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المركز الوطني لإدارة النفايات
National Center for Waste Management

الضوابط والأدلة الفنية لإدارة نفايات البناء والهدم (المعالجة)

Technical Guidelines for Construction and Demolition Waste Management **Treatment**

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LIST OF ACRONYMS

BAT	Best Available Technologies
CDW	Construction and Demolition Waste
CDWMP	Construction and Demolition Waste Management Plan
COPD	Chronic obstructive pulmonary disease
CPR	Cardiopulmonary resuscitation
EMP	Environmental Management Plan
EMS	Environmental Management System
EPC	Environmental permit to construct
EPL	Environmental Protection Law
EPO	Environmental Permit to operate
ESIA	Environmental and social impact assessment
FLS	Fire and life safety
HAVS	Hand-Arm Vibration Syndrome
HDPE	High Density Polyethylene
H&S	Health and safety
HSE	Health, safety and environment
IRs	Implementing Regulations of Waste Management Law
KPI	Key performance indicator
KSA	Kingdom of Saudi Arabia
LDPE	Low Density Polyethylene
MoMAH	Ministry of Municipalities and Housing
MRF	Material Recovery Facility
MSW	Municipal Solid Waste
MWAN	National Center for Waste Management
NCEC	National Center for Environmental Compliance
NORM	Naturally Occurring Radioactive Material

NWMS	National Waste Management Strategy
O&M	Operations and Maintenance
PET	Polyethylene Terephthalate
PP	Polypropylene
PPE	Personal Protective Equipment
QA	Quality Assurance
QC	Quality Control
QMS	Quality Management System
RDF	Refuse Derived Fuel
RGA	Roads General Authority
SASO	The Saudi Standards, Metrology, and Quality Organization
SBC	Saudi Building Code
SCA	Saudi Contractors Authority
TIA	Traffic Impact Assessment
WAC	Waste Acceptance Criteria
WML	Waste Management Law
WMP	Waste Management Plan

DEFINITIONS

Centre	National Centre for Waste Management (MWAN)
Aggregates	Materials such as sand, gravel, and crushed stone used in construction, often derived from Recycled CDW.
Aluminum	Refers to a recyclable metal commonly used in construction for building materials such as window frames, roofing, cladding, and structural components. When a building is demolished or renovated, Aluminum can be separated from other materials as part of the CDW management process. Due to its high recyclability and value, Aluminum is often targeted for Recovery and Reuse, contributing to sustainable Waste management practices by reducing the demand for raw materials and minimising environmental impact.
Aluminum Profiles	Lightweight, corrosion-resistant metal extrusions used in construction for windows, doors, curtain walls, and structural components. Aluminum profiles are highly recyclable, making them a valuable material in CDW management.
Architects, Developers, and Engineers	Professionals involved in the design, planning, and engineering of construction projects, ensuring that structures are safe, functional, and aesthetically pleasing.
Asbestos	A hazardous fibrous mineral used historically in construction for insulation, fireproofing, and other applications. Asbestos poses significant health risks when disturbed and must be carefully handled and disposed of by specialized contractors.
Authorized Person	The person who has obtained the permit from the National Centre for Waste Management (MWAN)
Built Up Area (BUA)	The total constructed covered area of all the floors within the building envelope up to the extent of external walls excluding the projections.
Bituminous Materials	Asphalt and tar-based products used for roofing, waterproofing, and paving. Bituminous materials are often recycled in road construction but can pose environmental risks if not managed properly.
Brass Fittings	Components made from copper and zinc alloy, used in plumbing, electrical, and decorative applications due to their durability, corrosion resistance, and aesthetic appeal. Brass fittings are often recovered and recycled from construction sites.
Brick	Solid or hollow blocks made of clay or concrete used in construction. When demolished or removed, bricks contribute to CDW and can often be cleaned and reused or crushed for recycling.
Buildings	Structures such as residential, commercial, and industrial properties, where construction and demolition activities generate CDW like concrete, bricks, wood, and metals that require management and Disposal.
Bulk Trailers	Large trailers used for transporting bulk quantities of CDW materials.
Cardboard	Cardboard in CDW primarily includes packaging materials used for construction supplies, such as boxes and cartons. Like Paper, Cardboard is highly recyclable but must be kept clean and dry to retain its value. Proper segregation of Cardboard in the Waste management process is crucial for Recycling and Reducing the

	environmental impact of Construction activities.
CDW Management Plan (CDWMP)	A plan outlining the methods and processes for managing CDW, including Collection, Transportation, Recycling, and Disposal.
Cement Kilns	Refers to industrial facilities used in the production of cement, which can also serve as an effective method for disposing of certain types of CDW. Cement kilns operate at very high temperatures, which allows them to safely incinerate Waste materials while incorporating the ash into the final cement product. This process not only reduces the volume of Waste that would otherwise go to Landfill but also recycles it into a useful construction material. Using CDW in cement kilns is a form of energy recovery and resource efficiency, contributing to more sustainable Waste management practices.
Ceramics	Non-metallic, inorganic materials made from clay and other natural compounds that are shaped and hardened through high-temperature firing. Ceramics, such as tiles, bricks, and sanitaryware, are widely used in construction for their durability, water resistance, and aesthetic qualities. They contribute to CDW when removed or replaced during demolition or renovation.
Chutes	Inclined tubes or channels used on construction and demolition sites to safely and efficiently transport CDW, such as debris, rubble, and other loose materials, from higher levels of a building or structure to designated collection points, skips, or containers on the ground level.
Circular Economy	An economic model that aims at sustaining products and consumable sources for the longest period possible by way of consuming products to each product's maximum limit if it is usable, and to turn it recyclable and regeneratable thereafter upon the end of its lifecycle.
Climate Considerations	Factors related to the impact of CDW management on climate change, including greenhouse gas emissions and energy consumption.
Civil Engineers	Engineers who design, construct, and maintain infrastructure projects, playing a crucial role in managing CDW through efficient project planning and execution. They are involved in the selection of materials, construction methods, and site management practices that minimize CDW production. Civil Engineers also develop and implement strategies for the recycling and reuse of materials, such as concrete and metals, and ensure compliance with environmental regulations. Their expertise supports the sustainable management of CDW by optimising resource use and integrating CDW reduction techniques into civil engineering projects.
Collection	The collection of waste from storage containers of various sizes and types, carried out using trucks and machinery specifically designed for this purpose.
Compactors	Machines used to compress Waste materials to reduce their volume for easier handling and transportation.
Competent Authority	The government entity responsible for the operational management of waste in compliance with specific regulatory provisions.
Commercial and Administrative Waste	Includes, without limitation, waste generated from economic activities that can be collected alongside household waste, considering their characteristics and the quantities produced, without specific technical constraints. This waste includes, but is not limited to, waste generated from commercial activities and businesses (such as craftsmen, merchants, and traders) as well as waste from general service sectors, including healthcare administrations and facilities (such as non-hazardous healthcare waste). It also encompasses other similar types of waste

	that are collected under the same conditions as residential waste.
Concrete	A composite building material made of cement, sand, gravel, and water. Concrete waste from demolition or construction is a significant component of CDW, typically crushed and reused as aggregate or recycled into new concrete.
Construction Contractors	Companies or individuals licensed by the Amanah or the Saudi Contractors Authority, responsible for constructing buildings and infrastructure, and managing the entire building process from planning to completion.
Construction and Demolition Waste (CDW)	All solid Waste arising from construction and demolition activities. This includes waste produced from construction of buildings and infrastructure, destruction or demolition of buildings and infrastructure, and the maintenance, renovation, rehabilitation and refurbishment of buildings and infrastructure. Construction and demolition waste includes without limitation brick, concrete, hardcore, subsoil and topsoil, materials resulting from excavation works, and it can also include quantities of timber, metal, plastics and, occasionally, hazardous materials.
Construction Project	A project involving the building, assembly, or renovation of structures, infrastructure, or other physical assets, typically involving activities such as excavation, concreting, bricklaying, and installation of systems.
Containment	The use of bins, skips, containers, or other designated structures to safely hold and control CDW at construction or demolition sites. Containment is essential for preventing spillage, cross-contamination, and exposure to hazardous materials, thereby ensuring safe storage and transport.
Copper Pipes and Wires	Copper is a highly conductive metal used extensively for plumbing pipes and electrical wiring in construction. It is valued for its resistance to corrosion and is commonly recycled from construction and demolition waste.
Demolition Contractors	Contractors licensed by the Amanah or the Saudi Contractors Authority and specialized in the safe and efficient demolition of buildings and structures, ensuring correct handling and Disposal of CDW.
Demolition Project	A project focused on the dismantling, deconstruction, or demolition of buildings, structures, or infrastructure, often to clear land for new development or to remove unsafe or outdated facilities.
Depositing	Depositing waste with another person
Destruction	The complete dismantling or demolition of structures, resulting in mixed CDW that must be sorted, recycled, or disposed of according to waste management regulations.
Disposal	Defined as Safe Disposal under IRs of WML – Safe storage or disassembly of any type of waste in an engineering manner that prevents causing any pollution or negative impact on the environment, including soil, air, water, and biological diversity. These methods include engineering cemeteries, prepared incinerators, and other licensed technologies and facilities, which contain the technical technology necessary to protect public health, safety, and the environment.
Disposal Document	A document issued by Service Providers to Waste Producers upon the completion of the safe disposal process, confirming that the waste has been disposed of in compliance with the MWAN's controls and requirements.

End-of-Life Dismantling	The process of systematically taking apart a building or structure at the end of its useful life in a controlled and selective manner. Unlike traditional demolition, end-of-life dismantling focuses on the careful removal of materials and components to maximise the recovery, reuse, and recycling of building elements such as metals, timber, fixtures, and concrete. This approach reduces the amount of waste sent to landfills, minimises environmental impact, and supports circular economy principles by extending the life of building materials through repurposing and recycling.
End of Waste	Moment when waste ceases to be waste and becomes a product or raw material.
Entity	Any entity that practices activities of an industrial, commercial, agricultural or service-provision nature.
Environment	Everything that surrounds a person, animal, plant, or any living organism, including water, air, land, soil, organisms, biodiversity, atmospheric gases, water bodies, inanimate objects, various forms of energy, environmental habitats, natural processes, and the interactions among these elements.
Environmental Impact	Every negative or positive change that affects the environment due to the practice of any activity.
Excavator	A powerful, heavy-duty machine with a rotating platform, a long arm (boom), and a bucket or other attachment at the end, used for a variety of tasks on construction and demolition sites. Excavators are commonly employed for digging, lifting, sorting, and moving large volumes of CDW, such as concrete, metal, and soil.
Ferrous Metals	Metals containing iron, such as steel, which are commonly Recycled from CDW.
Front Loader	Refers to a heavy-duty, wheeled machine equipped with a large, front-mounted bucket used for loading and transporting bulk materials. Front loaders are commonly utilized on construction and demolition sites to scoop, lift, and move large volumes of CDW, such as soil, rubble, concrete, and other debris, into trucks, skips, or other containers for sorting, Recycling, or Disposal.
Green Waste	Any Waste that is produced from accumulations of cut grass, plants, tree leaves and tree corners, and other accumulations resulting from public and private gardening and green landscaping caring at roadsides and parks.
Hardcore	Dense, inert materials such as crushed concrete, brick, or rubble used as a base layer in construction. Hardcore waste from construction or demolition can be recycled as aggregate for new building projects.
Hard Standing Surface	A durable, solid surface area used for storing and processing CDW materials.
Hazardous Waste	Waste classified as hazardous based upon the provisions of the Law and Regulations, which is resulting from industrial or non-industrial activities that contain toxic, flammable, or reactive materials, or corrosives, solvents, degreasers, oils, colorants, paste residuals, acids and alkalis.
High-Density Polyethylene (HDPE)	A durable, high-strength plastic used in piping, containers, and other construction materials. HDPE is widely recycled due to its versatility and resistance to chemicals and moisture.
Hook lift Trucks	Trucks that are equipped with a hydraulic hook lift system for loading and unloading large containers of CDW.
Incineration	**Implementing regulations definition:** Burning of waste component for disposal, either by open burning or by controlled burning in special incinerator, with or

	without energy recovery. **Proposed definition:** The EU Directive 2010/75/EU on Industrial Emissions (also known as the Industrial Emissions Directive, IED) defines incineration as: "The thermal treatment of waste with or without the recovery of the combustion heat generated, including pyrolysis, gasification, or plasma processes if the substances resulting from the treatment are subsequently incinerated."
Inert Materials	Waste that does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter that it comes into contact with, in a way likely to cause environmental pollution or harm to human health. The total leachability and pollutant content of the Waste and the ecotoxicity of the leachate must be insignificant and not endanger the quality of surface water or groundwater.
Infrastructure	Large-scale projects such as roads, bridges, and utilities where construction and demolition produce CDW, including asphalt, concrete, and soil that need proper management.
Iron	A strong, durable metal commonly used in construction for various applications, including structural beams, frames, and components. Iron is often recycled from CDW due to its value and widespread use in building materials.
Laborers	Workers who perform manual tasks on construction sites, including activities such as loading and unloading materials, digging, cleaning, assisting skilled tradespeople, and handling basic construction duties. Laborers play a crucial role in the day-to-day operations of construction projects, providing essential support to ensure the smooth progress of work. They are typically involved in tasks that require physical strength, endurance, and basic construction skills, contributing to the overall efficiency and safety of the work site.
Law	Waste Management Law
License	A written permission issued by the Centre for the purpose of carrying out any activity related to waste management in accordance with the controls determined by law and regulation
Licensee	The person who has obtained the license from the Centre
Low-Density Polyethylene (LDPE)	A flexible plastic used in sheeting, film, and insulation materials in construction. LDPE is less commonly recycled than HDPE but still contributes to the plastic waste stream in construction.
Maintenance	Routine upkeep activities on buildings and infrastructure that generate small amounts of CDW, such as debris from repairs and replacements, requiring appropriate Disposal or Recycling.
Material Recovery Facility (MRF)	Material Recovery Facilities can be described as infrastructures that accept waste materials, either source segregated or mixed, and further separates, processes, and stores for further processing, in order to divert reusable and recoverable waste from landfill, while also obtaining the maximum value out of each material.
Materials Audit	An assessment of the types and quantities of materials present in a building or site, often conducted before demolition.
Mechanical Recycling	The process of physically breaking down Waste materials into smaller pieces for Reuse in new products.

Metal	Includes steel, aluminum, copper, and other metals used in construction. Metal waste from CDW is highly Recyclable and valuable, often collected for recycling into new metal products.
Minimizing Waste	Reducing waste production to the lowest possible level
Minimizing Waste Products	Reducing waste production to the lowest possible level. Materials or goods manufactured or derived from other materials for sale or consumption.
MSW (Municipal Solid Waste)	Includes residential Waste, which is Waste resulting from the usual activity of households, whether or not they are collected mixed or separately, and also includes commercial and administrative Waste, which is Waste that is produced from other sources that are similar in nature and composition to Residential Waste.
National Waste Management Strategy (NWMS)	Comprehensive national plan that outlines the vision, ambitions, strategic objectives, and measurable targets to improve the performance of the Waste management sector in KSA. It identifies current gaps, sets directions and actions for sector transformation, establishes a timeline for progress monitoring, and outlines the sector's contribution to the national economy.
Non-Ferrous Metals	Metals that do not contain iron, such as Aluminum and Copper, which are commonly Recycled from CDW.
Non-Hazardous Waste	Waste that does not impose any risks to the general health or environment, and that may not be classified as Hazardous Waste.
NORM (Naturally Occurring Radioactive Material)	Materials that contain radioactive elements naturally found in the environment, sometimes present in CDW.
Oils and Lubricants	Used oils and lubricants from machinery and equipment on construction sites. These substances are hazardous and must be collected, stored, and disposed of in accordance with environmental regulations to prevent soil and water contamination.
Other Contractors	Various specialised Contractors involved in specific aspects of construction and demolition, such as electrical, plumbing, and roofing Contractors.
Biodegradable Waste	Any waste that can undergo anaerobic or aerobic decomposition, such as food and garden Waste, and paper and paperboard.
Paint Cans and Paint Residues	Empty containers and leftover paint from construction and renovation activities. These materials can contain hazardous chemicals and require proper Disposal or Recycling to prevent environmental contamination.
Paper	Paper typically refers to materials such as architectural plans, packaging, and office Waste generated during construction activities. Although paper is Recyclable, it must be properly sorted and kept dry to ensure it can be effectively Recycled. In CDW management, separating paper from other Waste streams helps reduce Landfill usage and supports Recycling efforts.
Permit	A document granted by the Centre to waste recycling facilities attesting that they fulfil the Centre’s Controls and Requirements before they obtain licenses issued by the competent authorities in accordance with their Regulations
Person	A natural or legal person
Personal Protective	Safety gear worn by workers to protect against hazards, including helmets, gloves, and masks.

Equipment (PPE)	
Polyethylene Terephthalate (PET)	A type of plastic commonly used in packaging, including bottles and containers. PET is recyclable and often found in construction sites as packaging Waste.
Plastics	Plastics in CDW include a wide range of materials, such as piping, insulation, packaging, and fittings. Plastics are often Recyclable, but their recyclability depends on the type of plastic and its condition. Segregating Plastics at the source is important to maximise recycling potential and reduce the environmental impact of CDW. Proper handling also prevents contamination of other Recyclable materials.
Polypropylene (PP)	A strong, lightweight plastic used in construction for items like piping, fittings, and insulation. PP is resistant to chemicals and moisture and can be Recycled, though it often requires separation from other plastics.
Quarantine	The process of isolating Waste materials that may be contaminated or hazardous until they can be safely managed.
Recycled Aggregates	Aggregates produced from the Recycling of CDW materials, used in new Construction Projects.
Recycling	The process of converting certain components of Waste into usable materials for recovery or use as raw materials in manufacturing processes.
Recycling Infrastructure	Facilities and equipment used for the collection, sorting, and processing of Recyclable materials.
Refuse Derived Fuel (RDF)	Fuel is produced from various types of Waste, including CDW, that can be used to generate energy.
Refurbishment	Upgrading or modernizing structures to improve their appearance or functionality, resulting in CDW from replaced or removed components that must be managed and recycled appropriately.
Regulations	The Implementing regulations of the Waste Management Law
Regulatory Bodies	Government agencies and organizations responsible for creating and enforcing regulations related to CDW management to ensure safety and environmental protection.
Rehabilitation	Restoring and repairing buildings and infrastructure to a functional state, producing CDW from the removal of damaged or outdated materials, necessitating careful Waste Management.
Relevant Authority	Government authorities responsible for issuing their licenses and / or permits in accordance with their regulatory requirements.
Renovation	The process of updating or improving existing structures, generating CDW from removed materials like old fixtures, flooring, and wall coverings that need proper handling and Disposal.
Residential Waste	Waste that includes without limitation: paper and cardboard, glass, metals, plastics, food residuals, Green Waste, wood, textiles, packaging, waste electrical and electronic equipment, and bulky waste, including without limitation mattresses and furniture.
Resource Recovery	The process of extracting energy, raw materials, or any other product from Waste and using it again.
Reuse of products	Reusing materials and resources as much as possible before turning them into

	Waste.
Rubber	A material commonly found in CDW, typically originating from components like flooring, roofing membranes, seals, and gaskets, as well as insulation and damp-proofing materials.
Safe Disposal	Safe storage or disassembly of any type of Waste in an engineered manner that prevents causing any pollution or negative impact on the environment, including the soil, air, water, and biological diversity. These methods include engineering cemeteries, prepared incinerators, and other licensed technologies and facilities, which contain the technological techniques necessary to protect public health, safety, and the environment.
Sand	A granular material composed of finely divided rock and mineral particles, typically used in construction as a key component in concrete, mortar, and asphalt. Sand is essential for creating stable foundations and various structural elements, and its management is important to ensure sustainable use and minimize environmental impact.
Sensitive Receptors	Receptors that may be notably affected by the activity or the project due to its location being nearby or due to its sensitive nature, and these include without limitation: environmental components, living organisms, historical and cultural and religious sites, or social groups, such as endangered species, hospitals, retirement homes, schools and residential compounds.
Separation	See Sorting.
Service Provider	The person licensed or authorized to engage in one of the waste management activities.
Skip Loaders	Vehicles equipped with a skip loading mechanism for transporting large containers of CDW.
Smart Buildings	Buildings that incorporate advanced technologies and sustainable design principles to minimize CDW production during construction, renovation, and demolition processes. In the context of CDW, smart buildings utilize efficient construction methods, prefabrication, and material tracking systems to reduce waste, promote recycling, and ensure the responsible Disposal of materials. They are designed with a focus on lifecycle management, incorporating strategies that facilitate the reuse of components and reduce the overall environmental impact of building activities.
Soft Strip	Refers to the process of removing non-structural elements from a building before demolition or significant refurbishment. This includes the careful extraction of fixtures and fittings, such as doors, windows, and light fixtures, as well as the removal of internal walls, partitions, ceilings, flooring, and mechanical systems like wiring and ductwork. The goal of a soft strip is to segregate materials that can be Reused or Recycled, thereby reducing the volume of Waste sent to Landfill and facilitating more sustainable Waste management practices. This process is a crucial preparatory step in ensuring that demolition projects are conducted in an environmentally responsible manner, aligning with regulatory requirements and sustainability goals.
Sorting	It means separating waste components from each other manually or automatically, such as paper, glass, metal, and setting aside other components in transitional stations or sorting and treatment facilities; with the intent of recycling or processing them.
Segregation of	The action of the generator of the Waste of segregating their waste to its

Waste at the Source	components as defined by the nature of such waste, to enable higher resource recovery through recycling or reuse.
Sorting at Source for CDW	Defined as Segregation at Source under IRs of WML – Refers to the action of the generator of the CDW segregating their CDW to its components as defined by the nature of such CDW, to enable higher resource recovery through Recycling or Reuse, as defined in the IRs.
Steel Rebar	Reinforcing bars made of steel used to strengthen and support concrete structures in construction. Steel rebar provides tensile strength and durability to concrete elements like beams, slabs, and columns, making them essential in construction projects.
Stones	Natural solid aggregates of minerals or rock fragments commonly used in construction for foundations, walls, paving, and landscaping. Stones, including granite, limestone, and sandstone, are valued for their durability, strength, and aesthetic appeal in various building and infrastructure projects.
Storage	Storing the waste components or some of them temporarily for the transfer or use later
Storage Bays	Areas designated for the temporary storage of CDW materials before processing or Disposal.
Subsoil and Topsoil	Layers of earth removed during excavation. Subsoil is the deeper layer of soil, while topsoil is the nutrient-rich upper layer. These materials from excavation can be Reused in landscaping, construction, or restoration projects.
Timber	Wood materials generated from construction, demolition, or renovation, including beams, planks, and off-cuts. Timber Waste can often be Reused, Recycled, or processed into wood products or biomass fuel.
Topsoil	See Subsoil and Topsoil.
Transportation	Transporting waste by approved means of transportation to transitional stations, treatment or sorting facilities, or approved landfills.
Transportation Document	The form specified by the competent authority to follow up the waste from the point of production to the point of production to the point of safe storage, handling or disposal.
Treatment	It means the use of physical, biological or chemical means, or a combination of these means, or other to bring about a change in the specification of waste in order to reduce its volume, or facilitate the process of treating it when reusing or recycling, or extracting some products from it or to remove organic pollutants and others in order to reduce or utilize some of the waste component or eliminate the possibility of harm to huma or the environment.
Triple Handling of Waste (minimize)	In the context of CDW, this refers to reducing the number of times waste is moved or handled on-site before reaching its final Disposal or recycling point. This approach streamlines waste management, saves time, reduces labour costs, decreases the risk of contamination, and enhances site efficiency by limiting unnecessary movements of waste materials.
UV-Resistant Polyethylene	A type of plastic resistant to degradation from ultraviolet light, used in various construction applications.
Waste	All materials that are discarded or disposed of, and that directly or indirectly affect public health or the environment
Waste from	waste resulting from equipment operating with electric current (or

Electrical and Electronic Equipment (WEEE)	electromagnetic fields). This shall include without limitation all components, sub-assemblies and consumables which are part of the product at the time of discarding, including but not limited to: mobile phones, chargers, printing machines, computers and automatic disponers.
Waste Hierarchy	A framework for managing Waste that prioritizes Waste prevention, followed by Reduce, Reuse, Recycling, Recovery, and Disposal.
Waste Incineration Plants	any stationary or mobile technical unit and equipment dedicated to the thermal treatment of Waste, with or without recovery of the combustion heat generated.
Waste Management	Organizing any activity or practice related to waste commencing from waste collection, transportation, sorting, storage, treatment, recycling, import, export, and safe disposal, including aftercare at waste disposal sites.
Waste Management Establishments and/or Waste Management Facilities	Establishments, facilities and sites, permitted and licensed by MWAN, that engage in Waste Management.
Waste Producer	Every person who produces classified waste according to the provisions of the Waste Management Law
Wood	In KSA, wood in the context of CDW typically includes timber used in structural frameworks, formwork, scaffolding, and interior finishes like doors, windows, and cabinetry.

