National Waste Quantification and Waste Information System

Geoff Purnell, Munitech

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

Disclaimer

National Waste Quantification and the Waste Information System

Prepared by Geoff Purnell of Munitech

August 2009

This research paper has been commissioned as part of the process of preparing a National Waste Management Strategy for South Africa. The views expressed in this paper are those of the researcher only, and do not necessarily reflect the views of either the Department of Environmental Affairs or of the consultant team preparing the NWMS. This research paper has been prepared for the purposes of stimulating discussion and informing debate prior to the commencement of the drafting process. In order to comment on the issues raised in this paper, and for more information regarding the process of preparing the NWMS please visit www.deat.gov.za/waste/

This paper is based on the information that was available to the researchers regarding waste streams for the main categories of waste. Any new or additional information not described in this paper will be welcomed, and should please be forwarded to Geoff Purnell at PurnellG@sbadbn.co.za. A revised version of this paper will be produced once new information has been received.

Executive Summary

The purpose of formulating the National Waste Quantification and Waste Information system is to present current baseline data where available and highlight issues for the main waste categories. This information should contribute to informed deliberations and formulation of an effective National Waste Management Strategy.

This paper addresses all major categories of waste, and where possible, gives an indication for each category of the amount of waste being produced, typical and possible destinations for that waste, and issues associated with it.

National Waste Quantification

The national waste quantification looked at the following waste categories:

General and domestic: Approximately 24,1 million tons per year of general and business waste was generated and disposed of in 2006/7. Many of the landfill sites receiving this waste are not licensed. The major challenge facing municipalities is the lack of waste management capacity and funding to undertake the required waste management activities.

In terms of the general and business waste stream, the area of current greatest focus of waste minimisation is recycling. The bulk of recyclable items include discarded packaging materials, consumer good and defective products.

Industrial & Mining Hazardous Wastes: Data from a survey (2007: DEAT) reveals that of 5 significant waste management companies handling hazardous wastes in four provinces, the total amount of 710,000 tons of hazardous waste was disposed of in 2007, of which 117,500 was organic. The hazardous classification is currently being reviewed in order to possibly rationalise and streamline the classification process.

e-Waste: A survey undertaken by eWASA in November 2008 estimated that approximately 136 000 tons of white goods, consumer electronics and IT products were distributed in 2007, however the actual size of the waste stream is unknown.

The quantities of recycled materials arising from e-waste is unknown and there is little information of the quantities of e-waste entering landfills in South Africa, as there is no systematic monitoring of e-waste quantities, mainly as it is a relatively new recognised waste stream.

Tyres: At present the total mass of new pneumatic tyres entering the South African market is approximately 175 00 tons per year. Tyre recycling currently is limited and a large number of waste tyres are being disposed of illegally.

Batteries: Approximately 2,500 tons of batteries are disposed of every year.

Fluorescent Lamps: Eskom estimates that in 2005/2006 some 137,857,000 mercury containing fluorescent lamps were imported. It is expected that due to the “energy crises”, the number of fluorescent lamps imported has increased significantly. (www.eskom.co.za)

Oil: Approximately 270 million litres of new lubricating oil is sold annually in South Africa. Of which 40 to 45% of this becomes used oil. Currently approximately 80 million litres of used oil is collected annually.

Construction and Demolition Wastes: Studies performed in 2002 estimated that 5 to 8 million tons of construction and demolition wastes were generated in South Africa per annum. Of this, nearly 1,4 million tons was disposed of in landfills.

Mining Waste: While residue deposits and residue stockpiles are not considered waste in terms of the Waste Act, it is not known what quantities and types of waste (as defined by the Waste Act) are produced by the mining sector. However, using StatsSA indices for Mining: Production and Sales as a basis for estimating the growth in mining waste since 1997 to 2007, it is estimated that approximately 510,000,000 tons of mining waste was produced in 2007.

