2 PROJECT DESCRIPTION

2.1 Purpose of the document

This IWWMP provides technical support as well as motivation for the application for an Integrated Water Use Licence (IWUL) in terms of the NWA to the DWA. Section 21 of the NWA requires all water users to register their different water uses with the DWA and apply for the necessary licence if the use is not covered as a General Authorisation or a Schedule 1 use.

This document therefore:
- provides technical support for the Integrated Water Use Licence Application (IWULA);
- provides motivation for the granting of an IWUL to the applicant;
- provides information on the current and future water uses on the site;
- provides the authority (DWA) with adequate information presented in a clear and concise manner to enable the authority to make a decision in terms of this IWULA;
- provides information in terms of future planning in terms of water use; and
- will be used in terms of the planning by the applicant as well as for monitoring purposes.

The purpose of this application is to legalise the existing situation.

2.2 Objectives of the project

The objectives of this project are as follows:
- To establish a water use inventory;
- To develop a water balance;
- To develop a water reuse and reclamation strategy;
- To prevent pollution of water by minimising water use (water conservation) and preventing storm water contact with operations (diversion of clean runoff around potential pollution sources) and potential pollution sources (such as the processing plant and material handling areas) by developing a storm water management plan;
- To minimise pollution of water sources (groundwater and surface water) by minimising the water quantities in contact with the process and operations (water conservation, good housekeeping, storm water management, process spillage and control);
- To capture, contain, treat and reuse water that has become contaminated due to its use on the site (water used in the process) thereby preventing its spread off the site into the receiving environment, and impacting on the receiving environment;
- To ensure water is used in the most effective and responsible manner possible, by minimising water usage/consumption (water conservation) and maximising reuse and reclamation of water that has already been contaminated (use of contaminated spring water and storm water);
- To maintain adequate water supply to the site and process to prevent operational problems;
- To limit Rand Carbide's impact on the surrounding environment and its water resources in particular;
- To achieve legal compliance;
- To meet a market demand; and
- To reduce the quantity of waste material requiring disposal by processing it and converting it into a usable product.

2.3 Industrial process description at Rand Carbide

Extent of operation:	**Site:**	56.281 ha
	Plant:	13 ha
	Waste dump:	2.25ha
Production rates:	**Fe-Si:**	60(D) + 60(E) + 120(F) = 240 tons/day
	Si metal:	45 tons/day
	E.C.A:	148 tons/day
	Paste:	100 tons/day

Table 2-1: Raw materials

Type:	Maximum consumption rate (tons/day)
Furnace D:	
Quartzite	100
Coal / charcoal	65
Woodchips	45
Millscale	20
Barium sulphate ($BaSO_4$), Silicon (Si); Manganese (Mn), Zircon (Zr) sand	2
Furnace E: (Fe-Si)	
Quartzite	100
Coal / charcoal	65
Woodchips	45
Millscale	20
Furnace E: (Si metal)	
Quartzite	103
Coal / charcoal	48
Woodchips	56
Limestone	1
Furnace F:	
Quartzite	200
Coal / charcoal	150
Woodchips	85
Millscale	40
Barium sulphate ($BaSO_4$), Silicon (Si); Manganese (Mn), Zircon (Zr) sand	2
Fe-Si / Si refining:	
Molten metal (Fe-Si / Si)	200
Silica sand	10.4
Lime	20.5
Oxygen (O_2)	18
Nitrogen (N_2)	10.4
Fe-Si / Si fines	20
Calciners 1 & 2:	
Raw Anthracite	120
Paste plant:	
E.C.A.	100
Tar pitch	25

2.3.1 Ferro-silicon (Fe-Si) production

Infrastructure: Fe-Si is produced in three furnaces (Furnaces D, E & F).

Raw materials: Coal, charcoal, quartzite, woodchips, millscale and ad hoc, in small quantities – Barium sulphate ($BaSO_4$), Manganese (Mn), zircon sand (Zr).

Process: Fe-Si is produced via the carbothermic reduction of quartz in a sub-merged arc furnace (3 phase) requiring approximately 8 000kWh to produce 1 ton of product. Liquid metal is tapped (intermittently) from a taphole at ± 1 600°C into a ladle lined with refractory material. The metal is then cast into a casting dam lined with ferrosilicon fines. The solidified product is then crushed and packed. See Figure 2-1.