1 PURPOSE AND SCOPE

1.1 Purpose

This guideline aims to establish a standard procedure for the treatment of construction and demolition waste (CDW) in the Kingdom of Saudi Arabia (KSA) following the provisions of the Waste Management Law (WML) and its Implementing Regulations (IRs).

The National Waste Management Strategy (NWMS), in conjunction with the CDW National Plan, sets forth specific objectives and targets to reduce the amount of CDW sent to landfills, promoting more responsible disposal and processing methods. This guideline emphasizes these objectives by integrating regulatory frameworks and sustainability targets for CDW. **Figure 1-1** below presents the relevant goals of the NWMS and the CDW National Plan, highlighting the targets for CDW diversion from landfills, recycling, and reuse. These initiatives aim to build a foundation for sustainable urban expansion in KSA, ensuring that environmental standards are met while the construction sector continues to grow.



Figure 1-1: CDW specific targets to be achieved by 2040

To ensure the successful achievement of these targets by 2040, a detailed breakdown of annual estimates and planning phases have been established and provide **Table 1-1** below.

Table 1-1: Annual estimates of objectives of the CDW National Plan

Performance Indicators	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
CDW Landfill Diversion Rates	9%	18%	27%	36%	45%	53%	58%	62%	67%	71%	76%	78%	81%	84%	86%	89%

1.2 Scope

The guideline for processing and treatment serves as an essential framework for responsibly managing the waste generated from construction and demolition activities. This procedure has been designed by considering groups as mentioned in **Figure 1-2** below.



Figure 1-2: Relevant stakeholders involved in the CDW processing and treatment activities

This technical guideline outlines the best practices for effective processing and treatment of CDW. **Figure 1-3** illustrates the comprehensive process flow of CDW treatment and processing. It also provides references to specific sections within the guideline where further details and explanations on each step can be found.

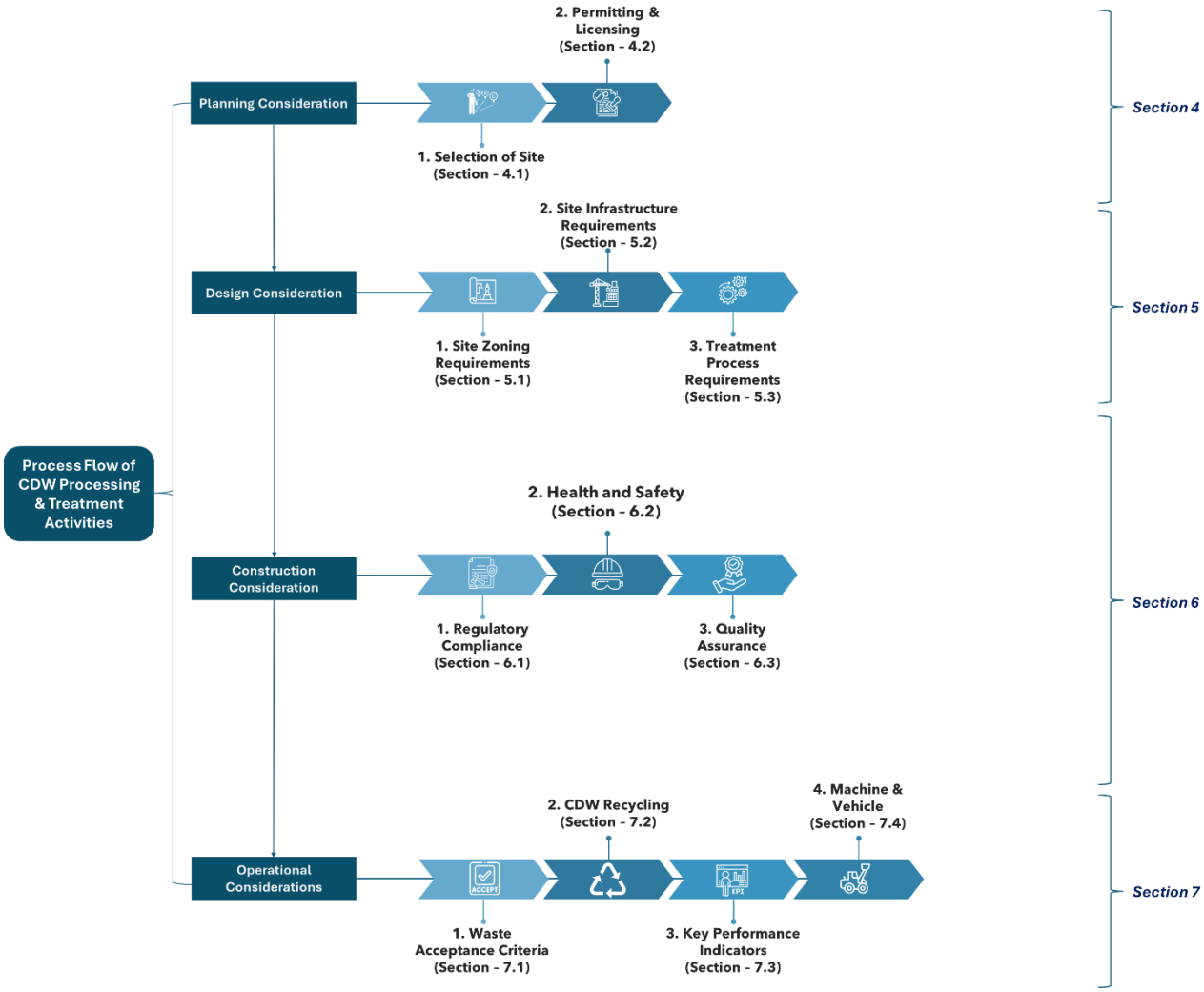


Figure 1-3*:* Process flow of CDW processing and treatment operations

1.3 Dependency on other technical guidelines

The guideline for treatment of CDW should be read in coordination with other technical Guidelines issued by MWAN to ensure safe, efficient, and compliant waste management. These guidelines support the accurate identification, management, and proper treatment of waste while minimizing environmental impacts and protecting public health. As such, this guideline should be used alongside the relevant technical guidelines shown in



Figure 1-4.



Figure 1-4: Relevant technical guidelines issued by MWAN

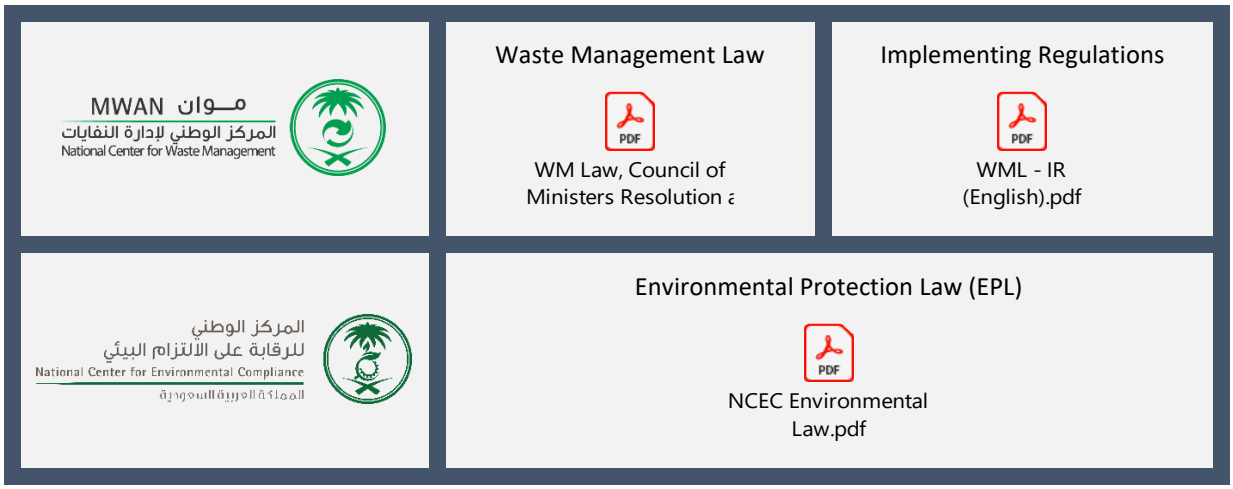
1.4 Applicability

The guideline aims to provide a comprehensive framework for CDW treatment to ensure consistent implementation across diverse project types and scales.

Source of CDW	▪ Construction activities ▪ Renovation activities ▪ Demolition activities ▪ Other related activities
Type of Projects	▪ **All types of building projects** including residential, offices, commercial, hospitality, educational, mixed-use developments, airports, sports facilities, etc. ▪ **Public Infrastructure Projects** including roads, parks, water sewage and drainage infrastructure, water supply, etc.
Types of Waste	▪ All types of waste generated during construction and demolition activities like inert waste, metallic, plastic, glass, gypsum, wood, textile etc. except for hazardous waste and as further detailed in the waste acceptance criteria section of this guideline.

2 LEGAL REQUIREMENTS

This section outlines the regulatory framework governing CDW treatment, providing the legal foundation necessary for compliance. The primary stakeholders and their associated regulations are as shown below:



The mandatory regulatory requirements for CDW treatment under these laws and regulations are detailed below.

2.1 Waste Management Law (WML)

The Waste Management Law (WML) establishes the legal framework for managing waste activities in compliance with environmental priorities. Key articles relevant to CDW treatment are summarized below:

Article 4 It is not permissible to engage in any activity related to waste management except after obtaining a license or permit from the Centre, according to the terms and requirements of each activity, and as specified by the Regulation.

Article 5 Everyone who engages in an activity related to waste management must provide the best environmental and economic results in accordance with the following priorities:

- Recycling
- Resource recovery
- Safe Disposal

Article 8 It is prohibited to leave, bury, burn, dump or throw any kind of waste in places other than those assigned for that particular purpose. The Regulation shall specify the necessary controls for this

Article 16

- The service provider shall dispose of waste by the methods determined by the Centre and in accordance with the Regulations
- The service provider must verify the authenticity of the waste information received and shall complete the transportation record and document details and ensure that they fall within the licensed competency of the licensee
- The service provider contracting with a government entity shall submit periodic reports to the Centre, as per controls stipulated by the Regulations
- Providers of transportation, storage, handling and safe disposal services are required to comply with the requirements of the transport document, in accordance with the provisions specified by the Regulations
- Providers of safe handling, recycling and disposal services shall accept any kind of waste that falls within their licensed competency

2.2 Implementing Regulations (IR)

The Implementing Regulations (IR) establish a comprehensive framework that governs the entire value chain of waste management, addressing critical aspects related to the processing and treatment of CDW. Key requirements relevant to this guideline are summarized below:

Article 03 No activity related to wastes, such as wastes collection, sorting, storing, treatment, recycling, import, export and safe disposal thereof, including the aftercare of disposal site, shall be undertaken without obtaining the proper license or permit out of the licenses and permits.

Article 43 Each Waste Producer and/or Service Provider shall commit to managing waste safely at a facility licensed to perform this task. This shall be carried out under the Transport Document.

Article 95 Upon choosing a site for the construction and operation of a Waste Management facility or landfill or favoring between more than one location, Persons must take into consideration a number of geological, hydrogeological, environmental, economical, and other elements and properties, which are as follows:

- The distance between the suggested site and the production, collection and storage of Waste locations.
- Availability of infrastructure and paths for facilitating the arrival to the location in all seasons, and the impact of the facility on the traffic at that area.

- Keeping away from historical sites and reserves.
- That the area has suitable capacity for all generated wastes throughout the facility's lifecycle.
- Avoidance of sites on very steep locations, as level grounds are preferrable.
- That the site is distant from valleys, reefs, flood streams, beaches, bodies of water and water sources, such that it does not pollute any water source.
- That the site is not in areas where the groundwater percentage is high, or in sabkhas.
- the dominant direction and speed of the winds, such that the facility must be located in the opposite direction from the wind direction in that area.
- That the site is distant from currently used lands or the lands that are planned for development purposes, such as urbanized, commercial, agricultural or industrial areas.
- In case of choosing a location for a landfill, the suitable and fulfilling soil must be existent to cover the waste, taking into consideration that the soil has low permeability and coherence.
- That the site is as far as possible from any masts, electric lines, railways, airports, facilities' pipelines and highways.
- Any other controls or requirements the Centre issues.

The Centre may exempt any of these conditions in accordance with the nature of the project.

Article 96 The facility may be authorized if compliance with the requirements under this Section is verified, or if the characteristics of the facility do not pose a risk or adequate corrective measures have been taken to prevent any consequences regarding the requirements under this Section.

Article 97 It is forbidden to build a waste facility on the following sites and areas:

- Sites adjacent to planned land for development purposes such as urban, commercial and agricultural expansion areas.
- Sites within the area of villages or seaside areas, or flood streams, where the treatment and disposal of waste may expose the water to contamination, as a result of leakage of fluids to the ground.
- Sites with high groundwater attributed, especially in areas where this water is used for agriculture or drinking.
- Sites on very steep locations.
- Sites on historical archaeological or natural areas or environmental reserves.

- Areas adjacent to airports and subject to the classification of the General Authority of Civil Aviation.
- Any other area deemed by the competent authorities as invalid for the establishment of a facility for the treatment and disposal of waste.

Article 98 The characteristics mentioned in Article 97 should be further considered whenever a site is expected to treat or dispose of Hazardous Waste.

Article 118 Mechanical Treatment of Waste includes a variety of technologies including but not limited to waste shredding techniques, waste sorting techniques (dimensional sorting, densimetric sorting, magnetic sorting, optical sorting, electrostatic sorting, X-ray sorting, manual sorting, flotation.), waste cleaning techniques (mechanical purification; washing in drum) and waste compaction and baling techniques.

Article 119 This Part shall apply to the mechanical treatment of Waste when undertaking treatment in shredders of metal waste, including waste electrical and electronic equipment and end of life Vehicles and their components; mechanical sorting of commingled or mixed waste streams; mechanical treatment of solid waste with calorific value.

Article 120 The design of a facility for the Mechanical Treatment of Waste shall include the following information as a minimum for approval by the Centre:

- Details of the Waste types to be treated and the planned waste treatment methods.
- The size, location and volume of stockpile areas for each individual Waste stream or Waste type, and for each recovered material produced.
- Plans detailing how direct access will be available to each storage area without having to pass through others, to avoid the risk of contamination between different types of waste.
- Details of the technology that will be implemented to control dust and odour emissions, noise and vibrations and emissions to water from the facility.
- Details of surveillance and security measures, including adequate fencing.
- Details of accessibility, as well as ease of cleaning and disinfection.
- Procedures for surveillance, operations and maintenance; and
- Any other details and information as shall be required by the Centre.

Article 121 The design of the facility for the Mechanical Treatment of Waste will identify all relevant environmental controls, contingency plans and emergency response plans, in accordance with the applicable laws and regulations.

Article 122

The Service Provider must grant the Centre's inspectors full access when inspecting the Waste Management facility, and shall provide the inspectors with any data, records and documents – as relevant – that the inspectors request for.

Article 123 The Service Provider shall comply with the Centre's controls and requirements in relation to the facility workers' qualifications, fitness and health ability, enter and exit procedures, and supplying the facility with the necessary tools and equipment that prevent or minimize the entry of non-personnel to the facility.

Article 124 The Service Providers of mechanical sorting of waste must provide specially designed areas for the temporary storage of the Waste to be sorted and to ensure the recovery of the entire quantity of sorted waste, avoiding the formation of stock.

Article 125 Service Providers shall comply with the Centre's controls and requirements in relation to the records and data of the quantity, nature and origin of waste; the quantity of products and materials resulting from recycling, or other recovery operations; and the destination, frequency of collection, mode of transport, and treatment method foreseen in respect of the Waste, and to provide it periodically to the Centre in accordance with the mechanism specified by the Centre.

Article 126 Mechanical Treatment Facilities shall reject and refuse to accept any Waste under the following circumstances:

- Where Waste is transported to it by an entity that is not appropriately licensed.
- Where Waste is not accompanied by an appropriate Transport Document.
- Where Waste received cannot be appropriately processed by the facility's treatment capabilities.

Article 127 Upon rejection of any Hazardous Waste, the Service Provider operating the facility must immediately notify the Centre and document that in his records.

2.3 Environmental Protection Law (EPL)

The Environmental Protection Law establishes principles and regulations aimed at protecting and sustaining the environment. It governs activities within all sectors including the waste management sector to ensure adherence to environmental principles and mitigate adverse impacts. Given that CDW treatment activities can significantly affect the environment, compliance with the following requirements is essential:

Article 3 Engaging in an environmental activity or an activity that has an environmental impact without a permit or license shall be prohibited, as specified by the regulations.

Article 8 A holder of a license or permit who engages in activities that may result in the release of emissions or pollutants or may affect environmental mediums shall:

- Comply with the environmental requirements, rules, procedures, standards, and measurements specified by the regulations.
- Take the necessary measures and procedures when approaching the limits of environmental measurements, as specified by the regulations.
- Develop programs and devices for detection and measurement, and for monitoring the quality of environmental mediums, as specified by the regulations.
- Provide the competent authority periodically with data and reports relating to emissions or pollutants resulting from the activities he engages in to review and verify their conformity, and determine any violation of measurements, standards, and requirements, as specified by the regulations.
- Provide the competent authority with the environmental audit, as specified by the regulations; and
- Rehabilitate environmental mediums that have degraded as a result of his activities, as specified by the regulations.

3 ROLES AND RESPONSIBILITIES

Effective management of CDW is essential for promoting sustainable construction practices and reducing environmental impacts. The growing construction activity, especially in countries like the KSA, underscores the need for structured CDW management processes. This responsibility is shared across multiple stakeholders, each playing a critical role in ensuring that waste is lawfully managed, treated, and processed in alignment with environmental regulations and sustainability goals.

Stakeholders include government regulatory bodies responsible for setting and enforcing guidelines, waste management service providers tasked with transporting, processing, treating, recycling and disposing of CDW, and construction and demolition companies implementing waste minimization strategies. These entities have distinct responsibilities, from policy creation and compliance monitoring to active participation in waste segregation, treatment, recycling, and disposal.

This collaborative approach mitigates environmental harm, transforms waste into valuable resources, minimizes landfill use, and promotes material reuse, fostering a circular economy in the construction industry.

This section focuses on defining the specific roles and responsibilities of stakeholders related to the treatment stage of the CDW value chain. It aims to provide clarity on the expectations and contributions of each entity to ensure compliance with technical guidelines for effective treatment.

3.1 Regulators and competent authorities

	National Center for Waste Management (MWAN)
Description: Regulates Waste Management activities, including licensing service providers for collection, transportation, Treatment, and Disposal of CDW.	
1	**Plans and regulates waste management activities:** Develops waste management plans and strategies and regulates waste management activities across the entire value chain and is mandated to develop and ensure economic sustainability of the sector.
2	**Issues licenses and permits:** Issues licenses to waste management services providers and permits to processing, treatment and recycling facilities and ensures that their operations are in accordance with the regulatory requirements.
3	**Sets the requirements for CDW Management Plans:** establishes technical requirement of construction and demolition waste management plans for construction projects to cover aspects such as reusing, recycling and treatment of waste prior to disposal.
4	**Carries out inspection:** Carries out inspections to assess stakeholder's compliance with the waste management regulatory requirements.
5	**Records and processes data:** Collects and processes periodic reports from waste producers and service providers.
6	**Raises Awareness:** Organizes awareness campaigns in relation to best waste management practices and develops technical guidelines to guide the stakeholders on sustainable waste management practices.
7	**Issues violations:** Issues violation and penalizes in case of any non-compliances against fulfilling regulatory requirements.

8	**Approves CDW treatment sites:** Approves the sites proposed by either the Amanahs or the private investors for developing treatment facilities.
9	**Approves treatment technologies:** Reviews and approves technologies proposed for the treatment of CDW.

Ministry of Municipalities and Housing (MoMAH)

Description: Sets requirements for construction and demolition permits and assigns Disposal sites.

1	**Sets requirement for permits:** Establishes requirements and pre-requisites for construction and demolition permits.
2	**Manages Balady Platform:** MoMAH manages Balady platforms for permit applications.

Amanahs

Description: Review and process the building permits applications and monitor compliance.

1	**Issue building and demolition permits:** Regional Amanahs are responsible for issuing permits for construction, demolition, and renovation works.
2	**Process Building permit applications through Balady Platform:** Amanahs process building permit applications submitted via the Balady Platform.
3	**Review and approval of CDWMP:** Regional Amanahs are responsible for reviewing and approving the CDWMP submitted as part of the building and demolition permit applications.
4	**Monitor compliance:** Oversee construction and demolition contractors' works to ensure they adhere to building regulations including compliance with the Saudi building code.
5	**Urban Planning Collaboration:** Work with MoMAH to implement urban development plans, including infrastructure upgrades and smart city initiatives.
6	**Issue violations:** Issue violation and penalize in case of any non-compliances against fulfilling regulatory requirements.

National Center for Environmental Compliance (NCEC)

Description: Protect, develop, and sustain the environment by regulating the environmental sector and related activities and services.

1	**Regulates the environment:** Develops, implements, and enforces environmental laws and regulations across the Kingdom of Saudi Arabia.
2	**Issues licenses and permits and monitors environmental compliance:** Issues permits and licenses to project owners and services providers and ensures that their operations are in accordance with the regulatory requirements.
3	**Carries Inspection:** Carries out inspections, measurements and tests to assess stakeholder's compliance with the environmental regulatory requirements.