Power-station Waste: Eskom's audited quantity of ash produced for 2007 was 34,16 million tons. Of this amount 2,16 million tons was sold for recycling, representing a recycle rate of 6,32%. The balance of the ash, 32,0 million tons, is transported to ash facilities situated close to each coal fired power station.

Agricultural Waste: As much as 71,81 tons of obsolete pesticides were collected in Limpopo Province, leading to estimates of approximately 750 tons being stockpiled throughout South Africa.

Health Care Waste: The health care waste stream consists of: Health Care General Waste (HCGW), Health Care Risk Waste (HCRW), and Health Care General and Health Care Risk Liquid Waste. It is estimated that approximately 42200 tons of HCRW were generated in South Africa in 2007.

National Waste Information System (NWIS)

The assessment of the National Waste Information System highlighted the following points:

Chapter 6 of the Waste Act, 2008, requires that the Minister must establish a national waste information system (NWIS) for the recording, collection, management and analysis of data and information.

The current SA WIS does not at this time, meet the requirement of the Waste Act in some respects. However It is evident that the SA WIS has been designed such that it can be incrementally expanded to included the above data and information, and in this sense it does comply with Chapter 6 of the Waste Act. Further, it is evident that the NWIS may be adapted to include information on the level of services provided by municipalities and information on compliance with the Waste Act.

Recommendations

The following recommendations are considered critical when formulating the National Waste Management Strategy:-

- The registration of the required waste management activities with the NWIS must be implemented, and waste management data must be submitted. To this effect, the Regulations contemplated by the Draft Waste Information Regulation be finalised, promulgated and implemented as a priority.

- Waste management capacity must be developed and maintained at all levels of government to properly plan, implement and monitor/enforce waste management activities. Consideration must be given to budgetary support for waste management in poorer municipalities.

- Landfills must be upgraded to comply with the Minimum Requirements, or properly closed and new licensed landfills developed, to meet immediate and future disposal needs.

- Industry waste management plans must be developed where necessary, and must address hazardous waste minimisation, treatment and disposal.

- Recycling initiatives established by the private sector are to be supported. The consideration, co-ordination and implementation of any systems to support recycling initiatives, be they regulatory, target setting, economic instruments, producer responsibility and or consumer awareness programmes, need to be very carefully considered to ensure the desired objective is achieved.

Table of Contents

1 Introduction

The purpose of formulating the National Waste Quantification and Waste Information system is to present current baseline data where available and highlight some strategic challenges and issues for the main waste categories.

This information will thus contribute to informed deliberations and formulation of an effective National Waste Management Strategy.

2 Methodology

The research approach was to source, access and summarise as much existing current information as possible, and precluded undertaking primary research. Sources included existing reports and research, and contacting existing acknowledged experts, relevant authorities, associations, institutes, organised business etc. The outcome attempts to model the waste streams in terms of production, transport, treatment and disposal for each of the five main categories of waste:-

- General and Domestic Waste including Sewage Sludge;
- Hazardous Domestic Waste and Hazardous waste from Manufacturing and Industry;
- Healthcare Waste;
- Waste from Agriculture and Forestry (Pesticides); and
- Mining and Power station waste.

The model where possible includes current and future potential waste flows with respect for the waste management hierarchy:-

- Waste prevention and reduction;
- Re-use and recycling;
- Transportation; and
- Treatment and Disposal.

Whilst investigating and analysing the National Waste Quantification, some key challenges and issues were identified.

Chapter 6 of the Waste Management Act requires the establishment of a national Waste Information System (WIS), and allows for the establishment of Provincial Waste Information Systems. As an outcome of the 1999 Waste Management Strategy, the Department of Environmental Affairs formulated and implemented a national WIS. Two provinces, Gauteng and the Western Cape have established provincial WIS's.

A brief assessment was made of the current Waste Information System in use to:

- Determine its effectiveness in meeting the requirements of Chapter 6 of the Waste Act, and make recommendations in relation to any identified short comings.
- Identify regulatory interventions required for best practice implementation of reporting / input required for a Waste Information System.