Use: Fe-Si raises the hardness of steel, increases tensile strength, elasticity, oxidation resistance and flow limits all the while reducing its ductility.

2.3.2 Silicon (Si) metal production

Infrastructure: Silicon metal is produced in Furnace E.

Raw materials: Coal, charcoal, quartzite, woodchips, limestone.

Process: For silicon metal production, composite electrodes are used versus the paste or Soderburg electrodes used for Fe-Si production. Si is produced via the carbothermic reduction of quartz in a sub-merged arc furnace (3 phase) requiring approximately 12 000kWh to produce 1 ton of product. Liquid metal is tapped (continuously) from a taphole at ± 1 600°C into a ladle lined with refractory material. Silicon metal is refined during and after tapping in order to oxidise impurities like Aluminium (Al) and Calcium (Ca). The metal is then cast into a casting pan lined with silicon fines. The solidified product is then crushed and packed. See Figure 2-1.

2.3.3 E.C.A production

Infrastructure: E.C.A is produced in Calciners 1 & 2

Raw material: Raw Anthracite

Process: Anthracite is graphitised in two (2) calcining electrical furnaces. The process of calcining entails the heating of high-grade anthracite to a temperature required to yield a material with a content of volatile matter not exceeding 0.5%. The main reason for calcining anthracite is to increase its conductivity.

Use: E.C.A is used in the production of electrode paste and is sold to the local and international market. See Figure 2-2.

2.3.4 Electrode paste production

Infrastructure: Electrode paste is produced in the paste plant

Raw materials: E.C.A; tar pitch

Process: Anthracite is graphitised in two (2) calcining electrical furnaces after which liquid tar pitch binder is added. Electrode paste therefore consists of a mixture of carefully sized electrically calcined anthracite and pitch binder. Carefully controlled conditions of many factors are necessary in order to ensure the optimum properties of the paste regarding fluidity, strength and current carrying capacity. See Figure 2-3.

2.4 Infrastructure

2.4.1 Furnaces

Function: Produce Fe-Si & Si metal.

D-Furnace; E-Furnace and F-Furnace (Fe-Si production)

Raw materials, upon receipt, are stockpiled on site from where the intermediate storage bunkers are fed. These raw materials include: coal, charcoal, quartz, wood chips, mill scale plus ad hoc (in small quantities), barium sulphate, silicon manganese, zircon sand. Batching of the raw materials takes place underneath these storage bunkers where the required ratios for each of the raw materials are weighed out and dispatched to the furnace bins.

The raw materials mixture is fed into the furnace via six feed chutes. Ferrosilicon is produced via the carbothermic reduction of quartz in a sub-merged arc furnace (3 phase) requiring approximately 8 000 kWh to produce 1 ton of product.

Liquid metal is tapped (intermittently) from a taphole at +/-1600°C into a ladle lined with refractory material. The metal is then cast into a casting dam lined with ferrosilicon fines. The solidified product is then crushed and packed in accordance with customer requirements.

E-Furnace (Fe-Si and silicon metal)

The main difference in the production of ferrosilicon (as described above) versus silicon metal is the electrode systems used and the fact that silicon metal does not contain millscale. For silicon metal production composite electrodes are used and for ferrosilicon, paste or Söderburg electrodes are used.

Raw materials, upon receipt, are stockpiled on site from where the intermediate storage bunkers are fed. These raw materials include: coal, charcoal, quartz, wood chips, and lime stone. Batching of the raw materials takes place underneath these storage bunkers where the required ratios for each of the raw materials are weighed out and dispatched to the furnace bins.

The raw materials mixture is fed into the furnace via six feed chutes. Silicon metal is produced via the carbothermic reduction of quartz in a sub-merged arc furnace (3 phase) requiring approximately 12 000 kWh to produce 1 ton of product.

Liquid metal is tapped (continuously) from a taphole at +/-1600°C into a ladle lined with refractory material. Silicon metal is refined during and after tapping in order to oxidize impurities like Aluminium (Al) and Calcium (Ca).

The metal is then cast into a casting pan lined with silicon fines. The solidified product is then crushed and packed in accordance with customer requirements.