4	**Records and processes data:** Collects and processes periodic reports from the project owners, contractors and service providers.
5	**Issues Violation and Penalties:** Issues violation and penalizes in case of any non-compliances against fulfilling environmental regulatory requirements.

Saudi Building Code (SBC)

Description: Establishes standards and guidelines related to construction and demolition activities and promotes through the Saudi green building code sustainable waste management practices on construction sites.

1	**Establishes Building Standards and Guidelines:** The SBC sets comprehensive regulations, codes, standards, and guidelines that govern the design, construction, and maintenance of buildings in Saudi Arabia. These include technical requirements related to structural design, building materials, and fire safety.
2	**Sets the requirements for CDW Management Plans:** Saudi Green Construction Code SBC-1001-CR sets the requirement to have construction and demolition waste management plans for construction projects to cover aspects such as reusing, recycling and treatment of waste prior to disposal.

Mostadam Program

Description: A green building rating system for the construction industry that sets various requirements including the requirements for the sustainable management of CDW on construction sites.

1	**Establishes green building rating system:** Mostadam provides a framework for certifying buildings based on their environmental performance. It sets sustainability standards that promote energy and water efficiency, waste management, indoor environmental quality, and the use of eco-friendly materials. These standards aim to encourage sustainable design, construction, and operation practices in Saudi Arabia, contributing to the Kingdom's Vision 2030 goals for environmental sustainability.
2	**Certifies environmental performance**: Mostadam issues certifications for different types of built assets that meet sustainability-focused standards, confirming their compliance with environmental performance requirements.
3	**Promotes the use of recycled materials, including recycled aggregates:** Mostadam establishes minimum mandatory percentages for the use of recycled aggregates in different types of projects. This ensures the integration of recycled materials into construction practices, reducing reliance on virgin resources.
4	**Promotes sustainable waste management:** Mostadam encourages the use of sustainable, locally sourced building materials to minimize waste generation during all phases of construction. It supports efficient material usage and waste reduction strategies aligned with green building principles**.**

5	**Promotes the development and implementation of CDW management plans:** Mostadam sets minimum requirements for CDW Management Plans to ensure that waste is managed responsibly throughout the construction activities**.**
6	**Promotes circular economy principles:** Mostadam supports local recycling initiatives and material recovery operations, reducing transportation emissions and fostering collaborative practices among contractors, engineering consultants, and waste management service providers. This approach encourages effective waste reuse and recycling, contributing to the transition to a circular economy.
7	**Provides training and awareness:** Mostadam offers guidance and training programs for stakeholders involved in implementing sustainable construction practices. These initiatives aim to maintain high standards in environmental management and ensure compliance with sustainability goals.

Saudi Standards, Metrology and Quality Organization (SASO)

Description: SASO establishes national standards for construction materials, including defining the applications for recycled aggregates and developing technical specifications for their application in construction projects.

1	**Defines applications and develops construction materials specifications:** SASO defines the specific applications where recycled aggregates can be used and develops detailed technical specifications to ensure their safe and efficient use in construction projects.
2	**Issues compliance certificates and set requirements:** SASO issues compliance certificates for construction materials, ensuring they meet the relevant specifications. It also defines the requirements and processes for certifying these materials, including recycled aggregates, to guarantee their suitability for reuse in construction projects.

Road General Authority (RGA)

Description: RGA establishes the requirements for the use of recycled aggregates in road construction, defining their applications across various types and layers of roads and defining the technical specifications for each application and the allowed percentages.

1	**Defines applications for recycled aggregates in roads construction**: Provides clear guidelines on where and how recycled aggregates can be used in the construction of different road types, including highways, local roads, and access roads. These applications aim to ensure the safe and effective use of recycled materials in road infrastructure.
2	**Sets technical specifications for recycled aggregates in roads construction:** Develops the technical specifications for the application of recycled aggregates in road construction including material properties, performance requirements, and environmental considerations.
3	**Implements quality control and monitoring**: Outlines procedures for monitoring and controlling the quality of recycled aggregates used in roads construction. This ensures that the materials meet the technical specifications and are properly documented throughout the road construction process, supporting sustainable practices and high-quality infrastructure.

3.2 Waste producers



Project Owners and Developers	
Description: Waste producers include individuals, groups, or business entities that generate CDW through their construction or demolition activities. They are responsible for ensuring compliance with regulations and adopting the best practices for the sustainable management of CDW.	
1	**Ensure compliance:** Comply with the regulatory requirements and implement efficient and effective on-site sorting of CDW as per the criteria outlined in the MWAN Technical Guidelines for CDW Source Segregation.
2	**Contract licensed providers:** engage licensed service providers and authorized facilities for waste collection, transportation, treatment, and disposal to ensure proper management of CDW.
3	**Record and report waste data:** Maintain accurate records of waste data and submit reports to relevant regulatory authorities. Ensure workers are trained in proper waste segregation practices to support compliance.
4	**Obtain environmental permits and ensure compliance:** Secure the necessary environmental permits from NCEC before initiating site activities. Implement all required environmental monitoring measures to ensure full compliance with applicable regulations.



Construction Contractors	
Description: Responsible for managing CDW generated during construction projects. Their duties include ensuring compliance with waste management regulations and adopting best practices for proper handling, segregation, and disposal of CDW.	
1	**Obtain licenses & registrations:** secure the appropriate licenses and registration certificates from relevant regulatory authorities including Saudi Contractors Authority (SCA).
2	**Implement CDW management plans:** Implement the CDW management plans in compliance with MWAN technical guidelines to ensure proper handling and disposal of construction waste.
3	**Identify & classify waste:** Conduct on-site identification and classification of construction and demolition waste at the point of generation in accordance with guidelines for waste classification.
4	**Ensure proper segregation and storage:** implement effective waste segregation and storage practices at the source to prevent mixing and contamination of different types of waste.
5	**Contract licensed service provider:** engage only licensed service provider for collection/ transportation and authorized facilities for treatment, processing, recycling or disposal of construction waste.
6	**Ensure waste is treated:** confirm that construction waste is treated, recycled and recovered in accordance with the best practices and regulatory requirements.

7	**Comply with regulations:** adhere to all relevant Waste Management regulations and technical guidelines related to sorting, handling, processing, treatment, recycling and disposal of construction waste.
8	**Build workers capacity:** Ensure that only trained workers are assigned to segregate waste, enabling effective source segregation and compliance with best practices.
9	**Maintain Records submit reports:** keep accurate records of construction waste and submit regular reports to relevant regulatory authorities to ensure transparency and accountability.
10	**Obtain environmental permits and ensure compliance:** Obtain the required environmental permits from NCEC for the construction site, when applicable. Implement all necessary environmental monitoring measures to achieve full compliance with the relevant regulations.



Demolition Contractors

Description: Responsible for managing CDW generated during demolition Projects. Their duties include ensuring compliance with waste management regulations and adopting best practices for proper handling, segregation, and disposal of waste.

1	**Obtain appropriate license & registration:** secure the appropriate licenses and registration certificates from relevant regulatory authorities including SCA.
2	**Implement CDW management plans:** Implement the CDW management plans in compliance with MWAN technical guidelines to ensure proper handling and disposal of construction waste.
3	**Preparation of the Demolition Plan:** Develop and implement a demolition plan tailored to the characteristics of the project and in accordance with the selective demolition framework established by the National Center for Waste Management (MWAN).
4	**Execute demolition:** Execute demolition activities and implement demolition as per method statement outlined in the CDW management plan.
5	**Identify & classify waste:** Conduct on-site identification and classification of construction and demolition waste at the point of generation in accordance with guidelines for waste classification.
6	**Ensure proper segregation and storage: implement effective waste segregation and storage practices** at the source to prevent mixing and contamination of different types of waste.
7	**Contract licensed service provider:** engage only licensed service provider for collection/transportation and authorized facilities for treatment, processing, recycling or disposal of construction waste.
8	**Ensure waste is treated:** confirm that construction waste is treated, recycled and recovered in accordance with the best practices and regulatory requirements.
9	**Comply with regulations:** adhere to all relevant Waste Management regulations and technical guidelines related to sorting, handling, processing, treatment, recycling and disposal of construction waste.
10	**Build workers capacity:** Ensure that only trained workers are assigned to segregate waste, enabling effective source segregation and compliance with best practices.

11	**Maintain Records submit reports:** keep accurate records of construction waste and submit regular reports to relevant regulatory authorities to ensure transparency and accountability.
12	**Obtain environmental permits and ensure compliance:** Obtain the required environmental permits from NCEC for the demolition site, when applicable. Implement all necessary environmental monitoring measures to achieve full compliance with the relevant regulations.

3.3 Service providers



Waste Collection & Transportation Service Providers	
Description: Licensed companies responsible for collecting and transporting non-Hazardous, recyclable and inert CDW to processing, treatment, recycling, or disposal facilities.	
1	**Obtain licenses & registrations:** secure the appropriate licenses from MWAN for collecting and transporting hazardous and non-Hazardous CDW to processing, treatment, recycling or disposal facilities.
2	**Obtain environmental permits:** acquire the necessary environmental permits from NCEC for the site allocated for vehicle shelter
3	**Collect CDW:** ensure the collection of segregated CDW directly from waste producers in accordance with the relevant guidelines.
4	**Ensure safe handling and transportation:** implement safe and secure transportation methods for CDW to processing, treatment, recycling or disposal facilities, ensuring that segregated waste is not mixed during transportation
5	**Comply with regulations:** adhere to all waste management regulations and technical guidelines related to handling, collection and transportation of CDW
6	**Maintain records and submit reports:** keep accurate records of CDW collected and transported and submit regular reports to MWAN as required for monitoring and compliance purposes.



Treatment Providers	
Description: Licensed entities permitted to operate recycling facilities and treat CDW according to regulatory standards.	
1	**Obtain permits & registrations:** secure the required permits and registrations from MWAN for the treatment of CDW.
2	**Acquire environmental permits:** obtain environmental permits (i.e., EPC or EPO) from NCEC for the construction and operational phases of the treatment facilities.
3	**Inspect and accept waste:** Monitor and inspect incoming waste to ensure it meets treatment acceptance criteria and identify non-conforming materials that should go to disposal sites or non CDW treatment and/or disposal facilities.
4	**Process and treat CDW:** Ensure that incoming CDW is efficiently processed, treated or recycled with minimal residual waste generation.

5	**Ensure quality control and assurance**: verify that recycled materials meet industry standards and quality requirements, making them safe and viable for use in construction projects.
6	**Dispose of residual waste: properly identify, classify, transport and dispose of** residual waste generated after processing or treatment, in compliance with regulations.
7	**Conduct environmental monitoring: perform** regular testing of air, soil, and water quality during processing or treatment of CDW to detect any potential contamination and ensure compliance with NCEC's regulations.
8	**Ensure regulatory compliance:** comply with all regulatory requirements and the relevant technical guidelines issued by MWAN.
9	**Maintain recordkeeping and documentation:** Maintain records of waste types, volumes, and sources, as along with operational activities, environmental monitoring data, and maintaining logs for regulatory reporting and tracking purposes.



Waste Disposal Service Providers / Landfill Operators

Description: Companies licensed to handle the final Disposal of CDW in designated landfill sites.

1	**Obtain permits & registrations:** secure the necessary permits and registrations from MWAN for the final disposal of CDW.
2	**Acquire environmental permits:** obtain environmental permits (i.e., EPC or EPO) from NCEC for all phases of landfill operations, including construction and operation.
3	**Inspect and accept waste:** Monitor and inspect incoming waste to ensure it meets landfill acceptance criteria, identifying any non-conforming material for further processing or treatment.
4	**Perform waste placement and compaction:** Place and compact waste to maximize landfill space, enhance stability, and minimize odors and emissions.
5	**Conduct environmental monitoring:** regularly test air, soil, and water quality around the landfill site to detect potential contamination and ensure compliance with NCEC's regulations.
6	**Ensure regulatory compliance:** comply with all regulatory requirements and technical guidelines related to waste acceptance criteria (WAC), landfill operations and the final disposal of CDW.
7	**Maintain records and documentation:** keep detailed records of waste types, volumes, and sources, as well as operational activities, environmental monitoring data, and maintenance logs for regulatory reporting and tracking.



Engineering Offices

Description: Entities responsible for supervising overall construction and demolition projects in accordance with approved plans, procedures, and regulations.

1	**Apply and acquire building Permit:** Acquire relevant construction and demolition permits on behalf of the developers, contractors and owners.

2	**Pre-Demolition Audit:** Conduct pre-demolition audit of the asset to be demolished.
3	**Waste Estimation and Quantification:** Based on the audit, estimate and quantify waste material to be generated.
4	**Identification of Hazardous Materials:** Identify the presence of any hazardous materials including asbestos, PCB, chemicals etc.
5	**Risk Assessment:** Carry out risk assessment based on the audit.
6	**Waste Inventory:** Prepare waste inventory based on the information collected and gathered during audit.
7	**Framework for Selective Demolition:** Implement framework of selective demolition for selection of appropriate demolition method.
8	**Develop CDW management plans:** Design and prepare CDW management plans for developers and contractors who lack the technical expertise to develop such plans.
9	**Demolition Completion Report:** Prepare a demolition completion report after the demolition works are finished, outlining all details related to demolition waste management, as well as site cleaning and clearance.
10	**Prepare Environmental and Social Impact Assessments:** Prepare Environmental and Social Impact Assessment (ESIA) studies for various projects, limited to consultants certified by NCEC.
11	**Supervise construction activities:** Oversee and supervise the construction, demolition, and operation phases of built assets to ensure compliance with project requirements and applicable regulations.
12	**Monitor the implementation of the CDWMP:** Monitor the implementation of the CDWMP by construction and demolition contractors when assigned as the supervision consultant to ensure compliance with CDW management requirements and alignment with national targets
13	**Ensure quality assurance:** verify that construction activities align with local codes, standards, and approved building permit documentation.
14	**Monitor and report:** Monitor overall performance by analyzing data, providing insights and adjustments for optimization, and maintaining records and reports for stakeholders.

4 PLANNING AND LICENSING STAGE OF CDW TREATMENT FACILITY

The planning and licensing phase for CDW treatment facilities involves several steps to ensure compliance with regulatory frameworks and project feasibility. **Figure 4-1** lists down the activities that must be implemented by the entities planning for the development of a CDW treatment facility.

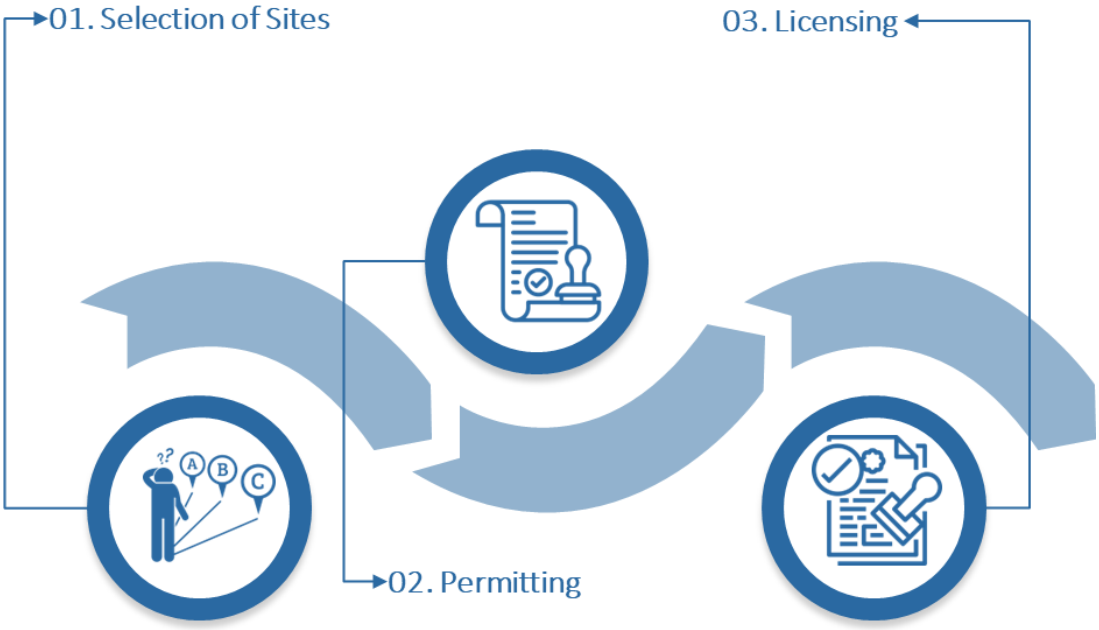


Figure 4-1: List of activities during planning and licensing phase

4.1 Site selection and approval

The selection of a suitable location for establishing a CDW processing and treatment facility is a critical step in effective waste management. It involves balancing operational requirements with the need to minimize environmental and social impacts, particularly on sensitive receptors in the vicinity. This process must adhere to Articles 95 and 97 of the Implementing Regulations, which outline provisions and considerations for the construction and operation of waste management facilities. Legal requirements relevant to site selection have been detailed in **Section 2: Regulatory Requirements**.

In addition to regulatory requirements, site-specific constraints, such as local controls or additional provisions issued by MWAN, must be assessed. These constraints should be validated through comprehensive site investigations to ensure the area is suitable for hosting a facility.

MWAN has developed a **Site Selection Framework** (refer to **APPENDIX - 1** for further details) to guide the process of selecting optimal locations for CDW treatment facilities. This framework provides a structured approach that ensures compliance with legal requirements while addressing environmental, social, and operational considerations.

Ultimately, the selected site must meet the requirements outlined in MWAN's Site Selection Framework to ensure operational, environmental, and social feasibility. The site must also receive formal approval from MWAN to confirm compliance with all regulatory standards and alignment with national waste management objectives.

4.2 Permitting and licensing

Facilities involved in the processing and treatment of CDW must obtain various permits and licenses from relevant authorities, including MWAN, NCEC, the Amanahs, the civil defense and other regulatory bodies. These permits are required at different stages of the treatment facility lifecycle and must be secured prior to commencing any construction or operational activities. The stages and corresponding permits are outlined in the chart below.

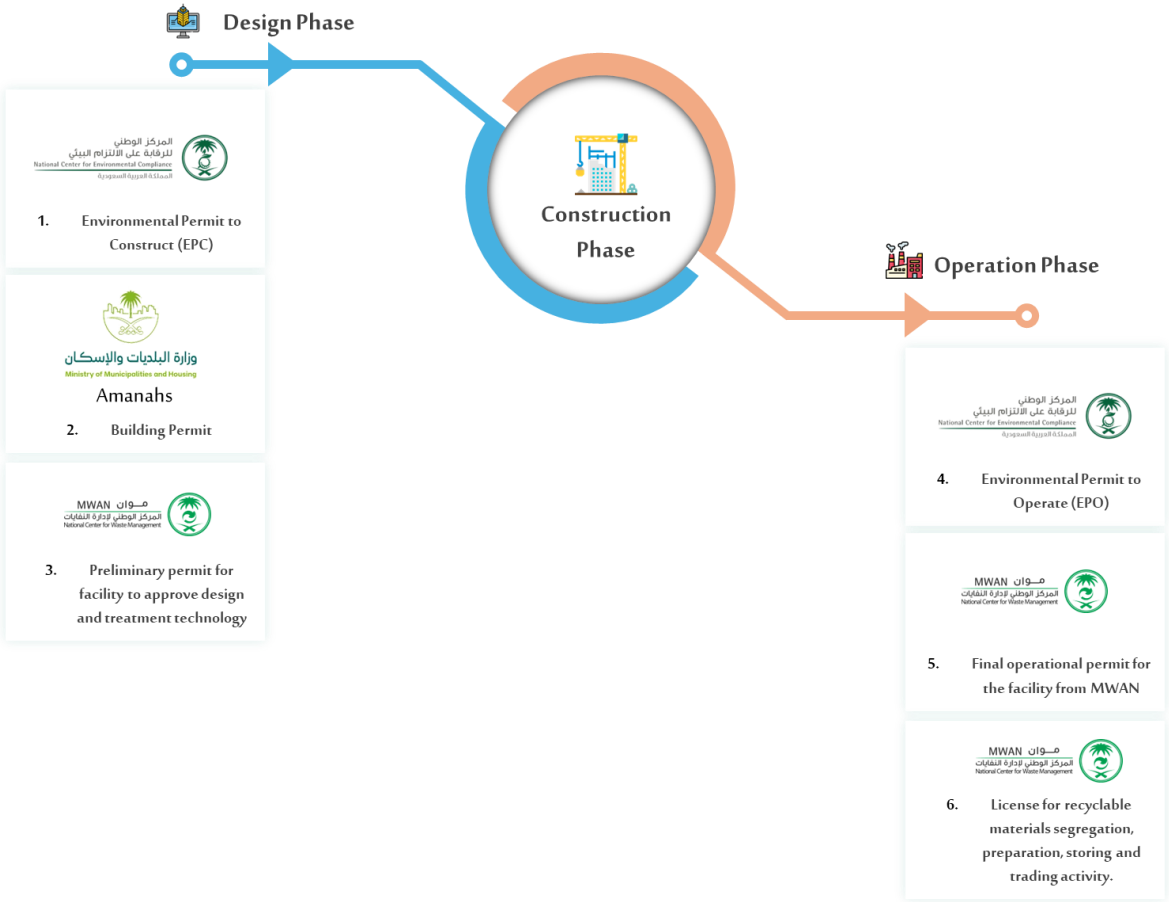


Figure 4-2: Permitting and licensing requirements for CDW treatment facilities

This section provides detailed guidance on acquiring the necessary permits and licenses from the relevant authorities.

4.2.1 Environmental permits from NCEC

All CDW treatment facilities operators are required to obtain environmental permits from the National Center for Environmental Compliance (NCEC) as part of the planning phase for their operations. There are two different permits that must be acquired i.e., the Environmental Permit to Construct (EPC) and the Environmental Permit to Operate (EPO).

- **Environmental Permit to Construct (EPC):** This permit must be obtained prior to the commencement of any construction activities related to the CDW treatment facility. The EPC ensures that the planned construction complies with environmental regulations and standards. It evaluates the environmental impacts associated with the construction and operations of the proposed facility, including aspects such as waste management, emissions, and water usage, to minimize any potential negative effects on the environment during the construction phase.

- **Environmental Permit to Operate (EPO):** This permit is required before beginning operational activities at the CDW treatment facility. The EPO ensures that the facility is compliant with all environmental regulations during its operational phase. It covers the management and treatment of CDW, air and water quality monitoring, waste disposal practices, and overall environmental impacts while the facility is running.

4.2.2 Building permit from Regional Amanahs

During the planning phase, treatment facility operators need to acquire a building permit from the regional Amanahs for all civil works planned as part of the facility.

The building permit application is submitted through the Balady platform and includes comprehensive documentation and design drawings, including without being limited to:

- **Schematic and detailed design drawings** covering structural, architectural, mechanical, electrical, and plumbing (MEP) systems.
- **Fire and Life Safety (FLS) drawings,** which are critical for ensuring compliance with safety regulations. These drawings must be reviewed and approved by the Civil Defence via -certified FLS consultants.
- **Any additional studies** requested by the relevant Aamanah including a traffic impact assessment (TIA) study, hydrology study, etc.