3 National Waste Balance

3.1 Domestic and Business Waste

3.1.1 General

Accurate domestic waste generation and disposal data proved difficult to source, as limited use has been made to date of the National Waste Information System. Interrogation of various available Integrated Waste Management Plans (IWMP's) at Metropolitan, District and Local Municipality levels illustrated widely differing methods of obtaining waste management data. Generally, the most reliable source of data is obtained from landfill weighbridge tonnages, however, weighbridges exist only at most Metropolitan landfills, and some secondary cities and larger towns landfills. In many IWMP's waste management data presented were based on estimated waste generation rates applied to socio-economic population figures, truck counts or visual estimates.

In view of the above, the data presented in an "Assessment of the status of waste service delivery and capacity of the local government level" (DEAT, 2007) is considered to present the best available data, and is used to generate the tables below.

3.1.2 Generation

Although not totally representative, the best available data on domestic and commercial waste generated would be reflected by the waste disposed of in landfills that accept such wastes.

The data that was received during the assessment was analysed according the municipal categories as defined by DPLG and National Treasury. The municipal categories are:

- **A**: Metros, 6 in total.
- **B1:** Secondary cities : the 21 local municipalities with the largest budgets.
- **B2:** Municipalities with a large town as core (29 in total).
- **B3:** Municipalities with relatively small population and significant proportion of urban population but with no large town as core (111 in total).
- **B4:** Municipalities which are mainly rural with, at most, one or two small towns in their area (70 in total).

Table 1. Estimated General Waste Disposed of at "General" Landfills (2006/7) (DEAT, 2007)

Municipality Category	*Number*	*Average Waste disposed (tons / annum)*	Total Waste disposed (tons / annum)
A	*6*	*2 419 000*	*14 514 400*
B1	*21*	*155 684*	*3 269 364*
B2	*29*	*65 410*	*1 896 890*
B3	*111*	*29 478*	*3 272 058*
B4	*70*	*16 607*	*1 162 490*

Municipality Category	*Number*	*Average Waste disposed (tons / annum)*	Total Waste disposed (tons / annum)
Total General Waste Disposed (2006/7)			***24 115 402***

It must be noted that municipal landfills accept wastes classified as General Waste, and do not make a distinction between wastes of domestic and business origins.

The estimated total of 24,1 million tons per annum for 2006/7 compares with the estimate of 20 million tons per annum for 2006 presented in "A Strategic Framework for Sustainable Development in South Africa (DEAT, 2006a).

Although this appears to represent a significant increase in one year, it must be stressed that the methods of measurement employed to estimate waste quantities vary widely.

As standards of living increase, it is to be expected that waste generation rates increase. However, improving service levels in many municipalities may also result in increased collection quantities. Typical waste generation rates were suggested in the "National Framework Guidelines for Integrated Waste Management Planning" (DEATb, 2006). Demographics, socio-economic conditions and land uses are of particular importance, as the level of wealth of a community directly influences the type and amount of waste generated.

Issues:-

- The general lack of reliable domestic and business waste generation data makes effective waste management planning problematic. The enforcement of submission of such data to the National (or provincial) Waste Information System is required through regulation.
- Guidelines on measurement of waste generated needs to be formulated, as only the larger municipalities will be able to install, operate and maintain weighbridges at landfill sites.

Table 2: Waste Generated per Land Use / Activity (DEATb, 2006)

Land Use type / activity	***Typical waste generated***	***Typical generation rates***
Residential houses: • *Low Income* • *Medium Income* • *High Income*	*Kitchen / food* *Packaging* *Clothing* *Furniture* *Electronic* *Ash* *Garden Waste*	*(Rate: kg/person/day)* • *Low: 0,2 – 0,7* • *Medium: 0,7 – 1,9* *High: 1,5 – 3,0*
Residential flats	*Kitchen / food* *Packaging* *Clothing* *Furniture* *Electronic*	*(Rate: kg/person/day)* *0,5 – 2,2*
Schools, hostels, educational centres, and other institutions	*Office paper and books* *Packaging* *Electronic* *Furniture* *Kitchen / food* *Plants and grass cuttings*	*(Rate: kg/occupant/day)* *0,5 – 1,3*

