface water and roof water storage ponds

(g) Access drive and tarmac parking areas.

Case Study – Mauritius Hazardous Waste Interim Storage Facility

- After an international tender exercise, a 5-year contract for the operation, management and maintenance of the facility was awarded on 16 December 2016 for the sum of 9 million US dollars
- A period of four months was given to the Contractor to procure and install its equipment, furniture, consumables and vehicles and mobilize and train its personnel
- The facility started operations on 24 April 2017

FILM

Polyeco Group in Mauritius

https://youtu.be/s_BN59ZAFc0

Procedures for the acceptance of hazardous wastes

Inspection

- Generator submits an **application** online with an exhaustive list of wastes present at his premises (description, MSDS, etc.)
- Operator reviews list and determines determine what is hazardous or non-hazardous according to their respective UN Class e.g. Ethanol is class 3 and sodium hypochlorite is class 5.1
- Joint site visit effected to assess the situation of the hazardous wastes (where it is stored, how it is stored, is the area properly ventilated, is it easily accessible, are the different classes of hazardous wastes properly segregated so as to prevent any chemical reaction)

Example of no proper segregation and poor housekeeping

Use of PPE and segregation into classes

Inventory

- Name of the hazardous waste, its weight, the container in which it is present, the number of containers, UN Number, UN class and Packaging group are all noted down properly for further use
- For an unknown sample inspected, a sample is collected for analysis in our laboratory. The sample is tested for heavy metals, flammability (and if so the flash point), pH, calorific value, anion levels such a chlorine
- Data gathered is analyzed and a collection report is prepared to safely collect and store the different hazardous wastes

Further Segregation

Segregation is further done on the different classes. Below are the classes and their subclassification:

Class 2 – compressed gases

Class 3 – Liquid Flammables

Class 4 – Solid Flammables

Class 5.1 – Oxidizers – this class is subdivided into solid and liquid

Class 6 – Toxic – this class is subdivided into solid and liquid

Class 8 – Corrosive chemicals are first and foremost divided into acids or alkalis. Acids come in solids and liquids and these are further subclassified into organic and inorganic. Hence, we have acid solid inorganic, acid solid organic, acid liquid inorganic and acid liquid organic. Alkalis are classified in exactly the same way.

Class 9 – Miscellaneous hazardous wastes exists in solids and liquids.

Collection

- No repackaging is required

Hazardous wastes are collected in their original packaging and brought to the facility where they are then re-packaged into specific UN approved containers for transboundary shipment.

- Repackaging required

Quarantine area in the facility

- Within the Quarantine area the hazardous wastes that have already been re-packaged into their appropriate UN Approved containers are moved to their respective storage areas.
- Each storage areas contain hazardous wastes specific to its class.

Storage areas

- Initial storage will be in quarantine area
- Once lab results are received and the classification has been confirmed it is moved to the appropriate long term storage area
- Group together compatible hazardous wastes and those having the same nature, taking into consideration the specifications of the final treatment/disposal, prior to storage at the facility and subsequent shipment to licensed facilities for recovery/treatment/disposal.
- The purpose of regrouping is to obtain larger and more homogeneous volumes for waste treatment, to improve safety (e.g. facilitating handling) and to rationalise the logistics cost.

Storage areas

Repackaged wastes storage

Waste loaded to container for exportation

Wastes loaded for exportation

Exportation

Wastes have to be labelled, packed, secured, marked in accordance with the IMDG Code and other applicable regulations.

The person responsible for the packing of the hazardous waste cargoes to a freight container need to provide a signed Container Packing Certificate stating that the cargo has been properly packed and secured and that all applicable transport requirements have been met. Such a declaration has to be attached to the transportation documents.

Container Ready

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Case Study – Northern part of Cyprus

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Starting with the end - Hazardous Waste Interim Storage Facility

Example from north Cyprus

Hazardous Waste Interim Storage Facility

Example from north Cyprus – Fireproof separation walls between compartments

Hazardous Waste Interim Storage Facility

Example from north Cyprus – fireproof separation walls extend above roof line to prevent fire jumping across roof

Hazardous Waste Interim Storage Facility

Example from north Cyprus – Located at landfill site to make use of existing weighbridge, administrative building, waste management licence, logistics.