After all necessary documents are submitted, the regional Amanah will review the application. If the application complies with all regulatory requirements and building code standards, the construction permit will be approved and issued.

Once the building permit is obtained, facility operators must coordinate with various utility providers to secure essential service connections:

- **Saudi Electricity Company** for load estimation, approval of electrical permits, and connection to the power grid.
- **National Water Company** for approval of water supply and sewage connections and service installation.
- **Telecommunication service providers** for the installation of communication infrastructure and services.

Completing these steps ensures that the facility complies with all regulatory requirements and is properly connected to essential utilities before construction or operation can commence.

4.2.3 Permit from MWAN

All CDW treatment facility operators are required to obtain a permit from MWAN to establish and operate a CDW recycling facility. Obtaining the permit is a two-stage process designed to ensure that facilities meet regulatory standards for environmental safety, operational efficiency, and sustainability.

- In the planning phase, operators must first submit an application for design approval. This preliminary approval focuses solely on the technical design, layout, and proposed processes of the recycling facility to ensure compliance with regulatory requirements. The approval at this stage does not authorize the facility to commence operations or handle CDW materials.

- Once the construction phase is completed and the facility is ready for commissioning, operators must apply for the final facility permit. The issuance of this operational permit requires demonstrating that the constructed facility adheres to the approved design specifications and all applicable regulatory, environmental, health, and safety standards. Additionally, operators must provide proof of readiness, including the availability of necessary infrastructure, trained personnel, and operational systems for safe and efficient CDW recycling. The facility permit is mandatory before any recycling or waste management activities can legally begin. The detailed requirements have been attached as **APPENDIX - 2.**

4.2.4 License from MWAN

All CDW treatment facility operators are required to obtain a license from MWAN for recyclable materials segregation, preparation, storing and trading activity. To apply for a permit to establish recycling facilities, operators must submit an electronic application along with the completed application form. The submission must include mandatory requirements including general and specific requirements, and administrative documentation as specified in the Implementing Regulations. The detailed requirements have been attached as **APPENDIX - 3**.

5 DESIGN CONSIDERATIONS FOR CDW TREATMENT FACILITIES

Designing a CDW treatment facility requires careful planning to ensure compliance with regulations, operational efficiency, and environmental responsibility. This section outlines the key design requirements across three main areas:

- Zoning requirements;
- Infrastructure requirements; and
- Treatment process requirements.

These considerations address critical factors such as site layout, supporting infrastructure, and operational processes to ensure the facility's functionality, safety, and sustainability.

The details for each category of design considerations are presented in the following subsections.

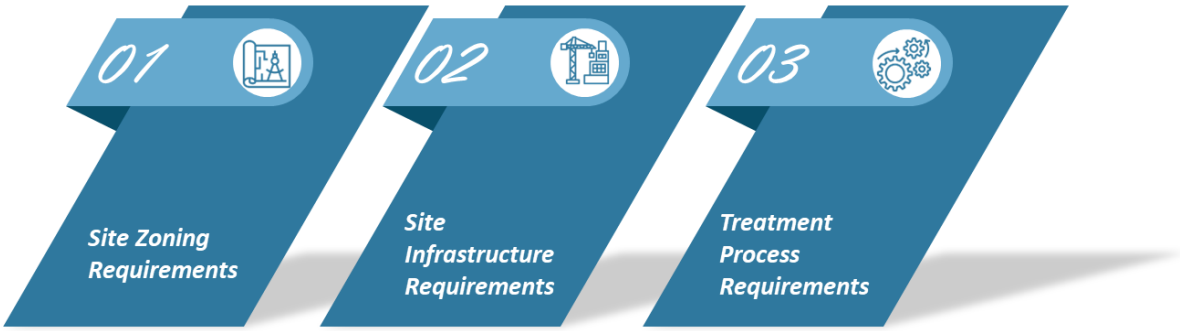


Figure 5-1: Key elements need to be considered during design stage

5.1 Site zoning requirements

A well-planned zoning layout is critical for the efficient operation of CDW treatment facilities, ensuring safety, functionality, and compliance with regulatory requirements. Below are the zoning requirements for a typical facility:

Table 5-1: Site zoning requirements

No.	Zoning Requirements	Description
1	Reception Zone	**Description and Purpose:** Entry checkpoint for receiving and inspecting incoming waste. **Location:** Adjacent to the incoming waste storage zone for efficient waste transfer. **Design Considerations:** ▪ Weighbridge to record waste volume and weight.

No.	Zoning Requirements	Description
		▪ Reception offices for administrative and inspection tasks. ▪ Unloading docks or ramps for waste delivery vehicles.
2	Staff and Visitors Parking Zone	**Description and Purpose:** Designated parking area for facility staff and visitors. Ensures easy access to administrative zones and safe vehicle management. **Location:** Close to the administrative building to facilitate access for visitors and staff. **Design Considerations:** ▪ Separate parking areas for staff and visitors. ▪ Reserved parking spaces for persons with disabilities. ▪ Adequate capacity for peak staff and visitor numbers. ▪ Optional shading structures to protect vehicles.
3	Machinery and Trucks Parking Zone	**Description and Purpose:** Parking and maintenance area for operational vehicles and machinery. **Location:** Adjacent to the operational zones for quick deployment during facility activities. **Design Considerations:** ▪ Sufficient space for heavy machinery and trucks. ▪ Demarcated parking bays to avoid congestion. ▪ Inclusion of a basic vehicle servicing and cleaning area.
4	Incoming Waste Storage Zone	**Description and Purpose:** Temporary storage area for incoming waste before processing. **Location:** Near the facility's entry point and the reception zone to streamline operations. **Design Considerations:** ▪ Spill containment systems to prevent contamination. ▪ Segregation of source segregated inert waste or mixed waste, if applicable. ▪ Clearly labeled storage areas to improve operational efficiency.

No.	Zoning Requirements	Description
5	Pre-Treatment and Pre-Screening Zone	**Description and Purpose:** Area for sorting and removing contaminants, hazardous materials, or materials that can damage the treatment equipment from incoming waste. **Location:** Close to the treatment and processing zone to ensure smooth material flow. **Design Considerations:** ▪ Sorting platforms or conveyor belts for efficient waste segregation. ▪ Dust suppression systems for environmental control.
6	Treatment and Processing Zone	**Description and Purpose:** Central operational area where CDW is treated and processed into reusable materials. **Location:** Centrally located within the facility for easy material transfer. **Design Considerations:** ▪ Equipped with crushing, grinding, and screening equipment. ▪ Noise control measures. ▪ Dust suppression systems to mitigate environmental impact
7	Recyclables Storage Zone	**Description and Purpose:** Temporary storage for separated recyclable materials awaiting shipment. **Location:** Adjacent to the processing zone for efficient handling. **Design Considerations:** ▪ Separate storage bays for different types of recyclables (e.g., metals, plastics, glass). ▪ Covered or open storage, depending on material requirements and climate ▪ Loading zones for transportation vehicles.
8	Recycled Aggregates Storage Zone	**Description and Purpose:** Area for storing processed recycled aggregates before distribution to off takers. **Location:** Near the treatment zone for seamless transfer of materials. **Design Considerations:**

No.	Zoning Requirements	Description
		▪ Segregated storage for different grades of recycled aggregates. ▪ Loading zones for transportation vehicles.
9	Rejects Storage Zone	**Description and Purpose:** Dedicated area for non-recyclable waste or residual material awaiting final disposal. **Location:** Isolated from other operational zones to prevent contamination. **Design Considerations:** ▪ Containment systems to manage potential leachate or odors, if and when applicable. ▪ Clear labeling for proper identification and management ▪ Loading zones for transportation vehicles.
10	Technical Area	**Description and Purpose:** Hosts utility systems such as power generation, fuel storage, and water supply. **Location:** Away from high-traffic zones but easily accessible for maintenance. **Design Considerations:** ▪ Secondary containment for fuel and hazardous materials. ▪ Compliance with fire safety and environmental regulations.
11	Offices and Administrative Zone	**Description and Purpose:** Provides space for administrative and operational staff. **Location:** Centrally accessible from all operational zones. **Design Considerations:** ▪ Include offices, meeting rooms, restrooms, and break areas. ▪ Equipped with IT and communication infrastructure.
12	Maintenance Workshops and Spare Parts Storage	**Description and Purpose:** Workshop for repairing machinery and storing spare parts.

No.	Zoning Requirements	Description
		Location: Near the vehicles and machinery parking zone for quick access. **Design Considerations:** ▪ Ventilated and well-lit workspace with designated storage for tools and spare parts. ▪ Waste oil and lubricant disposal area. ▪ Safety features such as fire extinguishers and spill containment systems.

The above requirements define the essential zones for a CDW treatment facility to ensure optimal functionality and compliance. The following diagram visually represents the zoning layout and integrates these requirements to provide a holistic site plan.

5.2 Site infrastructure requirements

The success of a CDW treatment facility relies on robust and well-planned infrastructure that supports efficient operations, safety, and regulatory compliance. This section outlines the key infrastructure elements necessary to ensure seamless functionality, including access roads, utilities, drainage systems, and security provisions. Each component is designed to optimize material handling, accommodate heavy machinery and vehicles, and protect the environment and surrounding communities. Properly implemented infrastructure not only enhances operational efficiency but also aligns with sustainability and safety standards.

Table 5-2: Site infrastructure requirements

No.	Infra requirements	Description
1	Access Roads and Traffic Management	**Purpose:** Facilitate efficient movement of heavy trucks and machinery while minimizing congestion and turnaround times. **Design Considerations:** ▪ Construct durable access roads capable of withstanding heavy loads. ▪ Ensure two-way traffic lanes with a sufficient width and turning radii for large vehicles. ▪ Include clear signage and traffic control measures to separate entry and exit routes.
2	Entrance and Exit Gates	**Purpose:** Control site access to enhance security and manage vehicle flow.

No.	Infra requirements	Description
		Design Considerations: ▪ Provide dedicated gates for entry and exit. ▪ Install automated barriers and monitoring systems (e.g., RFID or cameras) to regulate vehicle movement and prevent unauthorized access.
3	Weighbridges	**Purpose:** Monitor incoming and outgoing waste volumes for compliance and operational efficiency. **Design Considerations:** ▪ Install weighbridges at the entrance and exit. ▪ Integrate digital recording systems for automated data collection and reporting.
4	Surface Water Drainage	**Purpose:** Manage stormwater and possibly contaminated run-off to prevent environmental pollution. **Design Considerations:** ▪ Separate stormwater drainage from contaminated water collection systems. ▪ Transfer contaminated water to dedicated storage and/or treatment if and when applicable ▪ Inspect drainage systems annually to maintain integrity and efficiency.
5	Utilities and Services	**Purpose:** Ensure the facility has essential services for uninterrupted operations. **Infrastructure Requirements:** ▪ Water Supply: Separate networks for potable and non-potable water, supported by pumping stations. ▪ Power Supply: Strategic placement of distribution substations with energy-efficient backup systems. ▪ Lighting: Use smart energy-efficient lighting, including solar-powered options, for internal roads and operational areas. ▪ Telecommunications and IT: Provide high-speed internet, internal communication systems, and robust data infrastructure.

No.	Infra requirements	Description
		▪ Sewerage and Effluents: Design systems for sewage collection, wastewater treatment, and recycling.
6	Fencing and Perimeter Security	**Purpose:** Control access, ensure safety, and prevent unauthorized entry or scavenging. **Design Considerations:** ▪ Install fencing at least 2 meters high around the entire perimeter. ▪ Use CCTV systems, nighttime lighting, and security personnel to enhance safety. ▪ Include signage at key locations to discourage trespassing and illegal dumping.
7	Emergency Response Infrastructure	**Purpose:** Provide facilities for managing accidents, fires, or other emergencies. **Requirements:** ▪ Establish a health and safety center equipped for first aid and emergency response. ▪ Include fire safety infrastructure such as extinguishers, hydrants, and alarm systems. ▪ Ensure preparedness for chemical hazards or natural disasters.

The above infrastructure requirements ensure smooth and safe operations at a CDW treatment facility while complying with regulatory and environmental standards. By carefully planning and implementing these elements, the facility can achieve operational efficiency, sustainability, and safety for all stakeholders.

5.3 Treatment processes requirements

The treatment process of a CDW facility is a critical component in achieving effective waste recovery and recycling. The technologies for the separation and recovery of the mineral inert fraction of CDW are well-established, readily accessible, and generally inexpensive when compared to technologies used for the treatment of other types of waste.

Different technologies are available to treat the CDW stream as shown below. Special treatment technologies are also used for recovering specific components of CDW like asphalt and gypsum.

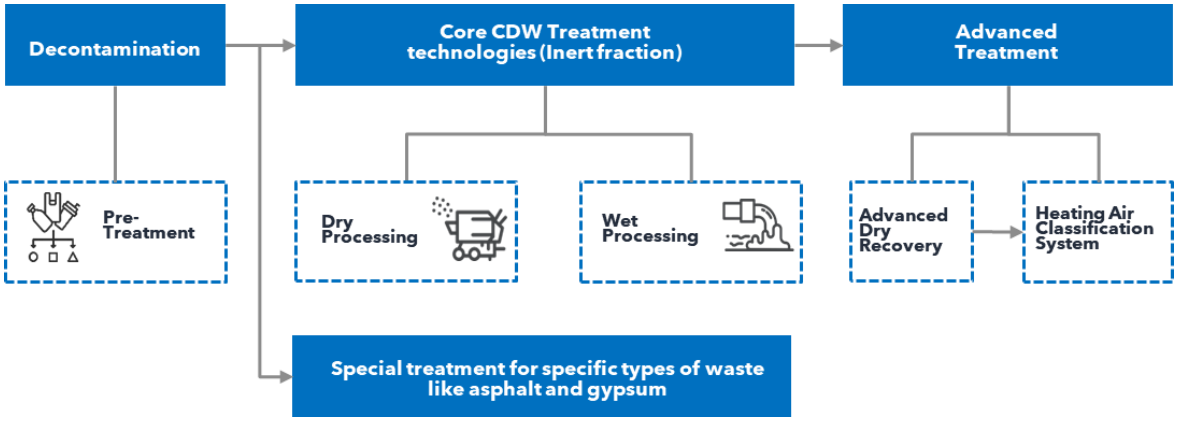


Figure 5-2: Different CDW treatment technologies

Information related to advanced treatment and special treatment for specific types of waste are included in **APPENDIX - 4** and **APPENDIX - 5** of this guideline and should be referred to for guidance. Alternative technologies may be proposed for the review and approval of MWAN.

Basically, the treatment facility must be capable of handling both mixed CDW and source-segregated inert CDW, as further detailed in the Waste Acceptance Criteria section of this document. To meet these needs, the treatment process needs to be structured into at least two mandatory primary stages to which optional advanced or additional stages could be added:

1. **Pre-Treatment Stage:** This stage is essential for:
    - Recovering recyclables mixed with the inert fraction.
    - Removing contaminants that may impact the quality of recycled aggregates.
    - Protecting treatment equipment by eliminating materials that could cause damage.
    - Safely handling and removing any hazardous materials present in the waste.
2. **Core Treatment Stage:** This is where the core processing of the inert CDW fraction takes place to produce recycled aggregates of different dimensions. The stage involves processing the waste using advanced technologies. Both **dry processing** and **wet processing** technologies are acceptable, with a preference for dry processes due to their environmental and socio-economic benefits.

Refer to **Figure 5-3** below for an overview of the required treatment process flow.

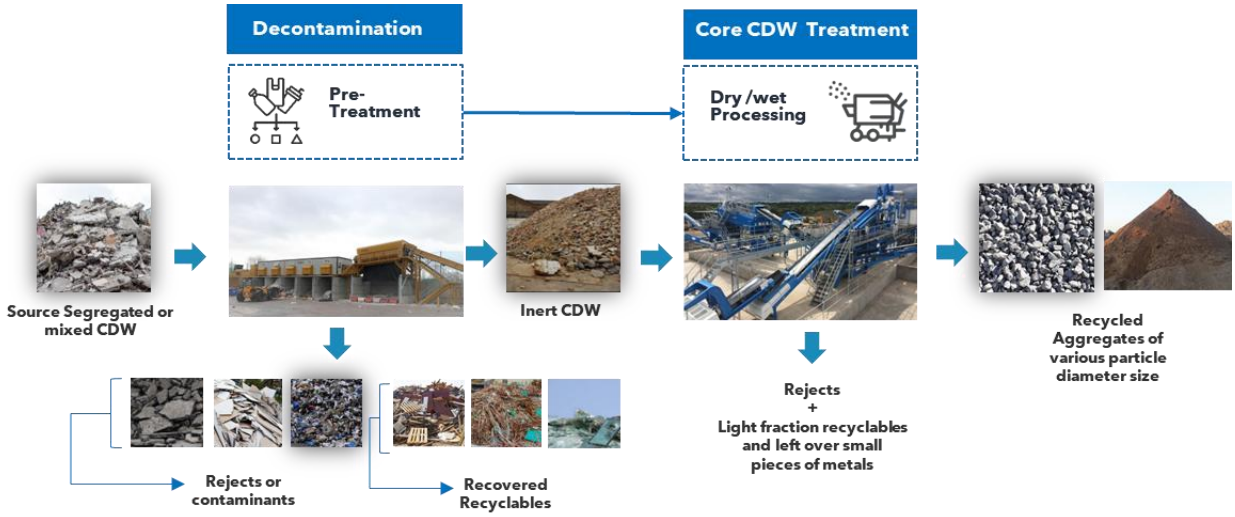


Figure 5-3: Overview of CDW treatment process flow

It is recommended that the facility design includes two parallel crushing lines to ensure operational continuity and reliability, which are critical performance criteria for CDW treatment.

The subsequent sub-sections will provide detailed requirements for each of these stages, ensuring the facility operates efficiently and meets regulatory and quality standards.

5.3.1 Decontamination / pre-treatment

The pre-treatment is often looked at as a preparatory stage that screens the incoming sorted waste stream and eliminates any remaining impurities and left-over recyclables. In most cases, this depends on manual sorting with the possibility of adding some equipment for the automatic recovery of some ferrous or non-ferrous materials. Less or more sophisticated sorting processes could be used as well.

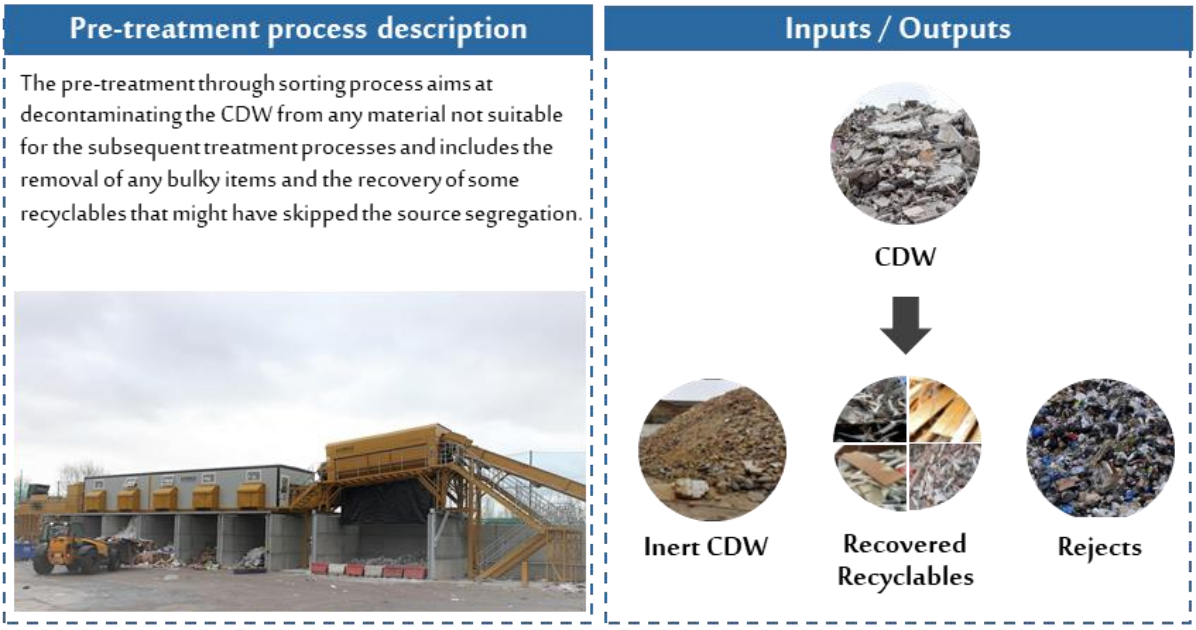


Figure 5-4: Summary of decontamination / pre-treatment

This stage can include a variety of techniques including without being limited to:

- **Manual Sorting**: Workers manually sort through incoming waste to separate large or hazardous items. This process helps identify items that might damage machinery or need special handling.
- **Magnetic Separation**: Ferrous metals are extracted from CDW using large magnetic separators, a critical step in preventing equipment damage and isolating valuable metals for recycling. High-strength magnets pull iron and steel from mixed waste streams, delivering these materials to recycling facilities, where they can be melted and reused in steel production.
- **Air Separation**: An airflow system separates lightweight materials from heavier ones using air pressure. Lightweight items (e.g., paper, plastics) are blown to one side, while heavier items (e.g., concrete and bricks) settle for later processing. This method is particularly effective in separating loose materials that may otherwise mix with aggregates and lower their quality.

5.3.2 Core CDW treatment technologies

Core processing technologies are where the bulk of material transformation occurs. The choice of treatment technologies depends largely on the application of the recovered aggregates. Simple technologies are used to produce aggregates for such applications as roads backfill or subbase. Alternatively, more advanced technologies are needed to upcycle the recovered materials and use them for higher grade applications.

In principle, the core technologies for treating CDW could be classified under either dry processing or wet processing with water being used in the latter to wash out impurities from the aggregates. More advanced technologies are also used as plugins to these processes to further process or treat the fine aggregate fraction that results from the former treatment technologies.

Dry Processing:

This technology usually consists of a series of crushing and screening stages where crushed inert waste components are then sieved to generate coarse and fine recycled aggregates of different dimensions.

Commonly, this process begins with crushing stony materials to produce a granular product of a given particle size. Current crushing trends include a combination of jaw crushers and secondary impact crushers:

- Jaw crushers fracture the particles by shearing across the main tension plane of compression; and
- Impact crushers pick the concrete into fast-moving rotor and smash against an impact plate repeatedly until the desired size fraction is achieved.

The crushed components are then sieved to generate coarse and fine recycled aggregates. Magnetic and eddy current separators could be integrated within the process to remove any ferrous and nonferrous metal impurities. Other technologies could be added as well to remove any possible contamination from lightweight plastics.