Suburban business centre / office park	*Old office material* *Packaging* *Furniture* *Electronic* *Food* *Plants and grass cuttings*	*(Rate: kg/employee/day)* *0,8 – 1,7*
Central business area / office buildings and towers	***Old office material*** ***Packaging*** ***Furniture*** ***Electronic*** ***Food*** ***Street sweepings/litter***	***(Rate: kg/employee/day)*** ***0,7 – 2,0***
Restaurants, hotels, and fast-food outlets	*Food* *Packaging* *Cutlery* *Electronic* *Textiles*	*(Rate: kg/client/day)* *0,5 – 1,5*
Industrial: • *Light* • *Heavy* • *Services / garages* • *Chemical and allied*	*Packaging/crates* *Used chemicals* *Old lubricants* *Used spares* *Old tyres* *Old office material*	*(Rate: kg/employee/day)* *0,5 – 3,0*
Building / construction	*Demolished buildings* *Wood, concrete, tiles,* *Roof sheeting, bricks,* *Pipes, packaging, old paint,* *used chemicals*	*(Rate: kg/company/day)* *10 - 1000*

3.1.3 Collection / Transport

The majority of domestic waste is collected by municipal services and transported either directly to disposal, or via a transfer station to disposal. Collection services include the use of purpose compactor equipped vehicles through to tractor / trailers and small trucks / bakkies. In many informal areas collection may be by hand to a centrally placed skip, which is emptied regularly, or when full.

For the purposes of the assessment a basic level of service was defined as “a refuse removal service” provided at least once per week. Table 4 presents the proportion of households per category of municipality that currently (2006/7) receive a basic level of service. It must be noted that the total number of households includes urban, peri-urban and rural households, and by definition, generally B4 category municipalities have the most rural households, and category A municipalities the least number of rural households.

Table 3: Percentage of households receiving a basic level of service (DEAT, 2007)

Municipality Category	***Access to Service %***
A	*80%*
B1	*61%*
B2	*60%*
B3	*55%*

Municipality Category	*Access to Service %*
B4	*20%*

As part of the assessment an estimate of waste collected by the municipalities was made, and is summarised in Table 5.

Table 4: Estimate of Waste collected by Municipalities (2006/7)(DEAT, 2007)

Municipality Category	*Number of Municipalities*	*Average Waste Collected (t/y)*	*Total Waste Collected (t/y)*
A	6	1 752 613	*10 515 678*
B1	21	247 743	*5 202 603*
B2	29	129 351	*3 751 179*
B3	111	16 041	*1 780 551*
B4	70	98	*6 860*
Total General Waste Collected (2006/7)			***21 256 871***

As expected, this figure of 21,3 million tons per year is significantly less than the total general waste disposed (24,1 million t/y) due to private contractors collecting (mostly business) waste and transporting it to disposal. Although the difference could be attributed to the collection of business waste, it must be noted that in most cities and large towns the municipality also collects and transports business wastes to disposal. As municipalities generally make no distinction between domestic and business general waste, it is difficult to estimate the quantity of business waste actually generated.

Issues:-

- The cost of transportation is generally the most costly component of waste management.
- The capital outlay required for specific waste collection vehicles is high, resulting in many smaller municipalities operating inefficient collection vehicles e.g. tractor trailer combinations.
- Most waste collection vehicles are old, requiring maintenance and suffering frequent break-downs. Few municipalities have back-up or standby vehicles, resulting in interrupted services.
- Newer landfill sites are frequently located at greater distances from areas of waste generation, requiring longer haulage distances and times, resulting in lower productivity from collection vehicles. The capital cost of transfer stations and specialised long haul vehicles are high.

3.1.4 Disposal

Disposal of all domestic and business waste occurs in landfills, mostly owned and operated by local authorities.