Hazardous Waste Interim Storage Facility

Example from north Cyprus

Hazardous Waste Interim Storage Facility

Example from north Cyprus

See short video at: https://youtu.be/wOrX6RznO9k

5

Design for Antigua

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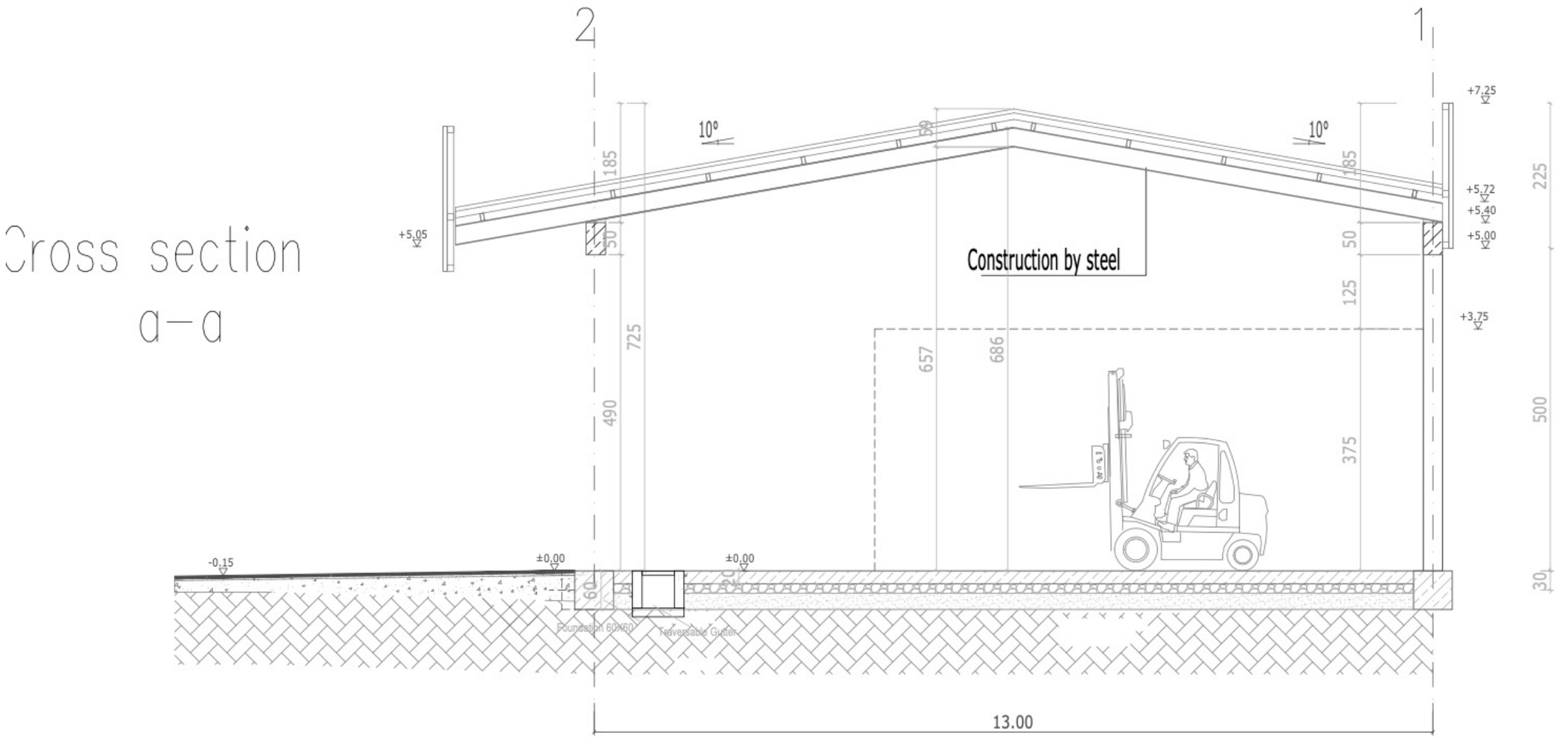
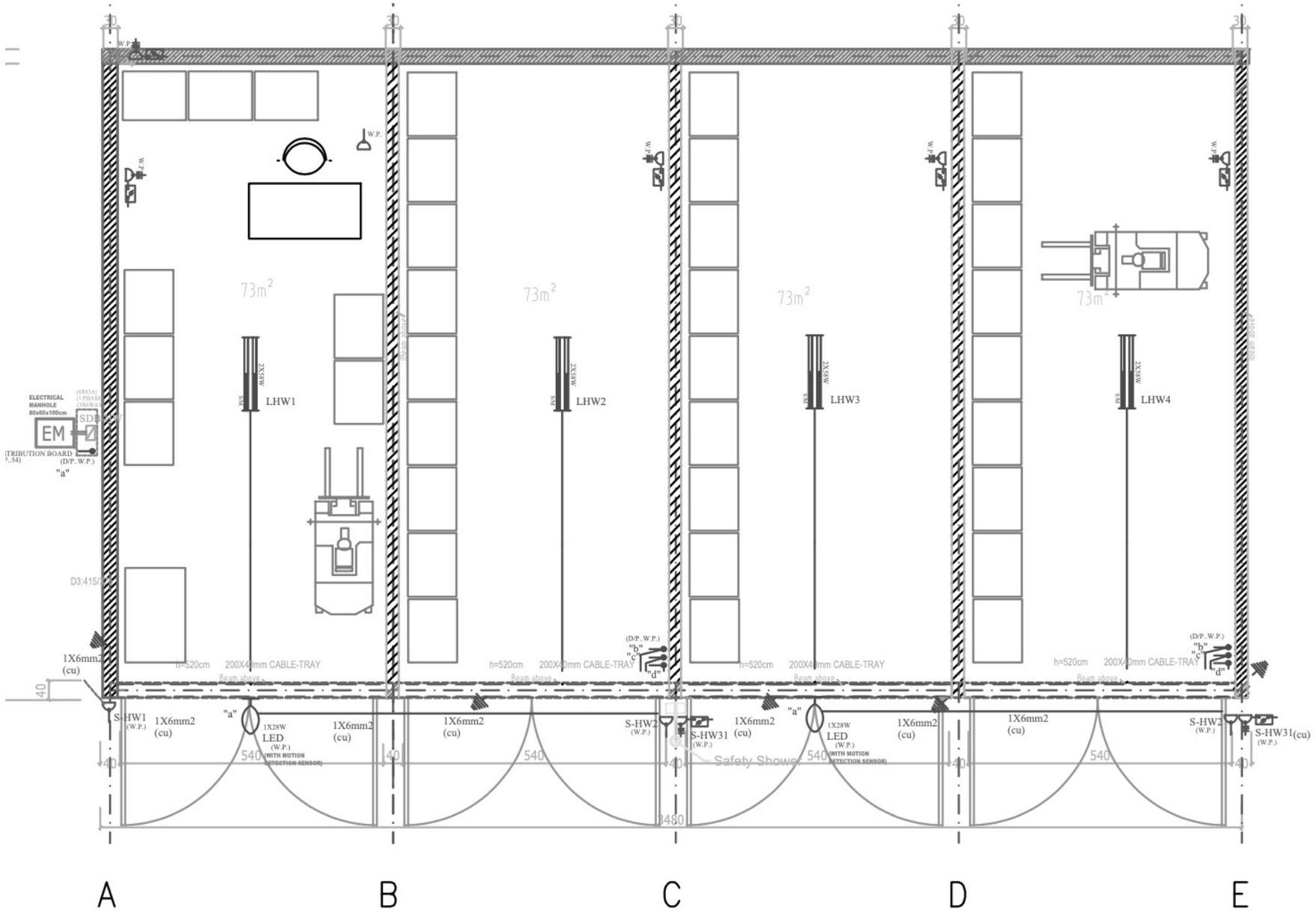
Hazardous Waste Interim Storage Facility