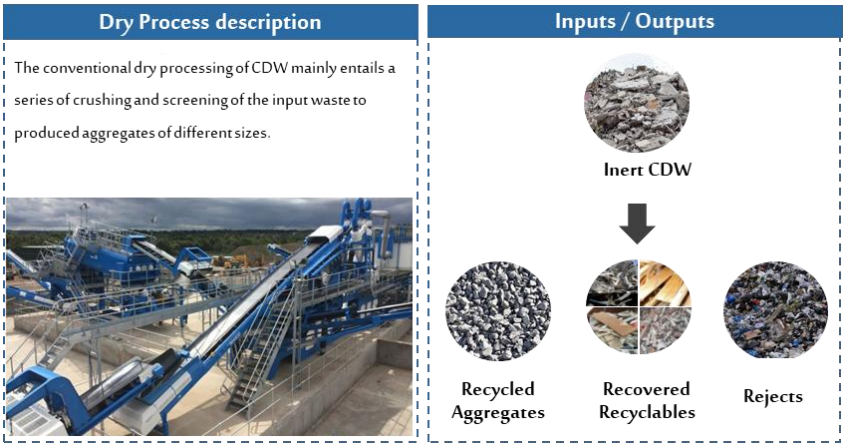


Figure 5-5: Illustration for the dry processing of CDW

Wet Processing:

Wet processing in CDW treatment involves using water to clean, separate, and refine materials, primarily focusing on producing high-quality recycled aggregates and removing contaminants. This process is particularly effective for CDW that contains fine particles, soil, dust, or other impurities, which, if not removed, could degrade the quality of the recovered materials.

In wet processing, washing and scrubbing techniques are commonly employed to clean aggregates like concrete, asphalt, and bricks by using high-pressure water jets and mechanical scrubbers to dislodge dust, clay, and other contaminants. This ensures the aggregates are cleaner and more suitable for reuse in construction projects, such as in the production of new concrete or as road base material.

When wet processing is used, operators must propose a treatment process for the generated sludge. The proposed process needs to be environmentally sound and should comply with NCEC and MWAN regulations.

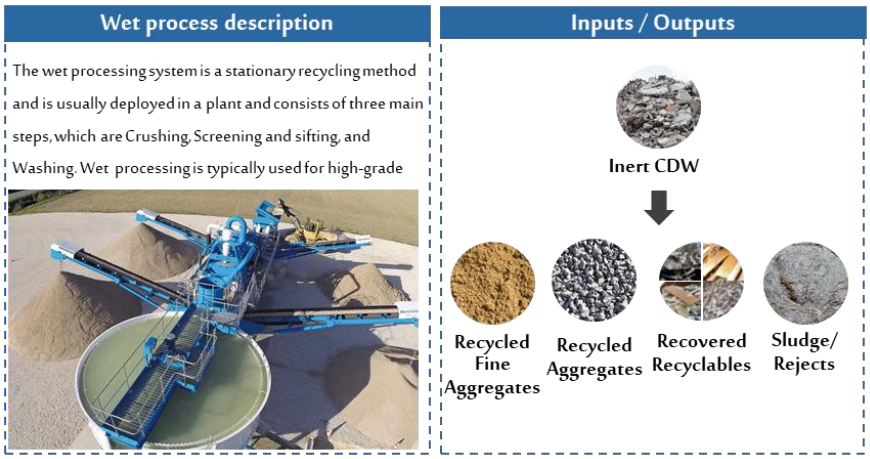


Figure 5-6: Illustration for wet processing of CDW

Operators need to propose appropriate treatment technologies, detailing their effectiveness, efficiency, and compliance with relevant standards and most importantly their capability to meet the KPIs set forth for the project.

6 CONSTRUCTION CONSIDERATIONS FOR CDW TREATMENT FACILITY

The construction of CDW treatment facilities must prioritize compliance, health and safety, and quality to ensure effective and sustainable operations. These considerations are essential to establish a facility that is safe, sustainable, and operationally efficient. The three main pillars are:



Figure 6-1: Key considerations to be addressed during the construction of CDW Treatment Facilities

6.1 Regulatory compliance

Regulatory compliance ensures that the facility is built in accordance with all legal, environmental, and technical standards. Adhering to these requirements minimizes legal risks and ensures alignment with the approved plans.

- Ensure all construction activities adhere to local building codes, environmental regulations, and the approved design plans.
- Contractors must secure and comply with all necessary permits and licenses issued by relevant authorities.

6.2 Health and safety

The health and safety of workers and the surrounding community must be a top priority during construction. Comprehensive planning and mitigation measures are essential to prevent accidents and protect well-being.

- Implement comprehensive health and safety plans, including worker training, emergency response protocols, and hazard mitigation measures.
- Employ dust, noise, and vibration control systems to protect workers and nearby communities.

6.3 Quality assurance

Ensuring high-quality materials and construction practices is critical to delivering a durable and functional facility. This requires stringent monitoring and adherence to established standards such as:

- Using construction materials and workmanship that meet industry standards and align with approved design specifications.
- Conducting regular inspections and quality control checks, documenting and resolving any deviations promptly.

By focusing on these three pillars, the construction phase ensures that the facility is built to meet operational requirements, maintain safety for workers and the community, and comply with environmental and regulatory standards.

7 OPERATIONAL CONSIDERATIONS FOR CDW TREATMENT FACILITY

The operational stage of a CDW treatment facility is critical to ensuring that the facility achieves its objectives of sustainable waste management, resource recovery, and compliance with regulatory standards. This stage involves detailed processes and performance monitoring to guarantee the efficient handling, treatment, and disposal of CDW.

This section outlines the key aspects of the facility's operations:

1. **Waste Acceptance Criteria:** Establishing clear criteria for the types of waste that can be processed, ensuring compliance with regulatory and environmental standards.
2. **Waste Acceptance Process:** Defining the steps for receiving and inspecting waste to prevent contamination and ensure compatibility with the facility's treatment capabilities.
3. **Key Performance Indicators (KPIs):** Identifying measurable metrics to evaluate the efficiency, effectiveness, and environmental performance of the facility.
4. **Machinery and Vehicles:** Highlighting the equipment necessary for efficient operations.

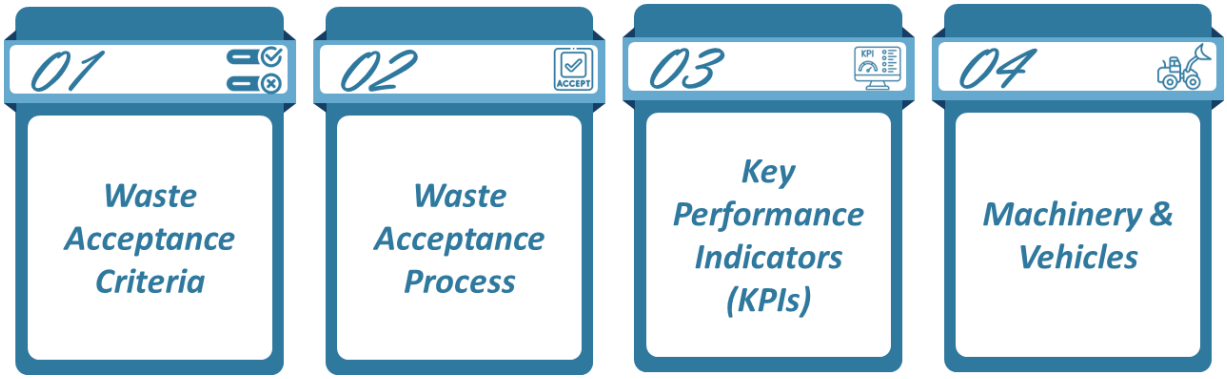


Figure 7-1: Elements the must be considered during the operational stage of a CDW treatment facility

Each of these aspects will be detailed in the subsequent sections, providing a comprehensive framework for managing the operational phase of the facility.

7.1 Waste acceptance criteria

The waste acceptance criteria outline the types and conditions of CDW that can be received and processed at the facility. These criteria are designed to ensure compliance with operational, environmental, and safety standards while optimizing the facility's efficiency and output quality.

The classification of CDW is based on **Table *7-1***, which categorizes waste into **inert**, **hazardous**, and **recyclable** materials, along with their respective processing or recycling potential.

The **treatment potential** indicated in **Table *7-1*** refers specifically to facilities equipped with the **Stage 1 (Pre-Treatment)** and **Stage 2 (Core Treatment)** processes of CDW treatment as presented earlier in **Section 5.3** of this guideline. These facilities are designed to process waste types that are compatible with standard treatment technologies used for recycling and recovery, such as:

- **Crushing and screening** (dry or wet methods) for inert materials.

- **Sorting and contaminant removal** during pre-treatment.

However, certain waste types, such as **gypsum-based materials** or **bitumen-containing waste**, require **specialized facilities** with advanced technologies to process them safely and effectively. For example:

- **Gypsum**: Requires specialized treatment technologies to recover gypsum or avoid contaminant release.
- **Bituminous mixtures**: Need technologies capable of separating or neutralizing bitumen components for recycling or safe disposal.

For this reason, **Table *7-1*** is limited to treatment facilities following the two-stage standard CDW process and excludes materials requiring specialized equipment or advanced technologies not available at general-purpose CDW treatment facilities.

Table 7-1: CDW materials classification and treatment potentiality

Code	Description	Classification				Treatment Potential
		Hazardous	Non-Hazardous	Inert	Recyclable	
17 01	**Concrete, bricks, tiles and ceramics**					
17 01 01	Concrete		✓	✓	✓	✓
17 01 02	Bricks		✓	✓	✓	✓
17 01 03	Tiles and ceramics		✓	✓	✓	✓
17 01 06	Mixtures of, or separate fractions of concrete, bricks, tiles and ceramics containing hazardous substances	✓				
17 01 07	Mixtures of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06		✓	✓	✓	✓
17 02	**Wood, glass and plastic**					
17 02 01	Wood		✓		✓	✓
17 02 02	Glass	✓	✓	✓	✓	✓

Code	Description	Classification				Treatment Potential
		Hazardous	Non-Hazardous	Inert	Recyclable	
17 02 03	Plastic	✓	✓	✓	✓	✓
17 02 04	Glass, plastic and wood containing or contaminated with hazardous substances	✓				
17 03	**Bituminous mixtures, coal tar and tarred products**					
17 03 01	Bituminous mixtures containing coal tar	✓				
17 03 02	Bituminous mixtures other than those mentioned in 17 03 01		✓	✓	✓	
17 03 03	Coal tar and tarred products	✓				
17 04	**Metals (including their alloys)**					
17 04 01	Copper, bronze, brass		✓	✓	✓	✓
17 04 02	Aluminum		✓	✓	✓	✓
17 04 03	Lead		✓	✓	✓	✓
17 04 04	Zinc		✓	✓	✓	✓
17 04 05	Iron and Steel		✓	✓	✓	✓
17 04 06	Tin		✓	✓	✓	✓
17 04 07	Mixed metals		✓	✓	✓	✓
17 04 09	Metal waste contaminated with hazardous substances	✓			✓	✓
17 04 10	Cables containing oil, coal tar and other hazardous substances	✓			✓	✓

Code	Description	Classification				Treatment Potential
		Hazardous	Non-Hazardous	Inert	Recyclable	
17 04 11	Cables other than those mentioned in 17 04 10		✓	✓	✓	✓
17 05	**Soil (including excavated soil from contaminated sites), stones and dredging spoil**					
17 05 03	Soil and stones containing hazardous substances	✓				
17 05 04	Soil and stones other than those mentioned in 17 05 03		✓	✓	✓	✓
17 05 05	Dredging spoil containing hazardous substances	✓				
17 05 06	Dredging spoil other than those mentioned in 17 05 05		✓	✓	✓	✓
17 05 07	Track ballast containing hazardous substances	✓				
17 05 08	Track ballast other than those mentioned in 17 05 07	✓	✓	✓	✓	✓
17 06	**Insulation materials and asbestos-containing construction materials**					
17 06 01	Insulation materials containing asbestos	✓				
17 06 03	Other insulation materials consisting of or containing hazardous substances	✓				
17 06 04	Insulation materials other than those		✓	✓		

Code	Description	Classification				Treatment Potential
		Hazardous	Non-Hazardous	Inert	Recyclable	
	mentioned in 17 06 01 and 17 06 03					
17 06 05	Construction materials containing asbestos	✓				
17 08	**Gypsum-based construction material**					
17 08 01	Gypsum-based construction materials contaminated with hazardous substances	✓				
17 08 02	Gypsum-based construction materials other than those mentioned in 17 08 01		✓	✓	✓	
17 09	**Other construction and Demolition Waste**					
17 09 01	Construction and demolition waste containing mercury	✓				
17 09 02	Construction and demolition wastes containing PCB (for example PCB-containing sealants, PCB-containing resin-based floorings, PCB-containing sealed glazing units, PCB-containing capacitors)	✓				
17 09 03	Other construction and demolition wastes (including mixed wastes) containing hazardous substances	✓				
17 09 04	Mixed construction and demolition wastes		✓	✓	✓	✓

Code	Description	Classification				Treatment Potential
		Hazardous	Non-Hazardous	Inert	Recyclable	
	other than those mentioned in 17 09 01, 17 09 02 and 17 09 03					

Note: The above table was extracted from the Construction and Demolition Waste Management Protocol of the European Union, with the exception of the "Treatment Potential" column, which was added independently.

Building on the classifications and treatment potential outlined in **Table 7-1 above**, the following criteria detail the specific conditions under which CDW can be accepted or rejected at the facility. These criteria are designed to address operational considerations, ensure compliance with environmental and safety standards, and maintain the quality of outputs, such as recycled aggregates. Each scenario takes into account factors such as contamination levels, segregation status, and the nature of incoming waste loads.

The acceptance criteria are defined based on the following parameters:

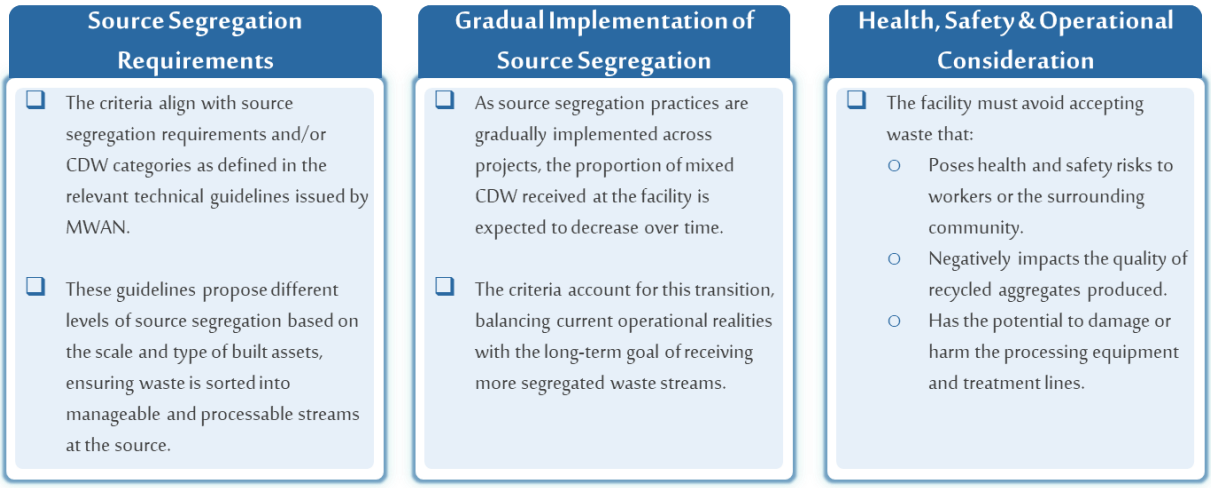


Figure 7-2: Elements which influence CDW acceptance for treatment and processing

The table below provides a practical framework for waste acceptance, along with examples to guide facility operators in implementing these criteria effectively.

Table 7-2: CDW acceptance criteria for treatment facilities

No.	Criteria	Allowed		Example
		Yes	No	
1	Waste classified in Table 7-1 as having potential for processing,	✓		- **Mixed loads** of concrete, bricks, and ceramics.

No.	Criteria	Allowed		Example
		Yes	No	
	whether received mixed or separately.			- **Separate loads** of recyclable metals such as steel or aluminum.
2	Incoming loads solely consisting of waste categories classified in Table 7-1 as having no potential for processing, whether mixed or separately, hazardous or non-hazardous.		✓	- **Hazardous waste** like insulation materials containing asbestos. - **Non-hazardous, non-recyclable waste** like coal tar or contaminated soils.
3	Waste classified in Table 7-1 as having potential for processing, but contaminated by less than 10% hazardous waste.	✓		- **Mixed CDW** with minor contamination, such as concrete with small oil stains or tiles with traces of hazardous coatings. - Contaminants must be removed during pre-treatment.
4	Waste classified in Table 7-1 as having potential for processing, but mixed with more than 20% non-hazardous waste with no potential for treatment.		✓	- **Mixed loads** of recyclables and inert materials contaminated with more than 20% gypsum boards must not be accepted, as they cannot be processed.
5	Waste classified in Table 7-1 as having potential for processing, but mixed with less than 20% non-hazardous waste with no potential for treatment.	✓		- **Mixed loads** of recyclables and inert materials contaminated with less than 20% gypsum boards. - Waste streams with manageable contamination levels that can be sorted and processed without harming operations.

Note:

Rows 4 and 5 also apply to contamination with Municipal Solid Waste (MSW). Loads contaminated with other types of non-hazardous waste may require separate evaluation depending on their impact on the facility's operations and treatment processes.

7.2 Waste acceptance stages

The CDW acceptance stage is critical to the effective operation of a CDW treatment facility. It ensures that only suitable materials enter the recycling stream, protecting equipment, safeguarding environmental and

human health, and complying with regulatory standards. This process involves evaluating waste characteristics before acceptance, inspecting deliveries, and organizing proper storage or holding areas to prevent contamination and maintain operational efficiency. A well-defined acceptance process supports sustainable waste management by enhancing material recovery and reducing landfill dependency. A three-step approach for waste acceptance is proposed as detailed below:

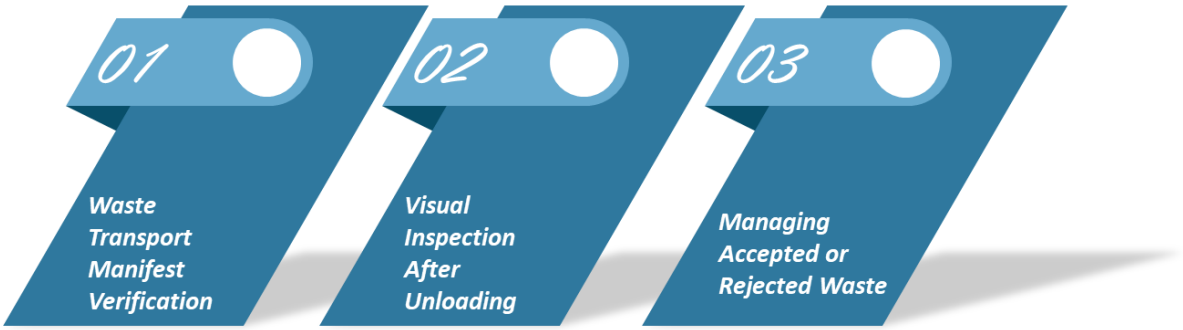


Figure 7-3: Stages for waste acceptance at CDW treatment facilities

7.2.1 Waste transport manifest verification

Upon arrival, the waste transporter must present the Waste Transport Manifest. This would allow the treatment facility operator to verify the type of waste listed on the manifest to confirm it falls under CDW. The decisions would be either one of the following:

- Allow the collection vehicle to enter the site if the waste type is CDW.
- Reject waste and deny site access if the waste type is not CDW.
- When the waste is rejected, the operator needs to report the reason for rejection in the Rejection Log.

7.2.2 Visual inspection after unloading

After unloading, a visual inspection of the waste needs to be undertaken to check compliance with the Waste Acceptance Criteria (WAC) defined by MWAN. The decisions would be either one of the following:

- If the waste meets the WAC, the facility operator would proceed to accept it.
- If the waste does not meet the WAC, mark it for rejection and isolate it.

7.2.3 Managing accepted or rejected waste

While the accepted waste would be stored in the zones dedicated to it, the rejected waste would be moved to a quarantine area within the treatment site, clearly marked as "Rejected Waste."

In the case of rejected waste, the operator should:

- Record the rejection in the Rejection Log.
- Update the Waste Transport Manifest with the reason for rejection.

- Notify the waste transporter of the rejection in writing while providing details on why the waste was rejected (e.g., contamination, hazardous materials, or non-conforming materials).
- Include next steps for corrective actions.

The corrective measures for the rejected waste include one of the following actions:

- Return to the generator:
  - The transporter must return the waste to the generator for further segregation, reclassification, or proper disposal.
- Redirect to appropriate facility:
  - If the waste is non-CDW or hazardous, direct the transporter to an authorized facility that can handle such waste.
- Temporary storage:
  - If immediate return or redirection is not feasible, temporarily store the waste in the quarantine area until appropriate action is taken. Ensure this complies with MWAN guidelines and local regulations.

7.3 Key Performance Indicators

The CDW treatment facilities need to meet the following Key Performance Indicators (KPIs) which have been defined to help achieve the high-level targets set at the level of the national waste management strategy. These include the following and are detailed in the subsequent sections:

- The landfill diversion ratio.
- The quality of recycled aggregates produced in the facility.
- The environmental performance of the facility.

7.3.1 Landfill Diversion Rate

The Landfill Diversion Rate is a key KPI that measures a facility's effectiveness in diverting CDW from landfills. It represents the percentage of waste that is recycled or reused rather than disposed of in landfills. The table below shows the targeted landfill diversion ratios until 2040 when the ultimate 89% landfill diversion ratio would be achieved.

Table 7-3: Annual estimates of objectives of the CDW National Plan

Performance Indicators	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
CDW Landfill Diversion Rates	9%	18%	27%	36%	45%	53%	58%	62%	67%	71%	76%	78%	81%	84%	86%	89%

7.3.2 Quality of Recycled Aggregates

CDW treatment facilities must produce recycled aggregates that comply with the standards and requirements set forth in SASO and Roads General Authority in terms of meeting the specifications of the

recycled aggregates for the applications allowed. If aggregates quality is poor, it can limit the facility's ability to sell recycled materials, impacting the profitability and sustainability of operations.

7.3.3 Environmental Performance

The Environmental Performance of the facility assesses the broader environmental impact of its operations. This KPI encompasses various elements of sustainability, such as.

- Implement the environmental monitoring plan and requirements set forth in the environmental permit to operate that is approved by NCEC.
- Comply with the relevant environmental law and regulations for the monitored matrices.

7.4 Machinery and vehicles

Recycling CDW demands specialized machinery and vehicles to support the treatment process. In the below section details of some machinery required for CDW treatment have been provided.

7.4.1 Transportation vehicles

CDW recycling facilities rely heavily on transportation vehicles to move waste to, from, and within the site. Dump trucks are commonly used for transporting loose materials such as concrete, rubble, and soil. Hook lift trucks handle roll-on/roll-off containers, providing flexibility for loading and unloading.



Figure 7-4: Illustration of dump trucks used for transporting CDW

7.4.2 Waste loaders

In recycling facilities, front-end loaders are the most commonly used vehicles for transferring waste from the tipping area into the initial processing section. These versatile machines are equipped with large buckets designed to handle bulky CDW, including concrete, bricks, and mixed debris.