2.4.2 Low AlFeSi Plant

Function: Reduce Aluminium (Al) content (dealuminising process). Refining of Fe-Si and Silicon metal.

In order to render a product containing small quantities of impurities (mainly Al and Ca), it is necessary for the product to be refined in its liquid stage. This can only be done during tapping or afterwards.

Refining during tapping is done via a ceramic plug fitted in the bottom of the ladle through which Oxygen (O_2) and Nitrogen (N) gasses are purged (low flow rates).

Refining subsequent to tapping can be done in a separate ladle with tuyeres tubes through which Oxygen and /Nitrogen gasses are purged at high flow rates.

2.4.3 Calcined furnaces (Calciners)

Function: Produce calcined anthracite (E.C.A.) for paste production.

Anthracite is fed into a cylindrical furnace and heated by electrical current passing between two electrodes. The calcined anthracite is discharged from the bottom of the furnace and conveyed to storage bunkers for use in the production of paste.

2.4.4 Paste plant

Function: Produce electrode paste.

Tar pitch is mixed with various fractions of ECA to produce electrode paste.

E.C.A. from the two calcined furnaces is drawn from storage bunkers to three hammer mills and a ball mill. The crushed E.C.A. is taken via bucket conveyors to two twin deck screens where it is distributed to different bunkers holding the different E.C.A. fraction sizes. The fractions are taken via feed chute to a dry mix scale for batch weighing. The batch is then discharged into two mixers where it is mixed with tar binder from the inside binder tanks to produce paste.

2.4.5 Water demand

Rand Carbide's water requirements can essentially be separated into requirements for domestic purposes (workers) and requirements for industrial purposes (process use). Domestic water requirement is 35 604 m^3/annum or 2 967 m^3/month or 97.6 m^3/day. Process water requirements are 45 298 m^3/annum or 3 754 m^3/month or 124.1 m^3/day.