Nationally there are estimated to be more than 2000 waste handling facilities, of which approximately 530 were licensed by 2007 (DEAT, 2007). It is expected that these include transfer stations, disused dump sites and other waste handling facilities. The low number of licensed facilities may be indicative of a lack of enforcement capacity, and a lack of capacity

and resources at municipal level to manage waste handling and disposal facilities effectively and in accordance with required standards.

It is apparent that there are over 540 municipal owned and operated landfills accepting General Waste, of which only about 350 are licensed in terms of legislation. In addition, it is reported that many of the licensed landfill sites, and most of the unlicensed landfill sites are not operated and maintained in accordance with their license conditions or the Minimum Requirements.

Issues:-

- Although the future focus of waste management is to significantly reduce waste disposal to landfill, properly planned, constructed, operated and maintained landfills will still be required for the foreseeable future.
- The capital costs of identifying, permitting and constructing new landfill sites are high, and beyond the financial capabilities of many municipalities.
- Insufficient landfill operating budgets and capacity constraints in many municipalities leads to poor operation and maintenance, resulting in environmental impacts.
- Few municipalities are actively planning new landfill sites to adequately meet increasing present and future disposal requirements.
- Limited capacity appears to exist at provincial level for compliance monitoring and enforcement.

3.1.5 Waste Minimisation (Packaging)

Aspects of waste minimisation are addressed in some detail in the accompanying paper "Producer Responsibility and Consumer Awareness" (NWMS Phase 2: Research, 2009) under the Section: South African Situation.

Waste avoidance in terms of domestic and business waste generators (consumers) is extremely difficult to quantify, and lies more in the realm of the product producers and strategies undertaken at manufacturing level. Strategies such as "extended producer responsibility measures" and "cleaner production" could have significant impact.

In terms of the domestic and business waste stream, the area of current greatest focus of waste minimisation is recycling. The bulk of recyclable items include discarded packaging materials, consumer good and defective products.

Packaging materials recycled include glass, metal cans, paper (packaging and print) and plastic packaging. The Packaging Council of South Africa closely monitors the packaging market and has produced the following data for 2007. (www.pacsa.co.za)

Table 5: Total South African Paper and Packaging Market (2007)

Sector	***Tons (2007)***
Paper and Packaging Production	*4 001 382*
Less Direct and Indirect Exports	*- 403 741*
Plus indirect Imports	*+ 72 451*
Total SA Packaging Consumption	***3 670 093***

Table 6: Total Recycled Paper and Packaging Material (2007)

Packaging Material	*Total Industry (tons)*	*Paper & Packaging Material Recycled (tons)*	*Recycle %*
Glass	*860 000*	*164 685*	*19,1*
Metal Cans	*240 679*	*171 100*	*71,1*
Paper (pack & print)	*1 914 362*	*1 030 445*	*53,8*
Plastic Packaging	*655 052*	*131 677*	*20,1*
Totals	***3 670 093***	***1 497 907***	***40,8***

3.1.5.1 Bottle Glass

A Section 21 company, consisting of a non-profit joint industry initiative, called the Glass Recycling Company has been established with partners that include government, bottle glass manufacturers, users of glass to package their products and bottle glass recyclers.

Since 2006 over 312 entrepreneurs have established organisations to purchase waste glass from collectors. More than 80% of these entrepreneurs are historically disadvantaged individuals (HDI). In addition over 2,180 glass banks have been placed at different sites around the country to facilitate collection of glass from consumers. (www.theglassrecyclingcompany.co.za)

The Glass Recycling Company records the following recycled materials:

Table 7: Waste Glass Recycled

Year	**05/06**	**06/07**	***07/08***
Glass Recycled (tons)	148 000	183 200	*204 685*
Recycling Rate %	*21%*	*23%*	*24%*

(www.theglassrecyclingcompany.co.za)

It is noted that the figures presented above differ marginally to those presented in Table 6 for glass. This is considered partially due to different reporting periods.