Figure 7-5: Illustration of waste loaders used for loading / unloading of CDW

8 QUALITY ASSURANCE & MANAGEMENT

Effective quality management is crucial for minimizing environmental impact, enhancing worker safety, and maintaining operational efficiency of CDW processing and treatment. Establishing clear, documented procedures for each step of the disposal process, including waste receipt, waste acceptance criteria (WAC), on-site verification upon arrival, handling, and final disposal, ensures consistency and compliance with relevant regulations. CDW treatment facilities must implement the following quality measures:

- **Waste Segregation and Acceptance Criteria:** The treatment process begins with the acceptance of incoming CDW, which must be subject to a stringent waste segregation protocol. This step involves checking that the waste meets predetermined criteria for material type, quality, and volume. Any waste found to be contaminated with hazardous materials or foreign objects is rejected to maintain the integrity of the treatment process. Effective waste inspection at the intake stage is critical to ensuring that non-conforming waste does not enter the treatment facility, which could lead to quality issues in the final processed materials or pose a risk to both the environment and human health.

- **Quality of Recycled Aggregates:** Another key element of quality management is the ongoing quality assessment of the recycled aggregates produced during the treatment process. These recycled aggregates must meet the specific requirements of the Saudi Standards, Metrology, and Quality Organization (SASO) and the Road General Authority (RGA) to be considered suitable for various applications. Ensuring that output materials adhere to these standards requires rigorous testing protocols and the mandatory acquisition of the Recycled Aggregate (RA) quality certificate issued by SASO. Detailed records of these test results, along with the quality certificate, must be maintained to confirm the product quality and ensure traceability in case of audits or customer inquiries.
- **Continuous Improvement:** The management of CDW treatment facilities should be guided by the principle of continuous improvement. Regular performance reviews and assessments enable management to identify opportunities for enhancement, whether related to operational efficiency, quality control measures, or environmental sustainability. Staying informed about advancements in technologies and methods for waste treatment is crucial for improving the facility's performance. Embracing innovation ensures the facility remains competitive and aligns with the industry's best practices.

Further, implementation of the integrated system for quality, health, safety and environment (QHSE) is also vital for CDW treatment facilities. The integrated QHSE system should outline procedures for overall processing, treatment, recycling and management of residual waste, with clear KPIs to follow, and regular and periodic monitoring for operational efficiencies. This thorough data collection is vital for assessing how well processing and treatment operations are performing and pinpointing areas that need improvement.

9 REPORTING, RECORDKEEPING AND DOCUMENTATION

Effective reporting, recordkeeping, and documentation are essential in managing CDW processing and treatment activities. These processes enable transparency, compliance with regulations, and efficient tracking of material flows, ultimately supporting a more sustainable and accountable approach to CDW processing and treatment. Specific documentation requirement include:

9.1 CDW inventory

CDW Inventory will be developed by the CDW producer / generator / construction and demolition contractor and send it to the processing and treatment facility. This inventory should also be maintained to track materials stored at the facility. It helps monitor waste management efficiency and ensures that waste is handled appropriately.

9.2 Third-party laboratory testing report

In some cases where material identification and characterization are difficult, then approved third-party laboratory will be engaged to evaluate the hazardousness of the generated CDW. CDW producer / generator / construction and demolition contractor will be responsible for this testing and testing reports will be sent to processing and treatment facility. Details of testing requirements have been presented in **APPENDIX - 1.**

9.3 Waste transport manifest

CDW transporters will be required to provide a complete waste transport manifest to the treatment facility. These manifests include the details of the waste transporters, the type and amount of material, and the waste's final destination i.e., either to treatment or disposal facility. This documentation ensures that all waste is recycled or disposed of in compliance with regulatory requirements.

9.4 Regulatory compliance records

Adherence to waste and environmental regulations is a key aspect of the documentation process. CDW processing activities require submission of compliance reports to relevant authorities, including information on waste diversion rates and recycling performance. Additionally, quality control documentation is essential to ensure that recycled materials meet necessary reuse standards, verified through testing and inspection records, such as strength tests for recycled aggregates and contamination checks for metals etc.

9.5 Documentation of waste streams

Records should include all incoming waste streams, the quantities of aggregates produced, sold, rejected waste, and recovered recyclables. Additionally, residual waste—non-recyclable materials—must be tracked separately, with documentation that details the volume, composition, and disposal methods (e.g., landfilling or hazardous waste treatment). Effective tracking of the incoming waste streams and the residual waste is essential for managing environmental impacts, ensuring regulatory compliance, and identifying opportunities to boost recycling rates. It also provides valuable data for developing waste reduction strategies and enhancing resource recovery efforts.

10 HSE Considerations

The CDW treatment poses various health, safety, and environmental (HSE) risks that must be addressed proactively:

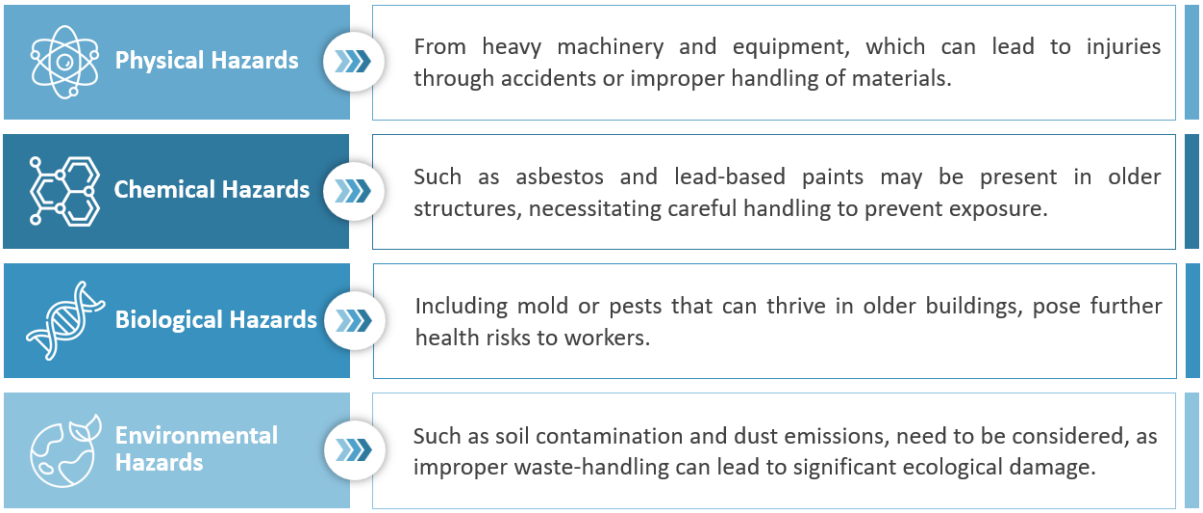
- **Health considerations:** Proper health management during CDW treatment is critical to protecting workers from harmful exposure to hazardous materials such as asbestos, silica dust, and other contaminants, which pose serious health risks if not managed correctly.
- **Safety considerations**: Safety is paramount in treating CDW, as CDW often present dynamic and hazardous fractions. Adherence to safety protocols, regular equipment maintenance, and comprehensive worker training on safe handling, lifting techniques, and emergency response can reduce risks and enhance operational safety.
- **Protection of the environment** is also paramount in CDW treatment. Adopted treatment technology should meet standards for air quality, noise, soil contamination and water quality.

This section outlines the critical HSE considerations necessary for the effective CDW treatment.

10.1 Health & Safety (H&S) Plan

10.1.1 Risk assessment

A comprehensive risk assessment for the treatment of CDW is essential to minimize potential hazards and enhance safety throughout the waste management process. The first step involves identifying various hazards associated with CDW, including:



After identifying these hazards, the likelihood of their occurrence must be assessed, alongside the potential severity of consequences, creating a risk matrix to prioritize risks and come up with a mitigation plan for those risks. Regular monitoring and review of the risk management plan are also necessary to adapt to any changes in the work environment or legislation, ensuring ongoing compliance and safety.

10.1.2 Dust and airborne contaminants

CDW recycling generates significant dust, especially when processing materials like concrete, brick, and gypsum. Dust may contain silica, which poses respiratory risks, including silicosis, chronic obstructive

pulmonary disease (COPD), and even lung cancer if workers are exposed over extended periods. To mitigate these risks, recycling facilities should implement the following measures:

- **Dust Control:** One of the most common and effective methods for controlling dust is the use of water spray systems. Water can be sprayed onto the material before and during crushing or screening to keep dust particles from becoming airborne
- **Personal Protective Equipment (PPE):** Equip workers with respirators rated for silica dust. Masks with appropriate filtration should be mandatory, especially for those working directly with crushing and grinding machinery.

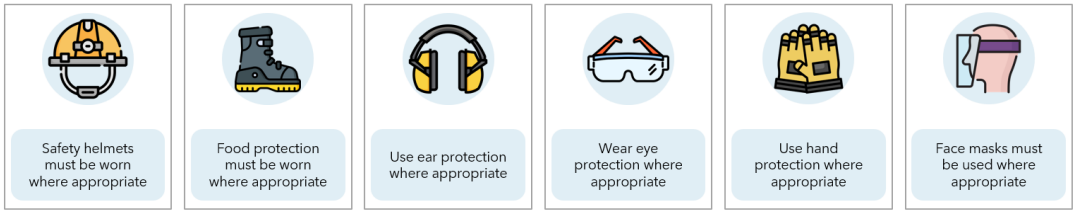


Figure 10-1: General PPEs to be Used during CDW Treatment Activities

- **Health Monitoring:** Regular health check-ups, including respiratory assessments, help detect early signs of respiratory issues, allowing for intervention and minimizing long-term health impacts.

10.1.3 Machinery safety

CDW recycling operations rely heavily on powerful machinery such as crushers, shredders, loaders, and conveyors, which pose risks of crush injuries, entanglement, cuts, and even fatalities. Proper safety practices for machinery include:

- **Routine Maintenance:** Regular inspection and maintenance of machinery prevent mechanical failures that could lead to accidents.
- **Clear Work Zones:** Establish designated safety zones around machinery with visible markings and barriers. Only trained personnel should access these areas during operation.
- **Protective Guarding:** Install guards on moving parts, especially on conveyor belts, to prevent entanglement and injury.

10.1.4 Noise control and hearing protection

High noise levels from crushing, grinding, and other recycling operations can result in hearing damage over time. Noise control measures include:

- **Engineering Controls:** Install sound-dampening materials around machinery and use noise barriers to reduce ambient noise levels.
- **Personal Protective Equipment:** Equip workers with hearing protection devices such as earmuffs or earplugs rated for high-decibel environments.
- **Exposure Limits and Monitoring:** Implement work schedules that minimize prolonged exposure to high noise levels and use decibel meters to monitor sound exposure regularly.

10.1.5 Ergonomics and manual handling

Handling heavy or awkward materials manually increases the risk of musculoskeletal injuries. To minimize these risks:

- **Mechanical Aids:** Use cranes, forklifts, and trolleys to reduce manual handling. Automated systems can also reduce strain on workers.
- **Training in Safe Lifting:** Workers should be trained in ergonomically correct lifting techniques to prevent back and joint injuries.
- **Rotation of Tasks:** Rotate tasks to prevent repetitive strain injuries, particularly in operations that require repetitive movements.

10.1.6 Fire and explosion prevention

Materials like wood, plastics, and combustible dust, as well as the presence of flammable chemicals and fuels, introduce fire and explosion hazards. Preventative measures include:

- **Storage Protocols:** Store flammable materials separately and away from heat sources. Ensure that combustible materials are in designated storage areas.
- **Regular Inspections:** Inspect equipment and storage areas to ensure proper handling of combustible and flammable substances.
- **Emergency Preparedness:** Maintain fire extinguishers and other firefighting equipment on-site and conduct regular fire drills to prepare employees for quick evacuation and response.

10.1.7 Emergency response and first aid

CDW treatment and processing facilities should be equipped to respond to accidents and emergencies promptly. Essential elements include:

- **First Aid Training:** Ensure that staff are trained in basic first aid and cardiopulmonary resuscitation (CPR) to provide immediate assistance if injuries occur.
- **Emergency Kits and Equipment:** Stock emergency kits with first aid supplies, burn kits, and other necessary items.
- **Emergency Response Plan:** Develop and regularly update an emergency response plan covering fire, chemical spills, machinery accidents, and medical emergencies. Conduct regular drills to ensure that all workers are familiar with response procedures.

10.1.8 Incident reporting and investigation

A system for reporting and investigating incidents, near misses, and safety concerns must be established, and workers must be encouraged to report any safety issues without fear of reprisal. These reports must be used to analyze trends, implement corrective actions, and continuously improve safety practices on-site.

10.2 Environmental Management Plan (EMP)

As per the requirements of Article 8 of Environmental Protection Act, all CDW processing and treatment operators must develop environmental management and monitoring plans and programs. This program along with risk assessment will also provide valuable guidance in managing the environment at the CDW treatment facility. The following key elements shall be included in environmental management program:

- Commitment from senior management to an environmental policy that is clearly communicated to all staff
- Articulation of statutory requirements
- A thorough review of the actual or potential environmental impacts and preparation of plans to reduce them, which include specific objectives and targets
- Mechanisms to implement improvements including the designation of responsibilities, communication processes, document control and operation procedures
- Training of all relevant staff in the implementation of improvements
- Mechanisms to check and review environmental performance
- Management reviews of the system's performance
- Commitment to continuous improvement.

Below are key components and strategies for effective environmental management during CDW processing and treatment activities:

10.2.1 Dust control and air quality

CDW recycling activities, especially those involving crushing, sorting, and grinding, can generate large amounts of dust, which may contain harmful particulates such as silica from concrete or asbestos from older buildings. For metal recycling facilities, flue gases from the furnaces also pose risk to the surrounding air quality. These airborne particles and fumes can pose health risks to workers and contribute to air pollution if not properly managed. Key dust control measures include water spraying and misting systems which can significantly reduce dust generation by wetting materials before or during processing.

10.2.2 Noise pollution management

During treatment of CDW workers often encounter high noise levels from machinery, tools, and equipment used on-site, such as heavy machinery, truck movement, loading and unloading operations, compaction etc., leading to potential hearing loss, increased stress levels, and reduced productivity. To effectively manage noise exposure, employers should conduct regular noise assessments to identify areas where sound levels exceed acceptable limits, facilitating the implementation of necessary control measures. Similarly, vibration exposure from tools and machinery can lead to health issues, including hand-arm vibration syndrome (HAVS) and other musculoskeletal disorders. To mitigate vibration risks, employers should select tools and equipment designed to reduce vibration, conduct regular maintenance to keep them in optimal condition, and rotate workers' tasks to limit individual exposure times.

Heavy machinery used in CDW recycling, such as crushers and grinders, produces high noise levels, which can disrupt surrounding areas, particularly if recycling operations are located near residential zones. Reducing noise pollution involves:

- **Sound Barriers and Enclosures:** Installing sound barriers around noisy equipment and operations helps minimize noise transmission.
- **Machinery Maintenance:** Regular maintenance and lubrication reduce noise levels by ensuring that equipment runs smoothly.

10.2.3 Energy consumption and efficiency

CDW treatment and processing requires substantial energy for machinery operation, material processing, and transportation. Reducing energy consumption not only lowers operational costs but also decreases the carbon footprint of recycling operations. Energy-efficient strategies include:

- **Energy-Efficient Equipment:** Using energy-efficient machinery and systems can lower overall energy usage.
- **Renewable Energy Sources:** Where possible, facilities can integrate renewable energy sources, such as solar panels, to power recycling operations.
- **Optimized Logistics:** Reducing transportation distances and improving logistics help minimize fuel consumption, especially for hauling large amounts of CDW to and from recycling facilities.

10.2.4 Water usage and management

Water is commonly used in CDW treatment and processing to control dust, wash recyclable materials, and sometimes to process the waste. However, excessive water use and improper wastewater management can lead to environmental degradation. Best practices for water management include:

- **Water Recycling Systems:** Recycling water within the facility reduces overall water usage and minimizes wastewater.
- **Treatment of Wastewater:** Treating wastewater before release ensures contaminants do not pollute local water bodies.
- **Minimizing Water Use:** Efficient dust suppression systems that use misting instead of excessive water spraying can significantly reduce water consumption.

10.2.5 Waste residuals and by-product management

Not all CDW can be fully recycled, and residual waste may remain after processing. Managing residuals is important to avoid increased landfill use and environmental impact. Strategies include:

- **Material Recovery Optimization:** Improving sorting and processing technologies can maximize recovery and reduce residual waste.
- **Safe Disposal of Non-Recyclable Materials:** For materials that cannot be recycled, such as certain hazardous wastes, facilities must follow strict disposal regulations to prevent environmental harm.

- **Development of Waste Management Plan:** A Waste Management Plan (WMP) for CDW processing facilities outlines the approach for handling, sorting, recycling, and disposing of construction and demolition waste to minimize environmental impact. The plan specifies waste types managed. To ensure safe disposal of residual waste.

10.2.6 Monitoring and reporting

Establish a monitoring program to evaluate the effectiveness of the EMP and compliance with NCEC's environmental protection law and its executive regulations. This may include air quality, flue gases, wastewater, noise level, and regular inspections. Prepare periodic reports detailing compliance status, environmental performance, and any incidents or non-conformities

10.2.7 Communication and coordination

Effective communication and coordination of Health, Safety, and Environmental (HSE) protocols CDW processing and treatment are critical to maintaining safety standards, ensuring compliance, and promoting a culture of safety. Here are key modes of communication and coordination typically used for HSE protocols:

- **Daily Toolbox Talks:** Short, daily safety meetings held on-site focus on current tasks, potential hazards, and any recent incidents. Toolbox talks help reinforce HSE protocols and ensure workers understand the risks associated with their specific activities.
- **Signage and Visual Communication**
  - **Warning and Instructional Signs:** Visual cues such as "Hard Hats Required," "Authorized Personnel Only," and "Danger: Falling Debris" signage reinforce safety and access controls on-site. Clearly displayed signage helps workers and visitors adhere to HSE protocols.
  - **Pictograms and Symbols:** Especially in multilingual environments, universally recognized safety symbols communicate essential information quickly, reducing the risk of misunderstanding.
- **Safety Bulletins and Updates:** Weekly or monthly bulletins on HSE updates, safety tips, and lessons learned from past incidents can be circulated via email or posted in common areas. This documentation keeps everyone informed about evolving HSE practices and insights.
- **On-Site Demonstrations and Drills:** Conducting regular emergency evacuation, fire, or first aid drills ensures that all personnel are prepared for potential incidents. Drills reinforce emergency protocols and allow for the assessment and refinement of response plans.

11 TRAINING AND CAPACITY BUILDING

Training and capacity building during CDW processing and treatment operations are essential for ensuring that workers and management understand best practices, comply with regulations, and effectively contribute to sustainable waste management efforts. Investing in training programs not only enhances operational efficiency but also mitigates environmental impacts, promotes worker safety, and fosters a culture of accountability within organizations.

One of the primary objectives of training is to educate workers about the nature of CDW, including its components, potential hazards, and the importance of proper handling. This includes understanding the differences between recyclable materials and hazardous waste, recognizing materials that can be reused and recycled. Training programs should cover the properties of common construction materials, the environmental impact of improper disposal, and the health risks associated with exposure to hazardous substances. In **Table 11-1** some significant training requirements have been identified specifically for CDW processing and treatment operations.

Table 11-1: Training requirements During CDW Processing & Treatment Operations

No.	Training Name	Training Description	Target Audience	Responsibility
1.	Hazardous Waste Identification	Training on how to identify hazardous materials within CDW, including asbestos, lead, and other contaminants, as well as proper handling techniques.	All workers involved in waste handling	Internal training provided by trained HSE personnel
2.	Waste Acceptance Criteria for CDW processing and treatment facilities	Training on the protocols on acceptance of CDW for recycling and treatment facilities	CDW processing or treatment Facility operator, or any worker involved in initial screening and verification of waste for further acceptance	Internal training provided by trained HSE personnel Approved third party training provider
3.	Health & Safety Trainings	Educates workers on general safety protocols, emergency procedures, PPE usage, and workplace hazard recognition.	All workers involved in waste handling, processing, treatment, and recycling activities	Internal training provided by trained HSE personnel Accredited training provider

No.	Training Name	Training Description	Target Audience	Responsibility
4.	Manual Handling and Ergonomics	Safe manual handling techniques are crucial to prevent injuries during the CDW processing or recycling process. Training should cover proper lifting methods, ergonomics, and the use of mechanical aids to minimize physical strain on workers	All workers involved in waste handling	Internal training provided by trained HSE personnel
5.	Legal and Regulatory Compliance	Educate on laws, regulations and guidelines of relevant regulatory stakeholders identified in Section 2 i.e., Regulatory Requirement.	CDW processing or treatment Facility Operator, or any worker involved in CDW processing or treatment activities	Accredited training provider Internal training provided by trained HSE personnel
6.	Operational Safety in CDW processing and treatment	Best practices for safe operations include machinery operation, site access, and minimizing hazards.	CDW processing or treatment Facility operator, or any worker involved in CDW processing or treatment activities	Accredited training provider Internal training provided by trained HSE personnel
7.	Environmental Management during CDW processing and treatment	Outlining the list of environmental risk associated with CDW processing and treatment and its mitigation strategies	CDW processing or treatment Facility Operator, or any worker involved in CDW disposal activities	Accredited training provider Internal training provided by trained HSE personnel

APPENDIX - 1. SITE SELECTION FRAMEWORK

Selecting a suitable site for CDW disposal facilities is a critical step in effective waste management, with far-reaching environmental, social, and economic implications. An appropriately chosen location enhances operational efficiency, reduces transportation costs, mitigates environmental impacts, and ensures compliance with local and national regulations.

For that purpose, MWAN has developed a site selection framework designed to guide stakeholders in identifying optimal locations for planned CDW treatment and disposal facilities. This framework aims to ensure sustainable management of CDW across the Kingdom of Saudi Arabia while aligning with and achieving the objectives outlined in the CDW National Plan.

The site selection framework consists of three distinct steps, each grounded in a diverse set of well-defined site selection criteria. These criteria, which encompass technical, environmental, economic, and social considerations, were meticulously consolidated through an extensive review of existing local regulations, as well as regional and international benchmarks, to ensure a robust and adaptable approach to identifying optimal sites to guarantee that the facility operates effectively while minimizing adverse effects on surrounding areas. At each step of the site selection process, a specific group of criteria is applied based on its significance to the overall selection framework.

The following figure outlines the different steps of the site selection framework:



Figure A1-1: Steps of the site selection framework

In this section, the various steps of the framework will be outlined and explained.

A. Step 1: Restrictive zone mapping

The first step of the framework is restrictive zone mapping, which aims to eliminate unsuitable sites using "restrictive criteria" derived from the national regulatory framework in KSA and more specifically MWAN's implementing regulations. These criteria serve as mandatory requirements and will be used to narrow down the study area. Using Geographic information system (GIS) tools, these restrictive criteria can be applied to identify viable study areas within each cluster.

The following figure illustrates the restrictive criteria defined for this stage of the site selection framework, outlining the specific conditions each criterion must satisfy:



Figure A1-2: Restrictive criteria of the site selection framework

Once these criteria are applied, suitable zones will be identified and carried forward to the next step of the framework.