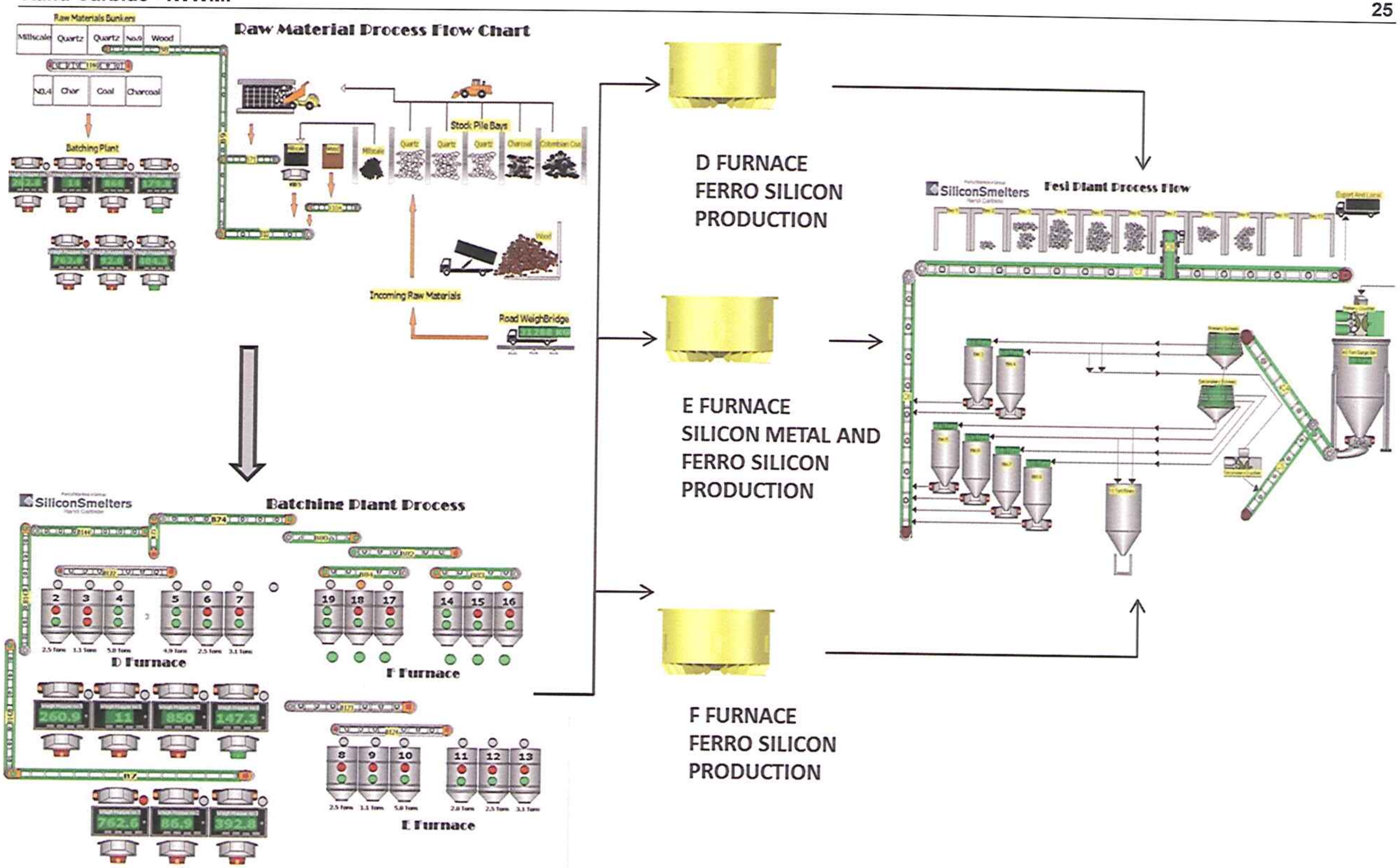

Figure 2-1: Fe-Si and Si metal Process flow diagram

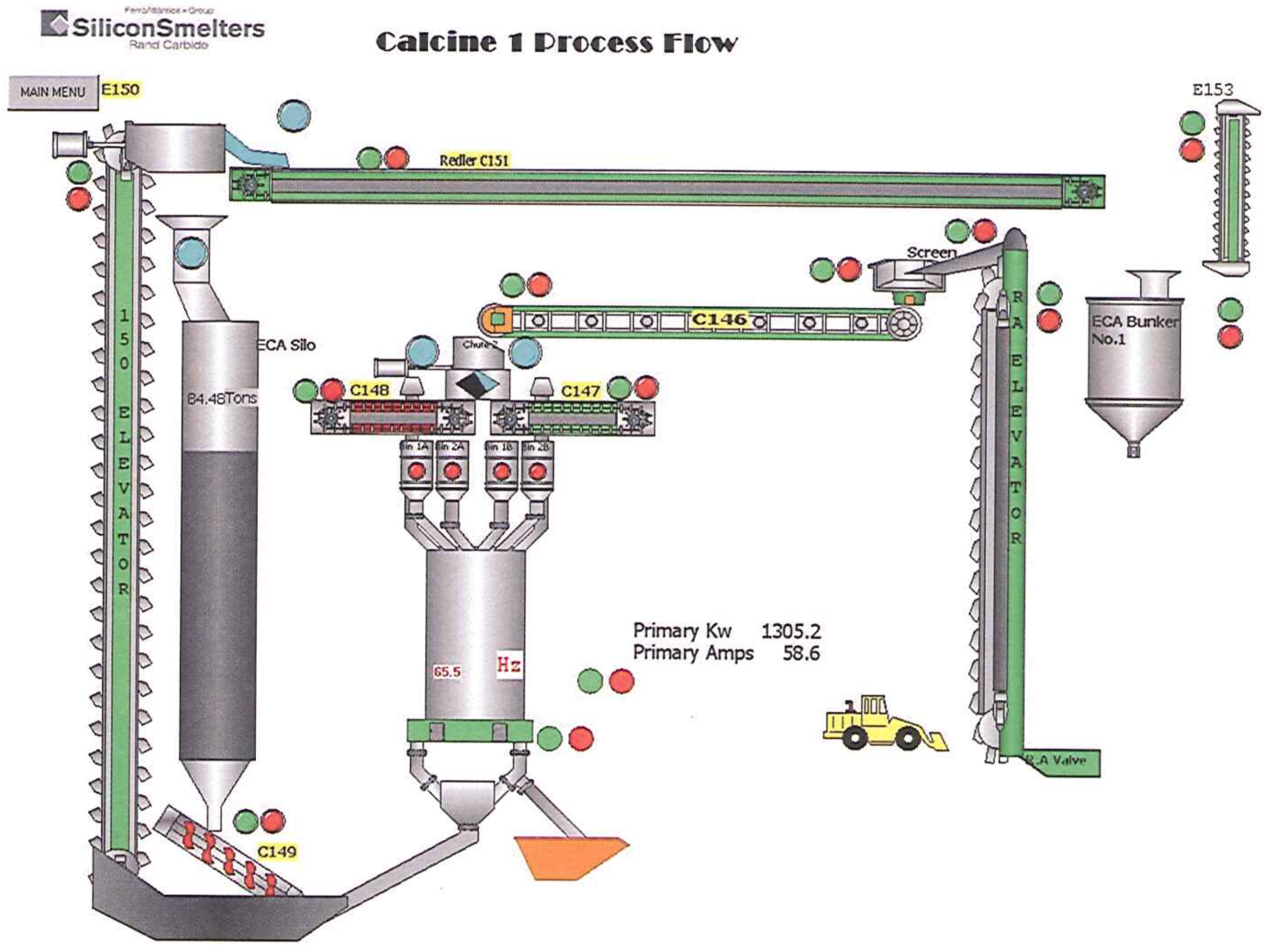

Figure 2-2: E.C.A production Process flow diagram

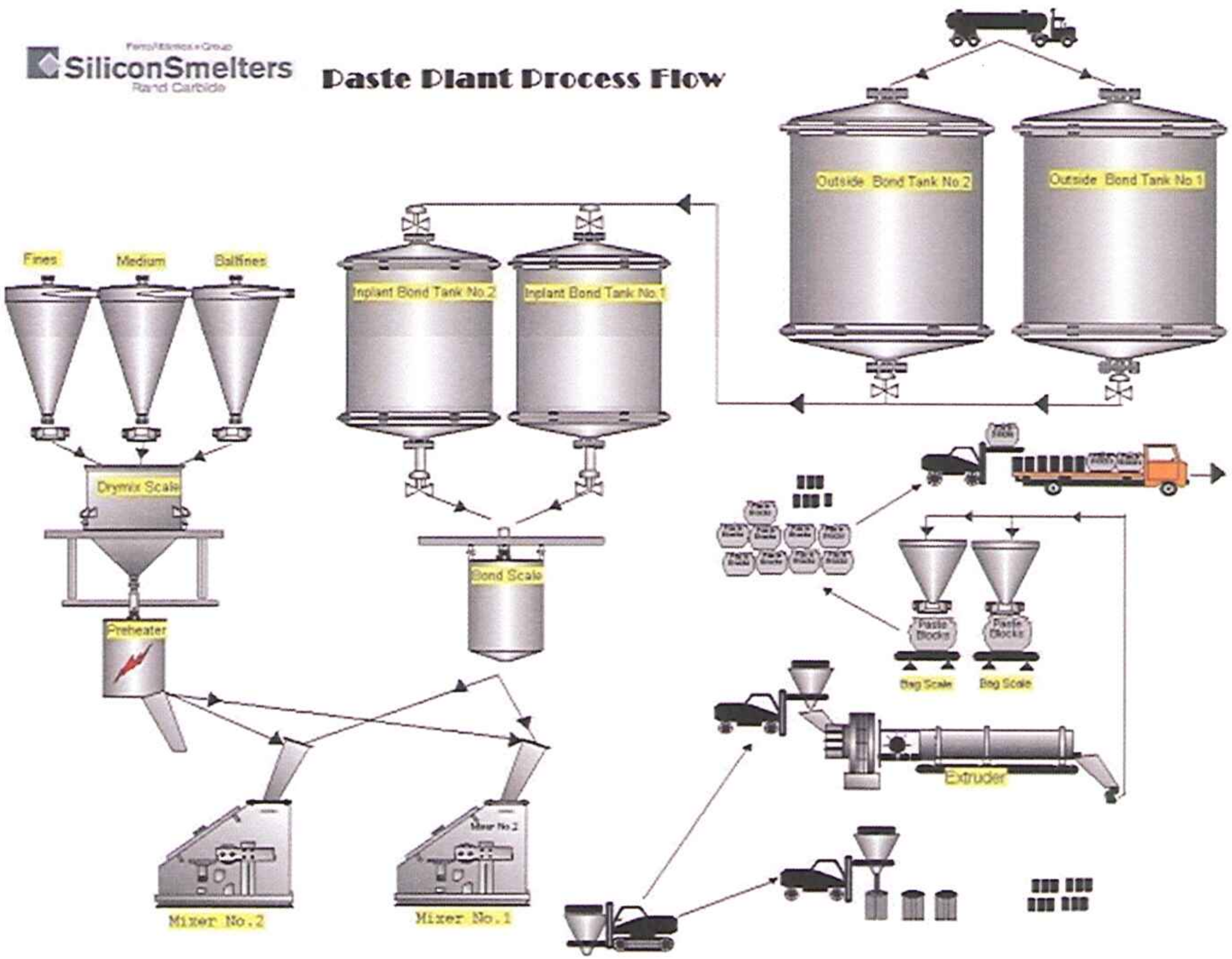

Figure 2-3: Paste production Process flow diagram

2.5 Residues & Emissions

2.5.1 Historic waste dump

Rand Carbide has a historic waste disposal dump which was started around 1926 and was actively used until 2006 for the discarding/dumping of most unwanted materials on site. The waste disposal area extends over 2.25 ha (length of 225 m; width of 100 m and height of 30 m) and contained about 500 000 tonnes of dry waste material. Currently, no additional waste is disposed onto the dump.

2.5.2 Waste stream identification & characterisation

Material on the historic dump includes the following:

- Contaminated Ferro-silicon (40 tons/annum)
- Amorphous silica fume
- Tarry materials
- Oil soaked calcined anthracite
- Paste
- Char (80 tons/annum)
- Slag (64 tons/annum)
- Coal fines/dust (52 tons/annum)
- Aluminium (18 tons/annum)
- Silica/Quartz fines
- Char/coal fines
- Anthracite fines/dust
- Sweepings (coal dust etc.)