Issues:-

- Recyclers need to be registered with the NWIS, and quantities etc. need to be reported in order to manage the effectiveness of recycling operations and impact on the waste stream.
- Glass is 100% recyclable, and the recycling process consumes less energy than manufacturing new glass.
- Significant quantities of new glass are used to manufacture returnable, re-useable glass containers, which in the short term is not available for recycling, but lowers the demand for new glass.
- Transport costs form a significant cost of the recycling process.
- The implications of possible regulatory and economic instruments need to be considered carefully before implementation.

3.1.5.2 Metal Cans

Collect-a-Can (Pty) Ltd (also a Section 21 Company) was established in 1993 to focus on the promotion of the recovery and recycling of used beverage cans and other steel packaging in Southern Africa. It is a joint venture between ArcelorMittal South Africa and Nampak. (www.collectacan.co.za).

Cans are purchased from collectors loose, in bags (approximately 30kg) or compressed and bailed. Collect-a-Can will arrange collection for sufficient quantities, however collectors obtain higher purchasing prices at Collect-a-Can branches (3 in Gauteng, 1 in the Western Cape and 1 in KwaZulu Natal) if they are delivered.

As reported in Table 6, over 240 000 tons of metal cans were consumed in 2007, with over 171 000 tons of this recycled. With a recycle rate of 71% this represents one of the highest recycling rates of metal cans in the world.

Issues:-

- The private sector initiative is considered successful, and the implication of any regulatory interventions needs to be carefully considered.
- Recyclers need to be registered with the NWIS, and quantities etc. need to be reported in order to manage the effectiveness of recycling operations and impact on the waste stream.

3.1.5.3 Paper

Paper recycling in South Africa is represented by the Paper Recycling Association of South Africa (PRASA) (www.prasa.co.za). A summary of their detailed analysis of paper recycling in 2007 is presented below.

Table 8: Summary of Paper Consumption in South Africa (2007) (including paper imports and exports)

Paper Consumption	***2007 (tons)***
Newsprint	*327 818*
Printing / Writing	*707 900*
Corrugated Materials / Containerboard	*875 545*
Other Wrapping Papers	*145 679*
Tissue	*197 464*
Other Paper	*80 563*
Board	*135 163*
Total	***2 470 132***

Table 9: Recovery of Recycled Paper (2007) (including paper imports and exports)

Recovery or Recyclable Paper	***2007 (tons)***
Newsprint	*105 922*
Magazines	*40 617*
Corrugated, solid cases, Kraft papers	*512 705*
Office, graphic papers	*168 132*
Mixed and other papers	*119 001*

Recovery or Recyclable Paper	*2007 (tons)*
Total	***946 377***

Table 10: Paper Recycling Rates (2007)

Recoverable Paper	*2007 (tons)*
Paper Consumption	*2 470 132*
Less paper exported in agricultural products	*183 549*
Less paper unsuitable for recovery (assumed 16%)	*395 221*
Recoverable paper	*1 891 362*
Recyclable paper recovered as % of consumption	*41,7%*
Recovered as a % of Recoverable Paper	***54,5%***

The paper consumption above differs from the figure for paper in Table 6. The above includes the total consumption for all paper products, where as Table 6 includes only paper consumed in print and packaging.

Issues:-

- Recyclers need to be registered with the NWIS, and quantities etc. need to be reported in order to manage the effectiveness of recycling operations and impact on the waste stream.
- The paper recycling industry appears well organised.
- Pre-sorting of recyclable paper before contamination by wet wastes in particular is important, and may require regulatory intervention.
- Transport costs are significant, and further consideration should be given to co-operation between the different organisations to share loads etc. wherever possible.
- The private sector initiative is considered successful, and the implication of any regulatory interventions needs to be carefully considered.