B. Step 2: Permanent infrastructure sites suitability mapping

In this step, the suitable zones identified in Step 1 will be categorized into three groups: most favorable zones, moderately favorable zones, and least favorable zones. This categorization is based on a multi-criteria analysis (MCA) conducted using the second set of criteria, ensuring a systematic evaluation of the zones' suitability.

These criteria will have three value ranges, identified based on reviewed regulations, benchmarks, and subject-matter expertise, to determine the level of favorability of the delineated zones. Criteria prioritization must also occur at this stage by assigning weights to these criteria, based on the specific needs and characteristics of each cluster, ensuring a tailored and effective evaluation process. This flexibility ensures that zones with marginally lower scores in one criterion can still be considered favorable if they excel in others, allowing for a balanced and context-sensitive selection process.

The following figure illustrates the criteria applied to the MCA stage, outlining the three value ranges for each criterion:



Figure A1-3: Criteria applied to the MCA stage of the site selection framework

Once these criteria are assigned weights (depending on the specificities of each cluster) and applied to the MCA using GIS tools, the suitable zones defined in step 1 will now be ranked based on favorability (most favorable, moderately favorable and least favorable). These ranked zones will be carried forward to the next step of the framework.

C. Step 3: Final selection of sites

In this step, candidate sites available to the stakeholders within the ranked zones identified in Step 2 will be reviewed and assessed using additional GIS layering techniques. This final evaluation aims to determine the most optimal locations for the construction of CDW infrastructure through comprehensive data analysis. Assessment of the available sites will be conducted using the third set of criteria, which is divided into two groups:

1- **Restrictive criteria at the site level:** These criteria must be met by the proposed sites to remain viable options; otherwise, the sites will be excluded from consideration.
2- **Criteria for the second Multi-Criteria Analysis (MCA) at the site level:** The remaining sites will be evaluated using these weighted criteria to score and rank the proposed viable options.

Figure A1-4 and **Figure A1-5** outline the site assessment and scoring process to be applied as part of step 3 of the site selection framework:

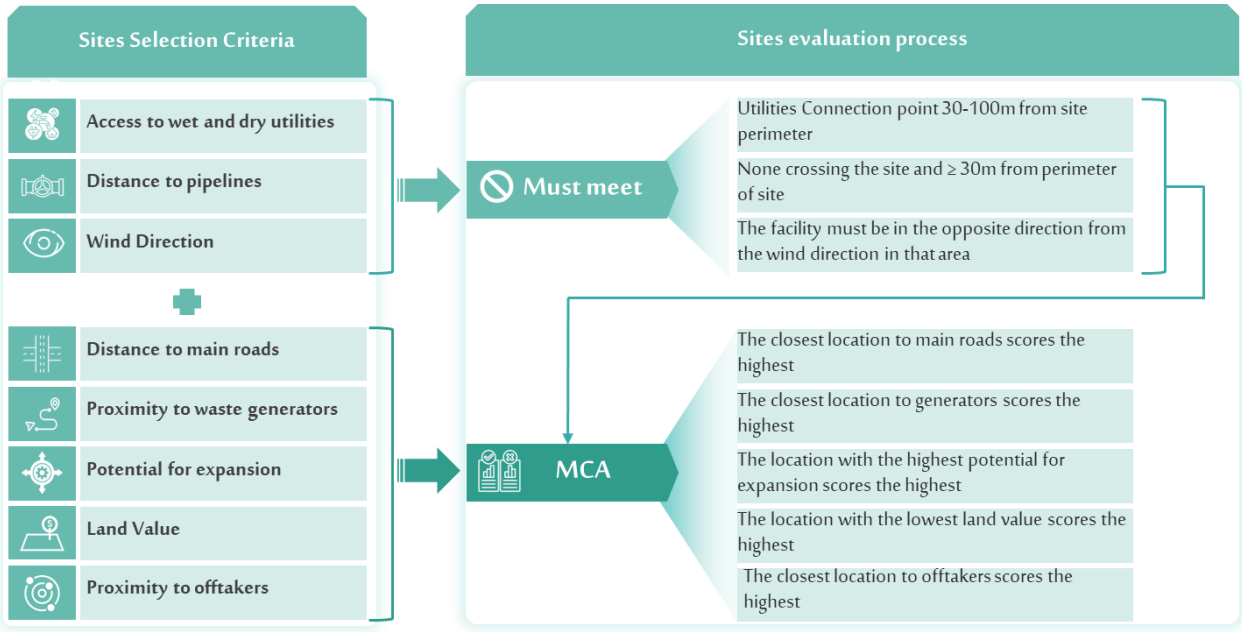


Figure A1-4: Site evaluation process

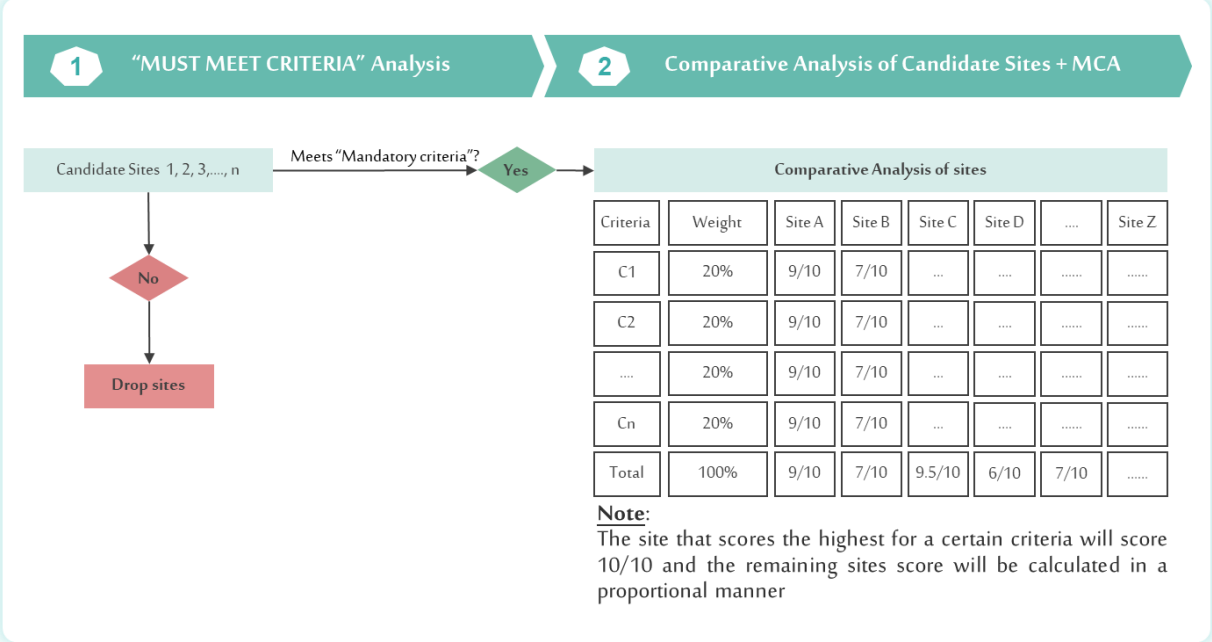


Figure A1-3: Depiction of scoring of each candidate site

Note: The site selection framework is designed with flexibility, allowing restrictive criteria from Step 1 to be applied in Step 3 if the required data is unavailable at the cluster level but is accessible at the site level.

At the end of step 3 of the framework, a list of ranked viable sites within the identified zones will be available to the decision makers. The site with the highest score will be the most suitable site, while the site with the lowest score will be the least suitable site.

APPENDIX - 2. MWAN PERMITTING REQUIREMENTS FOR RECYCLING FACILITY

Permit for the Recycling Facilities	
To obtain permit for establishing recycling facilities, an electronic application must be submitted, the application form completed, the general and special requirements and administrative requirements must be provided according to the activities practiced and compliance with the requirements.	
Activity	○ Organic Waste Recycling ○ Plastic recycling ○ Paper and cardboard recycling ○ Electronic waste recycling ○ Used batteries recycling ○ Tire recycling ○ Oil recycling ○ Construction and demolition waste recycling ○ Any other activities classified as recycling activities.
Beneficiary	Entities working at the recycling field
General Requirements	• Fill out the application form electronically. • Attach the commercial register to which the activity is added. • Attach the title deed or lease contract. • Attach the Zakat and Income Certificate. • Attach a diagram showing the organizational and administrative structure of the entity. • Attach the CVs of all technicians showing their experiences in the required field of activity. • Attach an illustration of the various facilities of the activity (the site of the activity). • A statement of the main equipment and devices used in the field of activity and their specifications. • Attach the proposed work plan and the technology used. • Attach the HSE plan
Special Requirements	1. Presenting a detailed work plan that accurately shows the project's ability to achieve the goals of the Centre, including its contribution to achieving the main goals and objectives of the national waste strategy, the targets for diversion from landfills, the adoption of best practices and modern technologies in the areas of waste management, and how the project contributes to reducing risks on Health, safety and environment, the strategic dimensions of the project, the benefit that will accrue to the city that will be the Centre of the project, and an estimate of the capital costs and financing needed for the project.

	2. The site must be appropriate to the nature of the activity. 3. Obtaining the environmental permit from the National Centre for Environmental Compliance 4. Providing electronic gates and scales at the entrances and exits of the recycling plant. 5. The area of the recycling plant is proportional to the volume of work and the quantity of production, according to the areas approved in the industrial plans. 6. Determine the quality of waste. 7. Determining the work area and the materials to be recycled accurately. 8. Description of the pretreatment stages of the recycling process. 9. Determining the means of disposal of the remaining non-recyclable waste. 10. Providing operating procedures manual. 11. Provide emergency and accident response plans
Administrative Requirements	Attaching a proof of the applicant's capacity to submit the request.
Conditions	○ The facility shall keep records and data related to its operations for a period of five years, and put them at the disposal of the Centre's inspectors during the visit, as well as provide the Centre with monthly reports showing the volume and types of waste and the quantities of waste that are recycled so that they can be viewed at any time by the Centre. ○ The facility shall provide periodic reports (electronic version) containing the movement of waste reception, its types, sources, volumes and other basic information on operational processes. ○ Not to make any operational, engineering or technical modifications without obtaining a prior approval from the Centre. ○ Not receiving waste that does not have pre-approved techniques from the Centre.
Main Outcome	Permit (Construction of Recycling Facility) specifying the activity(s) and subsidiary activities
Note	**The Centre has the right to modify the application requirements at any time or to request any additional requirements without prior notice.**

APPENDIX - 3. MWAN LICENSING REQUIREMENTS FOR RECYCLABLE MATERIALS SEGREGATION, PREPARATION, STORING & TRADING ACTIVITY

Recyclable materials segregation, preparation, storing and trading activity	
To obtain a licence in the field of **segregation, preparation, storing and trading of recyclable materials**, an electronic application must be submitted, the application form filled out, the general and special requirements and administrative requirements must be satisfied according to the activities practiced, and in compliance with the requirements	
The main activity	Segregation, preparation, storing and trading of recyclable materials
Sub activities	• Segregation, preparation and trading of recyclable materials • Temporary storage of recyclable materials
Beneficiary	Companies working in the field of segregation, preparation and trading of recyclable materials
General requirements	• Fill out the application form electronically. • Attach the commercial register to which the activity is added. • Attach the deed or lease contract. • Attach a certificate of tax and income. • Attach an illustration of the various facilities of the activity (the site of the activity). • A list of the main equipment and devices used in the field of activity and their specifications. • Attach the proposed business plan and the technology used.
Special Requirements	1. Determine the type of waste. 2. Provide a site to conduct the aforementioned activity in a proper manner, with the fulfilment of the following requirements: a. The site area should be commensurate with the materials to be traded. b. Provide good lighting and ventilation. c. Maintain the cleanliness of the site. 3. Provide a response plan for emergencies and accidents. 4. Attach an environmental permit for the site or sites of trading recyclable materials issued by the National Centre for Environmental Compliance 5. Providing electronic gates and scales at the entrances and exits of the sites.
Administrative Requirements	- Attaching the lease/title deed and site map. - Attaching a proof of the applicant's capacity to submit the request.
Conditions	- Only after the issuance of the activity licence by the Centre does the enterprise have the right to engage in any activity related to waste. - Undertaking not to receive waste of unknown source. - Electronic gates and scales must be provided at the entrances and exits of sites.

	- The facility shall maintain records and data on its operations for a period of five years and the status thereof and put them at the disposal of the inspectors of the centre. It shall also provide periodic reports on the size and types of waste and the quantities of waste sold or purchased. Such reports and records shall be accessible at all times by the centre.
Licence renewal requirements	1. A detailed operational report during the previous licence period containing a registry of the quantities and sources of waste purchased and sold; and the documents and invoices made during the previous licence period shall be attached thereto. 2.The above general, special and administrative requirements.
The Main Output	Licence (Segregation, Preparation, Storing and Trading of Recyclable Materials)
Note	**The Centre has the right to modify the requirements for making an application at any time or to request any additional requirements without prior notice.**

APPENDIX - 4. ADVANCED TREATMENT TECHNOLOGIES

A. Advance Dry Recovery

Advanced Dry Recovery is a cutting-edge, dry processing technology that offers a cost-effective and environmentally sustainable alternative to traditional wet processing methods. This system is designed to recover and classify materials, specifically extracting the fine fraction from crushed concrete aggregates. By utilizing mechanical and air-based separation techniques, the process eliminates the need for water-based treatments like drying or wet screening, making it a highly efficient solution for construction and demolition waste recycling.

i. Process Overview

The process flow of Advanced Dry Recovery consists of several key steps, each utilizing specific technologies to separate fine particles from larger aggregates without the need for water. Below is a detailed explanation of each step in the recovery process.

- **Material Feed and Pre-Processing:** The process begins by feeding moist crushed concrete aggregates into the system. These aggregates, which are typically sourced from construction and demolition waste, may contain varying moisture content. A conveyor system transports the material to the initial processing unit, ensuring a consistent and controlled flow of materials into the recovery system. This step prepares the aggregates for further separation.

- **Air Classification (Primary Separation):** The core technology used in Advanced Dry Recovery is air classification. In this stage, the aggregates pass through an air classifier, which uses a high-velocity air stream to separate lighter fine materials, such as dust, sand, and smaller particles, from heavier materials like larger concrete chunks and stones. The air classifier creates a controlled airflow that lifts the lighter particles upward while the heavier particles continue their downward trajectory. This efficient separation mechanism allows for the extraction of fine fractions even when the materials are still moist.

- **Cyclone Separator (Secondary Separation):** After primary separation in the air classifier, the material enters a cyclone separator for further refinement. The cyclone separator utilizes centrifugal forces to enhance the separation process. As the material spins inside the cyclone, the heavier particles are forced toward the outer walls, while the lighter particles are drawn toward the center and exit through the top. This secondary separation ensures that any finer particles, which may have been missed by the air classifier, are effectively captured and isolated.

- **Sieving and Screening:** Following the cyclone separator, the material undergoes mechanical sieving or screening. This step employs sieves or screens of various mesh sizes to further classify the material based on particle size. Sieving ensures that the fine fractions meet the necessary specifications for reuse in construction applications. The screening process also helps achieve the desired gradation, ensuring the final product's suitability for applications such as concrete production, road base materials, or other infrastructure projects.

- **Dust Collection System:** Throughout the process, a dust collection system is employed to capture airborne particles generated during the separation and classification stages. This system plays a critical role in minimizing environmental impact by preventing fine dust from being released into the air. The dust collection system also ensures compliance with air quality regulations and enhances workplace safety by controlling airborne dust. The collected dust can either be safely

disposed of or processed for potential recycling, further contributing to the sustainability of the process.

- **Product Discharge and Sorting:** Once sieving and screening are complete, the materials are sorted into different fractions based on size and quality. The fine fraction, which is the primary product of the Advanced Dry Recovery process, is discharged for further use. This fine material, having been separated from the coarser aggregates, is typically dry and ready for use in construction applications. The coarse aggregates, which may still contain valuable material, can either be sent for additional processing or used in other construction projects.

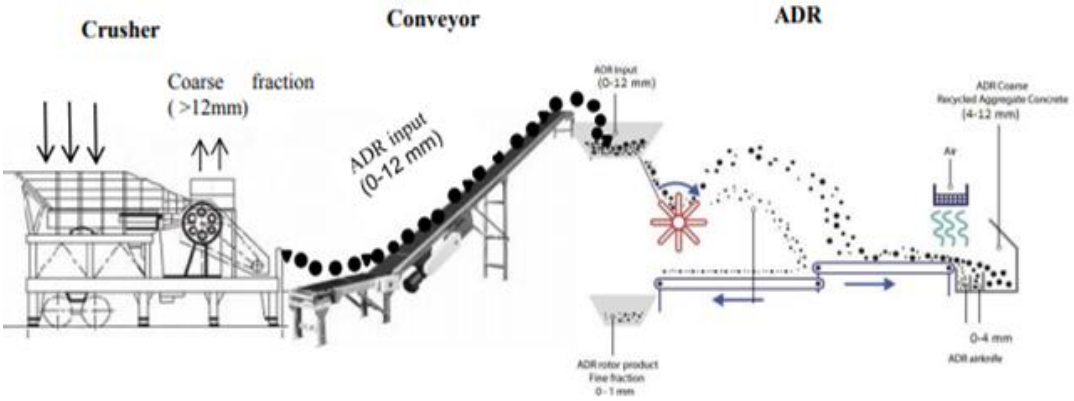


Figure A4-1: Illustration of ADR Technology

ii. Key Process Technologies

- **Air Classifier Technology:** Air classifiers are the central technology in Advanced Dry Recovery. These devices utilize a combination of air flow and mechanical forces to separate aggregates based on their size and weight. The air classifier's ability to separate particles without the use of water is one of the main advantages of this system. By creating a controlled airflow, it allows for the efficient extraction of fine fractions from moist concrete aggregates.

- **Cyclone Separators:** Cyclone separators further enhance the efficiency of the separation process by using centrifugal forces to isolate finer particles from the coarser materials. This technology improves the purity of the fine aggregates, ensuring that the final product is of high quality. The centrifugal action of the cyclone separator ensures that finer particles are separated and captured, preventing contamination of the final product.

- **Sieving and Screening Systems:** Sieving and mechanical screening technologies are used to refine the classification process by sorting the material based on specific particle sizes. This step is critical in ensuring that the recovered aggregates meet industry standards for quality and suitability in construction applications. The sieving process helps achieve the desired gradation of materials, which is essential for the final product's use in concrete production, road construction, or other applications.

- **Dust Collection and Environmental Control:** A dust collection system is integrated throughout the processing line to capture airborne particles generated during the separation stages. This system helps reduce environmental pollution by preventing the release of fine dust particles into the air. It also ensures compliance with air quality regulations and improves workplace conditions by controlling dust levels. Additionally, the collected dust can be processed or disposed of safely, contributing to the overall sustainability of the system.

B. Heating Air Classification System

The Heating Air Classification System (HAS) represents an innovative approach to refining and upgrading recycled fine aggregates, such as 0-4mm sieve sand, into clean secondary sand and cementitious particles. This process plays a vital role in transforming construction and demolition waste into high-quality materials suitable for use in concrete production and other construction applications. Through a combination of heating, air classification, and particle separation technologies, the HAS system effectively removes contaminants, enhances the purity of the materials, and contributes to sustainability by reducing reliance on virgin raw materials.

i. Process Overview

Below is a more detailed description of the process flow, technologies, and steps involved in HAS:

- **Material Collection and Pre-Screening:** The first step in the HAS process is the collection of fine recycled aggregates, commonly referred to as sieve sand. These aggregates often consist of a mix of sand, dust, cementitious particles, and organic contaminants. The source material for these aggregates is typically construction and demolition waste, which may be of inconsistent quality due to the presence of various debris, organic matter, and other unwanted substances. To ensure that only the desired fine aggregates enter the refining system, the material undergoes a pre-screening process. During this stage, larger particles (greater than 4mm in diameter) and debris are separated from the fine aggregates. This step is crucial for optimizing the performance of the fluidized bed and ensuring that only materials within the correct particle size range (0-4mm) are processed in the subsequent stages.

- **Heating Process in the Fluidized Bed:** After the pre-screening, the fine aggregates are introduced into a fluidized bed for heating. This is the core stage of the HAS system. The aggregates are subjected to high temperatures ranging from 600°C to 800°C, which is achieved using indirect heating methods such as electric or gas-fired heaters. The heat is applied uniformly throughout the fluidized bed, ensuring that the aggregates are evenly exposed to the required temperature.

  In the fluidized bed, the aggregates are suspended in the air stream, which causes them to mix and agitate. This motion increases the surface area exposure to heat, ensuring efficient thermal treatment. The heat serves several crucial purposes. First, it thermally degrades organic contaminants, such as wood, plastics, rubber, and other volatile substances that may be present in the recycled aggregates. These materials are broken down or vaporized at elevated temperatures, preventing them from contaminating the final product.

  Secondly, the heating process activates cementitious particles present in the aggregates. Cementitious materials such as lime, gypsum, and cement are commonly found in construction waste, and their reactivation at high temperatures helps break down any clumps or hardened masses that might be present. The heat also assists in the removal of moisture and other volatile materials from the aggregates, which improves the overall quality of the final product.

  Furthermore, the heating process causes lighter contaminants, such as small organic materials, dust, and fibers, to vaporize or burn off. The fluidized bed's agitation allows for effective mixing and ensures that only the denser, cleaner materials—sand and cementitious particles—remain.

- **Air Classification and Particle Separation:** Once the aggregates have been subjected to the heating process, they move into the next phase: air classification and particle separation. The heated aggregates enter a separation chamber, where high-velocity air is introduced. The air stream causes particles to separate based on their aerodynamic properties—specifically, their size and density.

Lighter materials, such as fine dust, small organic particles, and other contaminants that have been vaporized or burned off during the heating stage, are carried away by the airflow. These materials are removed from the process, ensuring that only the heavier particles—such as clean sand and cementitious materials—remain. The separation chamber is equipped with adjustable air velocities that allow for precise control over the classification process, ensuring that each particle fraction is properly sorted.

As the air flows through the separation chamber, the aggregates are classified into different fractions based on their size and density. The fine fraction (typically particles smaller than 1mm) contains clean sand and cementitious materials and is ideal for use in concrete production. The coarse fraction (particles ranging from 1mm to 4mm) consists of larger aggregates that can be used in various construction applications, such as in road base or landscaping. Finally, the light fraction, which consists of dust, fibers, and organic materials, is separated and discarded or further processed if needed.

- **Post-Processing and Final Screening:** Following the air classification, the aggregates are subjected to post-processing in the form of screening. This ensures that the final product has a consistent particle size distribution and meets the required specifications. The screening process typically involves vibrating screens or additional air classifiers that remove any remaining oversized particles or fine dust. These screening systems help achieve the desired quality of the final aggregates, ensuring that they are homogenous and meet the standards for construction materials. The post-processing stage also serves to remove any residual contaminants that may not have been fully eliminated during the previous steps. By the end of this process, the aggregates are refined and ready for use in high-quality concrete, mortar, or other construction applications.