- Stoker refractory (large lumps)
- Stoker ash (fly ash)
- Ladle refractory
- Carbon stoker mix fines
- Refractory bricks
- Paper/wood

Current waste streams are summarised in Table 2-2.

Table 2-2: Waste streams and management summary

Type	Quantity (annual)	Handling on site	Destination
General solid			
Non-hazardous	42 m^3 6 tons	Collect in bins/skips	Removed off site by Whale Rock and taken to municipal landfill site at Kriel.
Compactable	1 176 m^3 42 tons		
Hazardous solid			
Compactable	42 m^3 24 tons	Collected in skips	Removed off site by Whale Rock and taken to Rietfontein site (delisted).
Fluorescents	0.2 m^3 0.05 tons	Crushed	Removed off site by Whale Rock and taken to hazardous landfill site (Holfontein).
Oil	1 155 m^3 5.5 tons	Collect in 210 litre drums with lids in	Removed off site by OIL-X/Oilkol and taken to refinery for recycling.

Type	Quantity (annual)	Handling on site	Destination
Oil & grease contaminated material	23 m^3 47 tons	bunded area	Removed off site by Whale Rock and taken to Rietfontein waste disposal site.
Process waste	3 700 m^3	EMB reprocess	Re-used (Rand Carbide) / disposed (Holfontein)
Emissions			
Dust (PM)		Baghouses & dust plants at furnaces	Sell
Silica fumes	23 743 tons	Emissions from furnaces (D, E, F) and refining.	Sell

2.5.3 Waste management

Waste originating from Rand Carbide is currently being reprocessed by EMB. Waste that cannot be reprocessed is disposed of off-site. Please refer to Table 2-2 for waste management procedures for additional waste streams.

2.5.4 Waste recovery and reduction

In 2005, Highveld Steel & Vanadium Corporation Limited entered into a memorandum of agreement with Chargold (Pty) Ltd (now EMB) to reduce the volume of the unlicensed waste dump in the course of the rehabilitation process. EMB (EnviroServe in a joint venture with Rand Carbide) is currently processing the Rand Carbide plant residues as well as the historic waste material. According to Mr Franco Boot (EMB site manager), it will take approximately another eight (8) years to fully process the dump at the current processing rate. EMB currently extracts about 50% of the material on the dump for placement back into the Rand Carbide process. The entire dump will be processed and material that cannot be utilised will be disposed off-site at suitable facilities.