Design plans for Antigua

Conceptual Design Drawings, BoQs and Tender docs

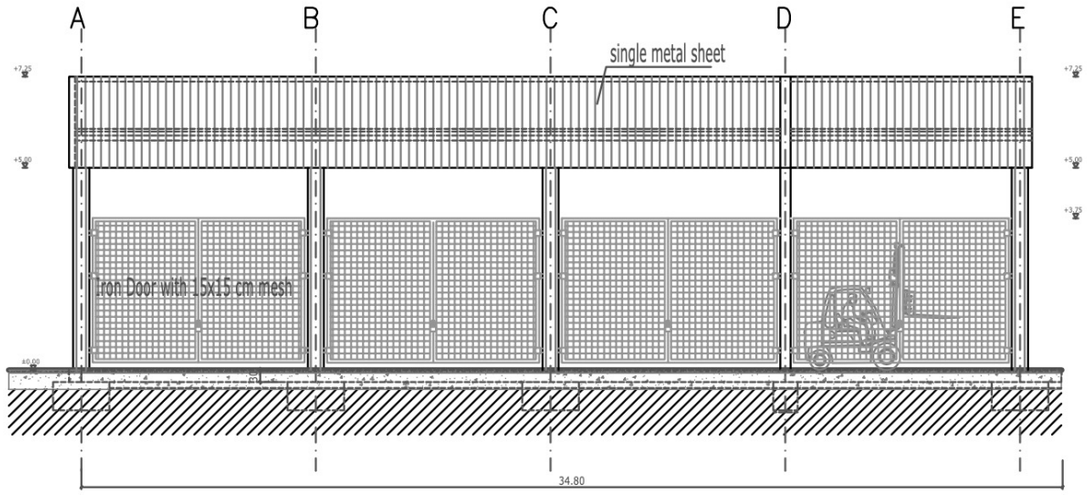


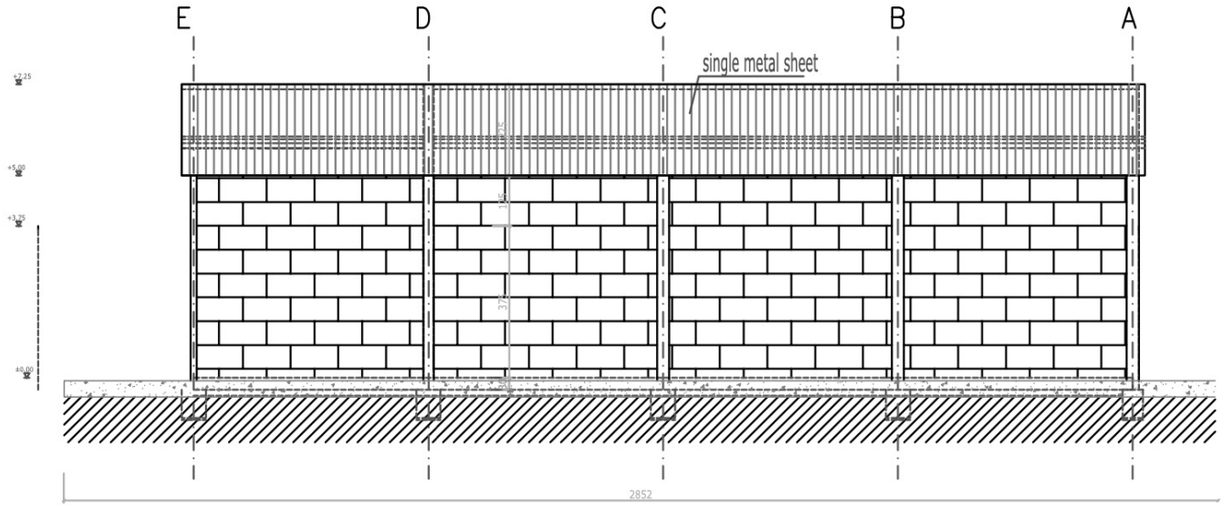
Conceptual Design Drawings, BoQs and Tender docs