- **Quality Control and Storage:** After the final screening, the clean aggregates undergo rigorous quality control checks to ensure they meet industry standards. These checks focus on several factors, including particle size distribution, purity, and strength. In particular, the aggregates are tested to ensure that they meet the required specifications for concrete production, such as the minimum strength and particle size limits.

  Once the aggregates pass these quality control tests, they are stored in silos or stockpiles, where they can be easily accessed for use in manufacturing construction materials. The storage system is designed to maintain the quality of the aggregates by protecting them from contamination or degradation before they are used in construction.

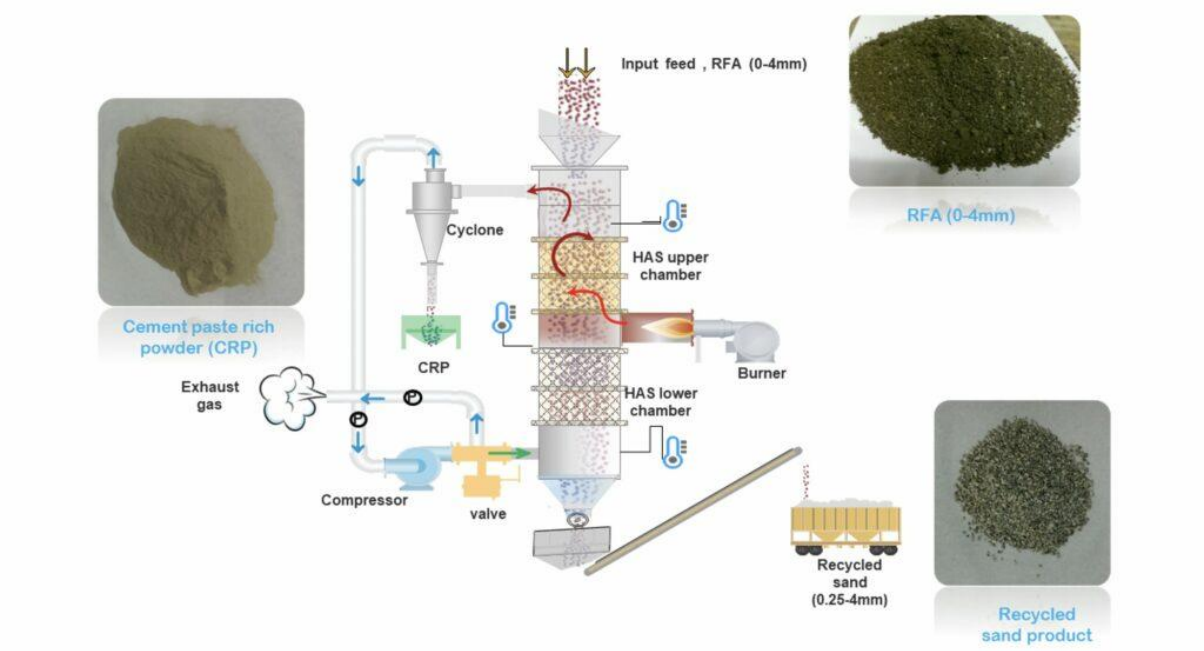


Figure A4-2: Illustration of heat air classification system

ii. Technologies Used in the HAS Process

The HAS system incorporates several advanced technologies to achieve the high-quality outcomes it delivers. Fluidized bed technology plays a central role in the heating stage. It ensures that the aggregates are evenly heated and agitated, improving the efficiency of the thermal treatment and ensuring that contaminants are effectively removed. This technology also allows for precise control over the temperature and mixing of the aggregates, ensuring that only the desired materials remain in the final product.

Air classification technology is crucial for separating the aggregates based on size and density. By utilizing high-velocity air, this technology separates the lighter contaminants from the heavier, usable particles, ensuring that the final product is pure and of high quality. The temperature control and heating system ensures that the fluidized bed operates efficiently, maintaining consistent temperatures that are necessary for the removal of contaminants without degrading the quality of the aggregates.

- **Fluidized Bed Technology:** Fluidized bed technology plays a critical role in the HAS system by ensuring efficient mixing and heat transfer. The aggregates are suspended in a stream of air, allowing for continuous agitation and uniform heating. This technology ensures that heat is evenly distributed across the material, which is essential for the thermal degradation of contaminants. Furthermore, it allows for precise temperature control, ensuring that contaminants are effectively removed without compromising the integrity of the aggregates. The fluidized bed's ability to maintain a consistent and controlled environment is key to achieving high-quality secondary aggregates.

- **Air Classification Technology:** Air classification technology is employed to separate particles based on their size and density. During this stage of the process, a high-velocity air stream is introduced, causing lighter particles to be carried away, while heavier particles, such as clean sand and cementitious materials, remain. This separation enhances the purity of the final product by effectively removing light contaminants, such as fine dust and small organic materials. The air classification system is adjustable, allowing for the fine-tuning of separation processes to produce aggregates with the desired characteristics, suitable for use in high-quality construction materials.

- **Temperature Control and Heating:** Temperature control and heating are vital components of the HAS process. Indirect heating methods, such as electric or gas burners, are utilized to ensure uniform and efficient heating of the aggregates. The heating process is carefully regulated to maintain specific temperature thresholds, which are critical for the effective removal of organic materials and the activation of cementitious particles. By carefully controlling the temperature, the system facilitates the thermal degradation of contaminants without affecting the quality of the aggregates. This controlled heating process ensures that the aggregates undergo optimal treatment, resulting in clean, high-quality secondary materials suitable for various construction applications.

APPENDIX - 5. SPECIAL TREATMENT FOR SPECIFIC TYPES OF WASTE

A. Gypsum

Gypsum recycling is a valuable process in construction waste management, helping to divert gypsum products like drywall and plasterboard from landfills and reduce resource consumption. As a widely used construction material, gypsum has numerous applications, but it also presents challenges when disposed of in landfills due to its potential to generate harmful gases. Recycling gypsum from CDW not only mitigates environmental impact but also provides cost-effective raw materials for new products.

i. Recycling Process

The recycling process for gypsum typically involves several detailed steps:

- **Pre-Processing:** Once collected, gypsum materials are sorted to remove contaminants, such as metal, wood, and other debris, which can compromise recycling quality. Some facilities use magnetic separation to eliminate metal fragments, while manual or mechanical sorting is done for other contaminants.
- **Crushing and Pulverizing:** Clean gypsum is crushed into smaller pieces to prepare it for grinding. This size reduction helps in further processing by making the gypsum easier to handle.
- **Calcination Removal:** To ensure that recycled gypsum has consistent chemical properties, it may undergo a process to remove residual calcination. Gypsum is heated to remove any set, hydrated calcium sulfate, breaking it down into calcium sulfate hemihydrate, which is easier to reuse.
- **Grinding and Powdering:** The crushed gypsum is ground into a fine powder, which can be reintroduced into manufacturing processes. The particle size is controlled to match the requirements of end applications, as certain products require finer grades of gypsum powder.
- **Final Product Formation:** After grinding, the gypsum powder can be repurposed or blended with virgin gypsum to produce new products, such as plasterboard, wallboard, or agricultural soil conditioners.

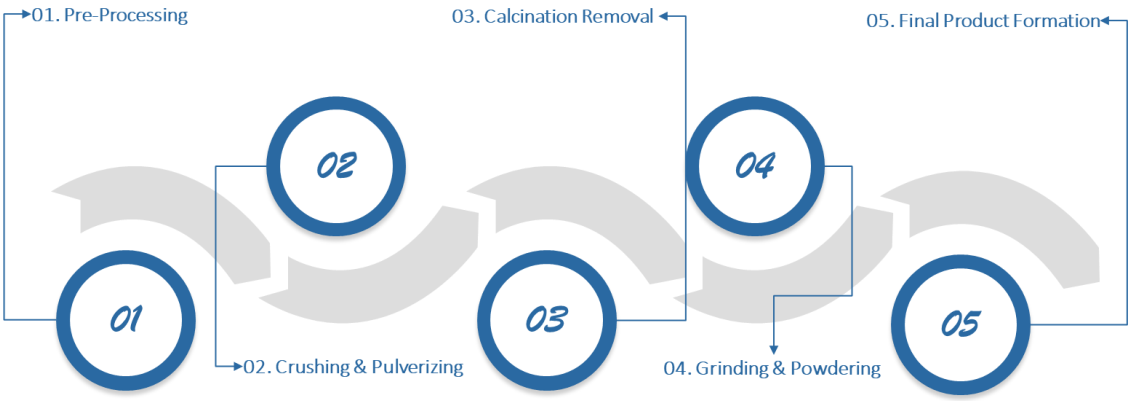


Figure A5-1: Typical process flow of gypsum recycling

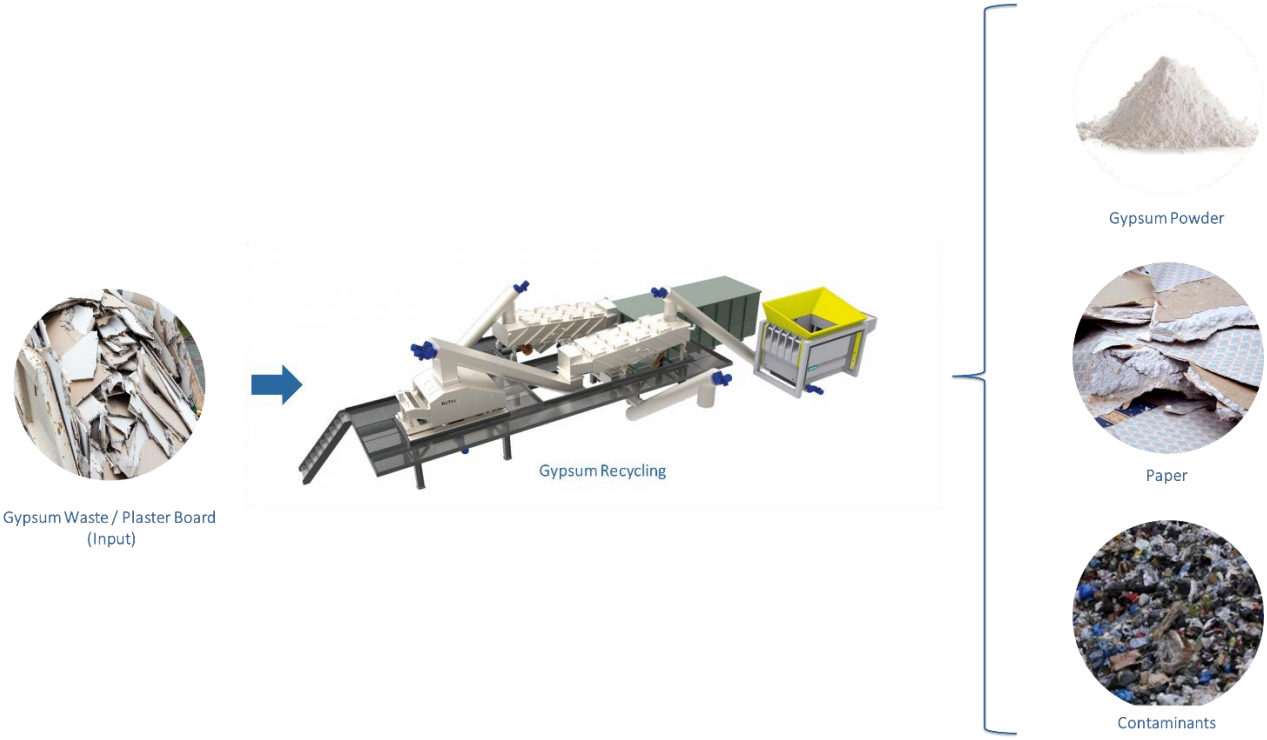


Figure A5-2: Illustration of gypsum recycling

ii. Quality Assurance and Management

Maintaining high-quality recycled gypsum is crucial for ensuring that the recycled material meets the necessary standards for reuse. Quality assurance and management in gypsum recycling are achieved through various protocols:

- **Contaminant Control:** Clean gypsum is essential for quality end products. Recycling facilities implement strict sorting and cleaning standards to prevent impurities like paper, adhesives, and metal from mixing with the gypsum. These contaminants can affect the strength and quality of recycled gypsum products.
- **Material Testing:** Testing the chemical composition of recycled gypsum ensures that it meets specific purity levels. Common tests include assessing the percentage of calcium sulfate ($CaSO_4$) and checking for moisture content. Properties like particle size, whiteness, and odor are also evaluated to ensure consistency.
- **Batch Control and Traceability:** Facilities often track gypsum batches from collection through processing to final distribution. This traceability allows for quality management, enabling facilities to isolate specific batches if quality issues arise. Detailed documentation ensures that each batch can be traced back to its source.
- **Quality Control Points:** Quality control checks are implemented at critical stages in the recycling process. For example, controls during pre-processing, grinding, and packaging help prevent contaminants and ensure that the recycled gypsum powder meets specific product requirements.

B. Asphalt

Asphalt is a durable and versatile material used extensively in road construction, parking lots, driveways, and various other pavements. Over time, however, roads wear out due to traffic, weather conditions, and aging, necessitating periodic repairs or complete resurfacing. In the past, old asphalt was often discarded, contributing to waste and environmental degradation. Today, recycling has become a key method for reusing asphalt, turning old pavement into high-quality new material for future projects. Asphalt recycling is a sustainable process that involves removal of the old pavement. This is usually done by milling or crushing the asphalt to break it into smaller pieces, typically called Reclaimed Asphalt Pavement. The processing and recycling of reclaimed asphalt pavement helps reduce the environmental impact of constructing new roads, conserves valuable natural resources, and lowers construction costs.

i. Recycling Process

After arrival at the recycling facility, the recycling process typically involves several stages, from the cleaning of used asphalt to its reprocessing and use in new projects. The details of asphalt recycling have been presented in the following section.

- **Cleaning:** Once the reclaimed asphalt pavement arrives at the recycling facility, it is sorted to remove any impurities such as dirt, debris, and foreign materials like metal or glass. Cleaning is a necessary step to ensure that the recycled asphalt can be reused without contamination, which might compromise its quality or performance.

- **Reprocessing:** After sorting and cleaning, the reclaimed asphalt pavement is processed in an asphalt plant, where it is mixed with new materials such as bitumen (asphalt binder) and virgin aggregates to create new asphalt. The proportion of reclaimed asphalt pavement used in the mix depends on the project specifications and the quality of the reclaimed material. In some cases, additional additives may be used to improve the properties of the recycled asphalt, ensuring that it meets the required performance standards.

- **Compaction and Laying:** The recycled asphalt mixture is then transported to the job site, where it is spread and compacted to form a new road surface. The process of compaction ensures that the recycled asphalt is firmly packed, providing a durable and long-lasting surface. The quality of the compaction is essential to the performance of the new pavement, as it affects the overall stability and smoothness of the finished surface.

- **Curing and Finishing:** Once the recycled asphalt is laid and compacted, it is left to cure and harden. Depending on environmental conditions and the mix design, this process can take varying amounts of time. After curing, the surface is checked for any defects or imperfections, and any necessary adjustments or repairs are made to ensure the final product meets the required specifications.

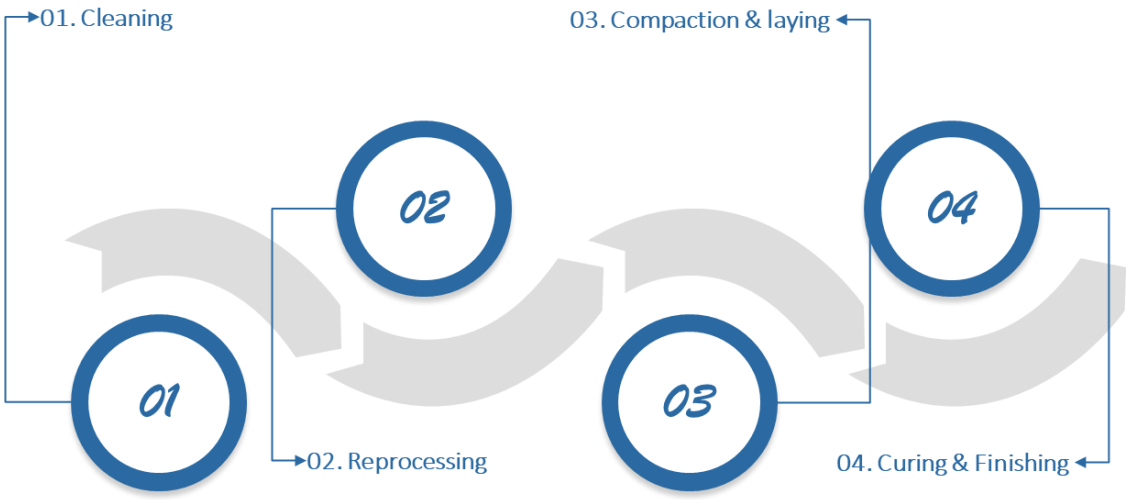


Figure A5-3: Typical process flow of asphalt recycling

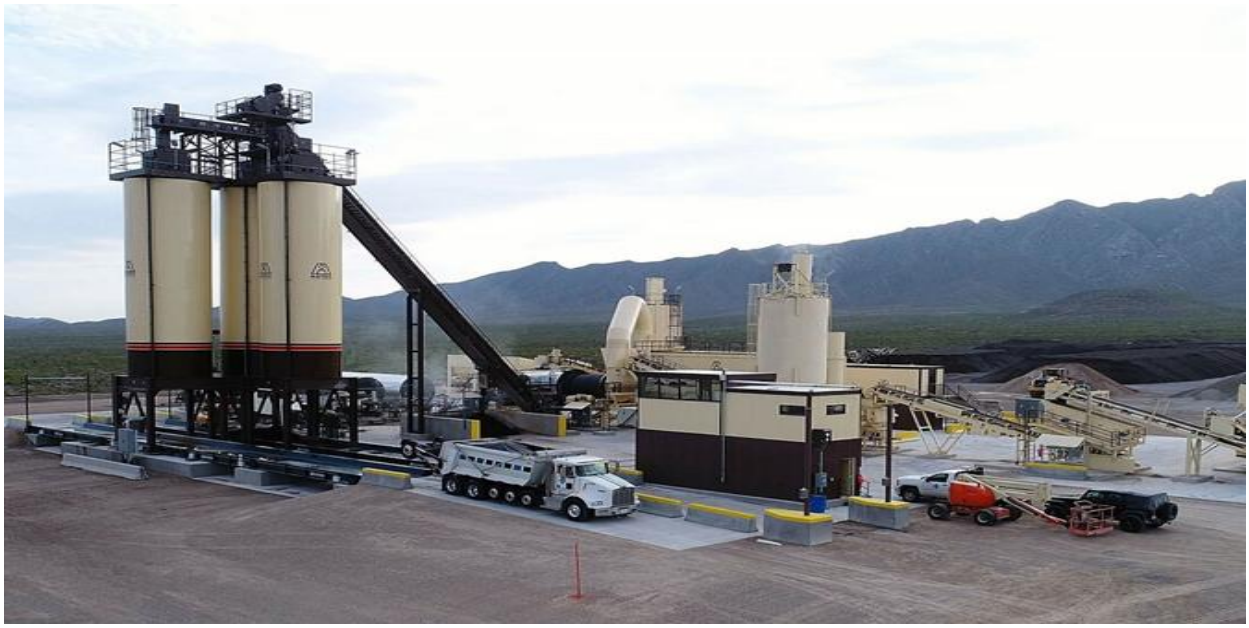


Figure A5-4: Illustration of asphalt recycling plant

ii. Recycling Quality Assurance and Management

Quality assurance in asphalt recycling involves the implementation of processes and standards to ensure that the recycling operation is consistent, efficient, and compliant with regulations.

- **Standardization of Processes:** Quality assurance ensures that the recycling process follows consistent procedures. This includes establishing guidelines for the cleaning of reclaimed asphalt pavement, as well as for the mixing of recycled and virgin materials. This helps maintain the quality and reliability of the final product.

- **Monitoring and Documentation:** Quality assurance involves the use of data to monitor the entire recycling operation, from the collection of reclaimed asphalt pavement to the final compaction of the recycled asphalt. Detailed documentation helps track the materials used, the performance of the recycled asphalt, and any issues that arise during the process. This transparency allows for continual improvement in the process.
- **Training and Workforce Development:** Quality assurance includes ongoing training and skill development for personnel involved in the recycling process. Properly trained workers are essential to ensuring the success of the recycling operation and the quality of the final product.
- **Material Testing:** Quality assurance involves testing the reclaimed asphalt pavement for its suitability for reuse. This includes testing for the asphalt binder content, aggregate gradation, moisture content, and any contaminants that may affect the quality of the recycled product. The binder content is especially important, as it determines the strength and durability of the final asphalt mix.
- **Mix Design and Performance Testing:** The recycled asphalt mix design is tested for its ability to withstand the stresses of traffic and environmental conditions. This includes testing for properties such as tensile strength, resilience, flexibility, and thermal cracking resistance. If necessary, the mix is adjusted by adding more virgin material or using additives to improve its performance.
- **Compaction Testing:** The final compaction of the asphalt mixture is critical to the durability and smoothness of the pavement. Quality assurance ensures that proper compaction equipment and techniques are used, and compaction is tested to confirm that it meets the required density and smoothness specifications.

APPENDIX - 6. TCLP CONCENTRATIONS LIMIT VALUES

Parameters	CAS Number	Limit Value (mg/Kg)
Arsenic	7440-38-2	5
Barium	7440-39-3	100
Benzene	71-43-2	0.5
Cadmium	7440-43-9	1
Carbon Tetrachloride	56-23-5	0.5
Chlordane	57-74-9	0.03
Chlorobenzene	108-90-7	100
Chloroform	67-66-3	6
Chromium	7440-47-3	5
o-Cresol	95-48-7	200
m-Cresol	108-39-4	200
p-Cresol	106-44-5	200
Cresol	*********	200
2,4-D Acid	94-75-7	10
1,4-Dichlorobenzene	106-46-7	7.5
1,2-Dichloroethane	107-06-2	0.5
1,1-Dichloroethylene	75-35-4	0.7
2,4-Dinitrotoluene	121-14-2	0.13
Endrin	72-20-8	0.02
Heptachlor (and its epoxides)	76-44-8	0.008

Parameters	CAS Number	Limit Value (mg/Kg)
Hexachlorobenzene	118-74-1	0.13
Hexachlorobutadiene	87-68-3	0.5
Hexachloroethane	67-72-1	3
Lead	7439-92-1	5
Lindane	58-89-9	0.4
Mercury	7439-97-6	0.2
Methoxychlor	72-43-5	10
Methyl Ethyl Ketone	78-93-3	200
Nitrobenzene	98-95-3	2
Pentrachlorophenol	87-86-5	100
Pyridine	110-86-1	5
Selenium	7782-49-2	1
Silver	7440-22-4	5
Tetrachloroethylene	127-18-4	0.7
Toxaphene	8001-35-2	0.5
Trichloroethylene	79-01-6	0.5
2,4,5-Trichlorophenol	95-95-4	400
2,4,6-Trichlorophenol	88-06-2	2
2,4,5-TP (Silvex)	93-72-1	1
Vinyl Chloride	75-01-4	0.2