In terms of the memorandum of agreement signed in 2007, Rand Carbide (as part of Highveld) appointed Chargold (now EMB) as its agent, to not only recover material, but to market and sell the recovered material on behalf of Rand Carbide. This contract was for a period of three (3) years and no renewals or subsequent contracts were made available (the agreement expired 20 August 2010). These contracts were drawn up between Highveld Steel & Vanadium Corporation Limited and Chargold (now EMB).

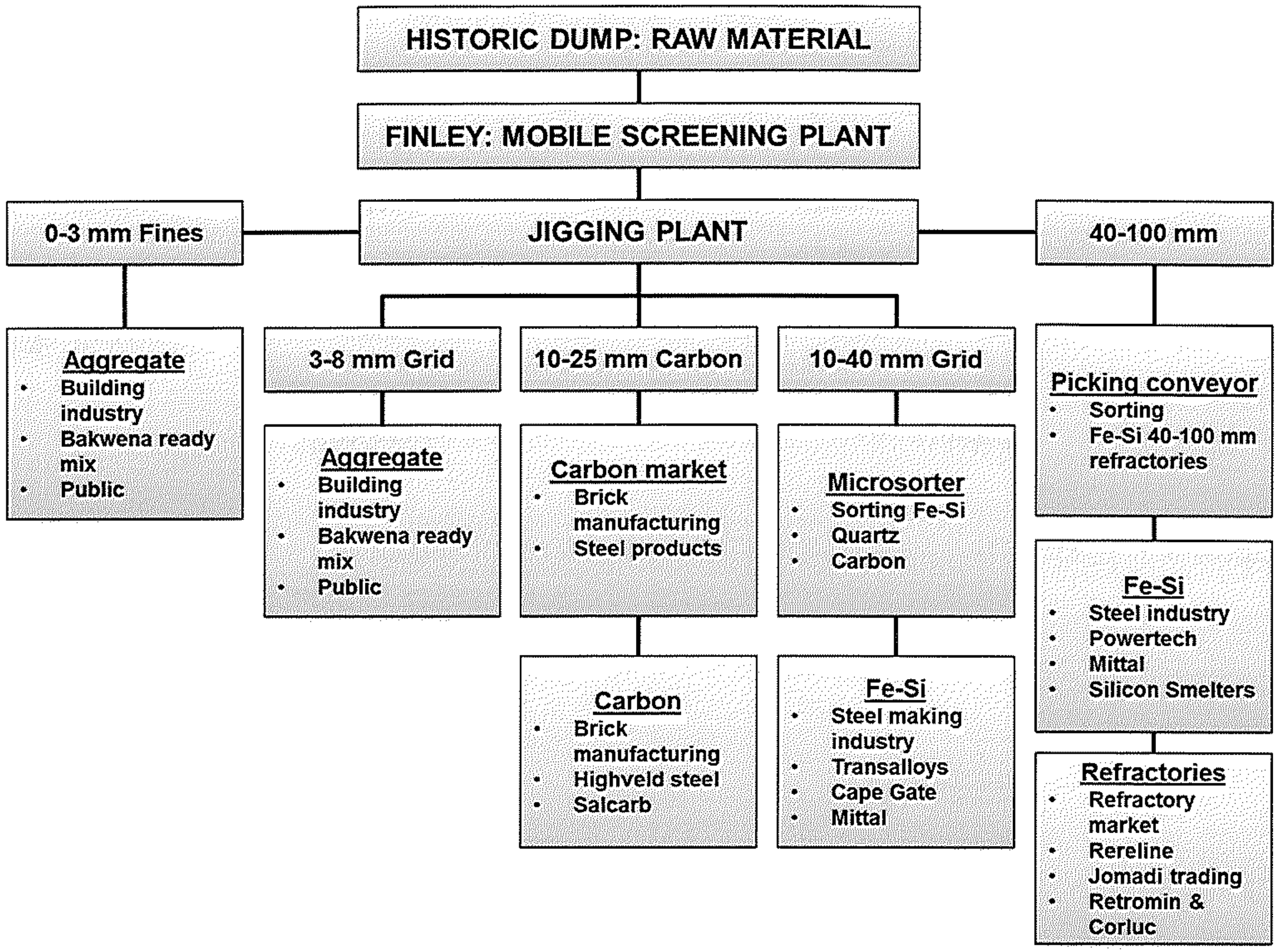

Figure 2-4: Paste production Process flow diagram

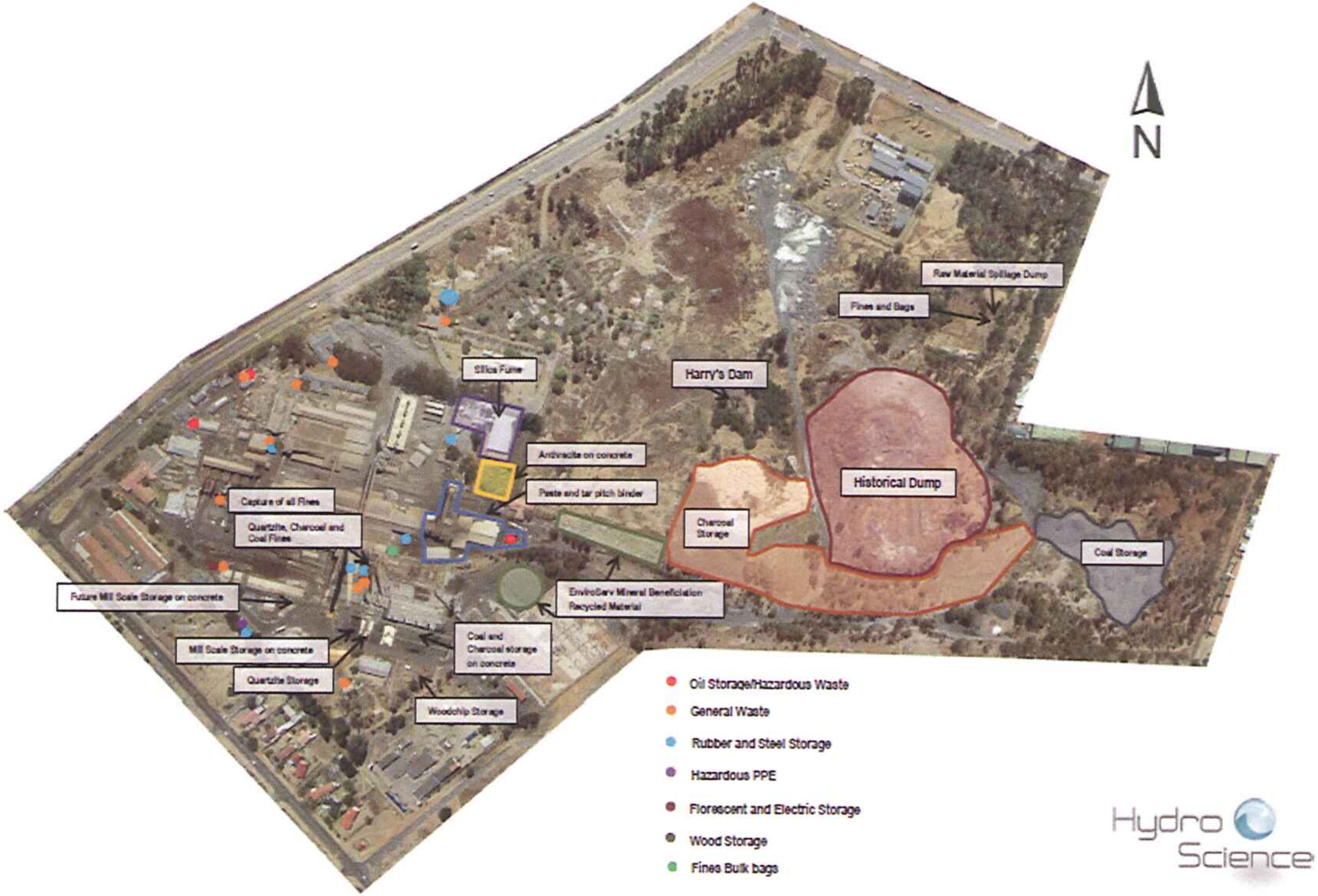

Figure 2-5: Storage areas at Rand Carbide