Conceptual Design Drawings, BoQs and Tender docs

View from front

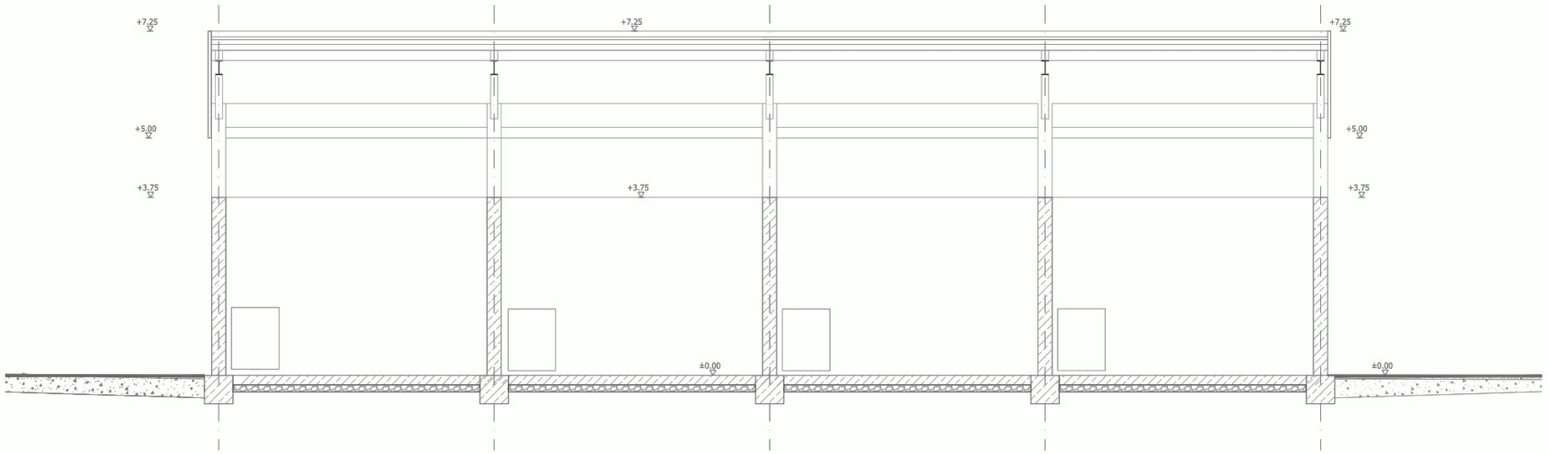




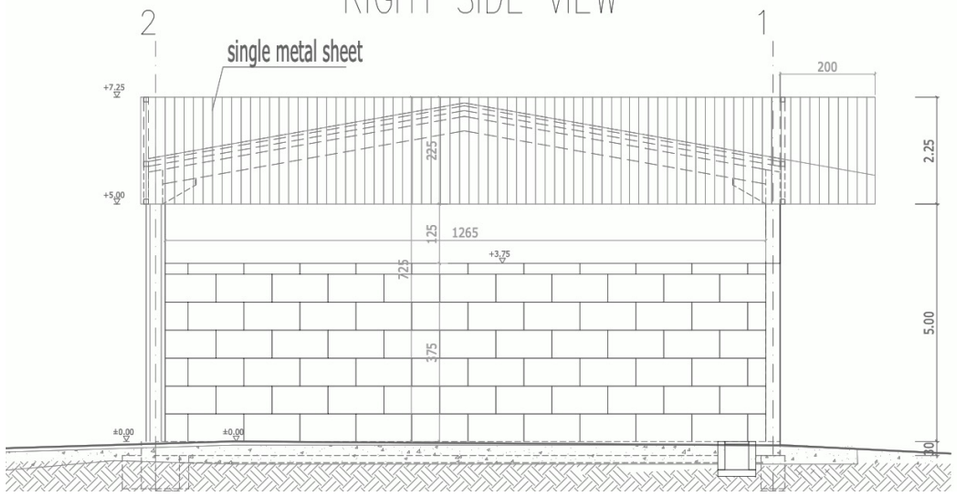
View from behind

Conceptual Design Drawings, BoQs and Tender docs

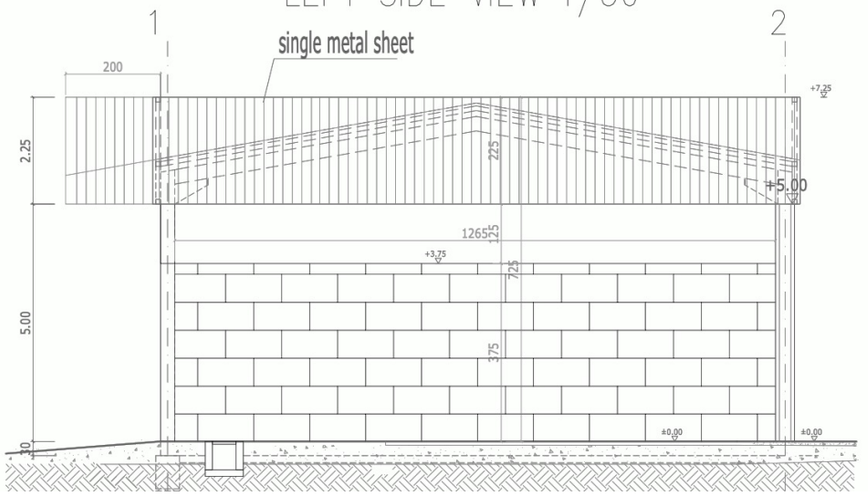
Cross section
b–b

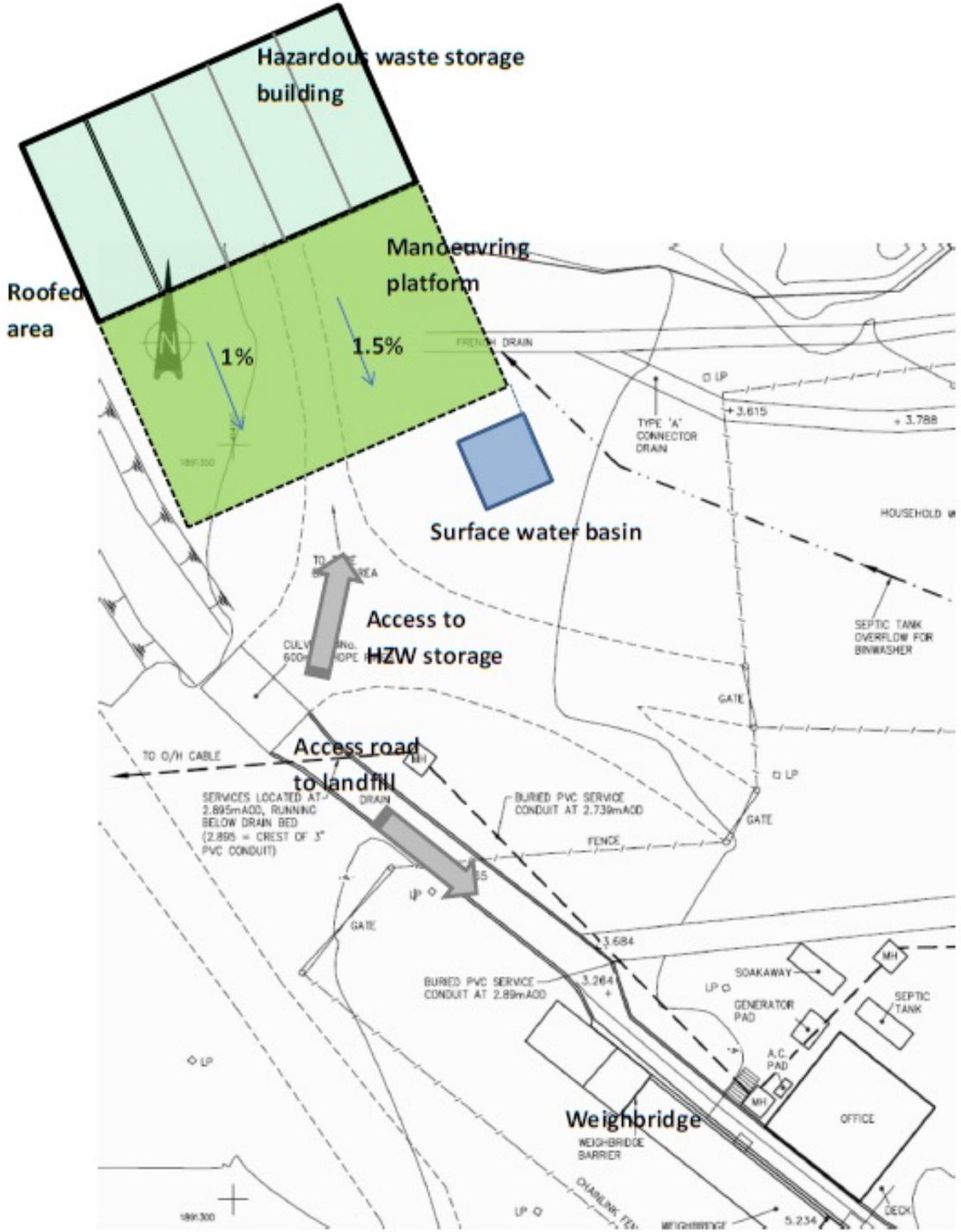


RIGHT SIDE VIEW



LEFT SIDE VIEW 1/50




Hazardous waste storage building
Roofed area
Manoeuvring platform
1%
1.5%
Surface water basin
Access to HZW storage
Access road to landfill
Weighbridge
TYPE 'A' CONNECTOR DRAIN
SEPTIC TANK OVERFLOW FOR BINWASHER
TO O/H CABLE
SERVICES LOCATED AT 2.895mAOD, RUNNING BELOW DRAIN BED (2.895 = CREST OF 3" PVC CONDUIT)
BURIED PVC SERVICE CONDUIT AT 2.739mAOD
BURIED PVC SERVICE CONDUIT AT 2.89mAOD
SOAKAWAY
GENERATOR PAD
SEPTIC TANK
A.C. PAD
OFFICE
WEIGHBRIDGE BARRIER
GATE
FENCE
DRAIN
MH
LP
3.684
3.264
3.615
3.788
5.234

Estimated volume of hazardous solids and liquids that require storage for 2020 to 2024

Description	Amount solids, tonnes	Amount liquids, Cubic metres	Total amount of solids and liquids	Approximate number of 210 litre drums
Wastes collected annually, 2020	119.3	5.1	124.4	593
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