3.1.5.4 Plastics

The plastics industry in South Africa is represented by the Plastics Federation of South Africa (Plasfed), which lists as its members:-

- Association of Rotational Moulders of South Africa
- Expanded Polystyrene Association of South Africa
- PET Plastics Recycling (PETCO) of South Africa
- Plastic Converters Association of South Africa
- Plastics Institute of Southern Africa
- Polystyrene Packaging Council
- Safripol (Pty) Ltd
- Sasol Polymers
- South African Machinery Suppliers Association for Plastics, Printing, Packaging and Allied Industries
- South African Plastic Pipe Manufacturers Association
- South African Plastic Recyclers Organisation
- South African Polymer Importers Association

As such, Plasfed represents raw material producers and suppliers, converters, research and recycling organisations, thus incorporating all aspects of the flow of material through the industry.

A system of identifying plastics is used worldwide to identify different packaging plastics. A number in a "recycling" triangle denotes the type of polymer used. Table 12 illustrates the number of polymers used in packaging and other products, along with their wide range of uses.

Table 10: Types and Uses of Common SA Polymers

Plastics Material	Packaging	*Non-Packaging*
PE-LD/LLD Low and Linear low density polyethylene PE-HD High density polyethylene	Packaging films, cling film, stretch wrap, bags, shrouds, dust covers, peelable lids, tubes, boutique shopping bags. Milk bottles, fruit juice bottles, drums, packaging films, vest type shopping bags, tubs, closures, cosmetic bottles, crates, pallets, bins.	*Pipes, cable insulation, cladding, agricultural films, rotational moulded products, e.g tanks, corner protectors, trays.* *Pipes, shade-cloth, netting.*
PP Polypropylene	Yoghurt tubs, margarine tubs, ice cream containers, wrappers, packaging films, bottles, caps and closures, buckets, canisters, strapping tape, woven bags, crates	*Coat hangers, battery cases, bobbins, reels, automotive components, furniture, bowls, carpeting, non-wovens, bristles, hair extension, bumpers.*
PET Poly (ethylene Terephthalate)	Carbonated drink bottles, mineral water bottles, clear bottles, dinky dome food packaging, clamshell packaging.	*Carpeting, hair extensions, coat hangers, non-wovens, woven cloth.*
PVC-P Flexible Poly (vinyl Chloride)	Cling film, pouches Clear bottles, jars, blister packaging, food packaging, inserts, e.g. chocolate trays	*Cable insulation, gum boots, flooring, matting, medical cloth and lubing (un-used!) tarpaulins, hoses, safety gloves, soft toys, rain wear.* *Pipes, conduit, profiles, cladding, stationery foils, plumbing, skirting, cornices, trunking, cooling tower packing.*
PS Polystyrene (general purpose and high impact)	Yoghurt tubs, display boxes.	*Coat hangers, take-away cutlery, take-away crockery, toys, cups, plates, audio and video cassette housings, CD covers, housings.*
PMMA Poly (methyl Methacrylate) or acrylics		*Signage, display lighting, light covers, lenses, number plates, reflectors*
ABS *Acrylonitrile Butadiene Styrene*	*Tubs*	*Cones, reels, bobbins, TV housings, other housings, toys, automotive components, telephone castings, signage.*

A survey was undertaken in 2005 on the total plastics market and levels of recycling (i.e. not only packaging, but including structural or engineering plastics e.g. car bumpers, pipes, etc.) and is summarised below:

Table 12: Plastic Material converted and Recycled in South Africa (2005) (Survey of the South African Plastics Recycling Industry in 2005, Buyisa-e-bag December 2006)

Type	*Polymer Identification Logo (Packaging only)*	*Total Converted (t)*	*Total Recycled (t)*	*% Recycled*
PET	*1*	*87000*	*18 964*	*21,8%*
PE-HD	*2*	*155 000*	*29 597*	*19,1%*
PVC-P (plasticised)	*3*	*78 250*	*11 293*	*14,4%*
PVC-U (un plasticised)	*3*	*78 250*	*2459*	*3,1%*
PE-LD	*4*	*280 000*	*74 666*	*26,7%*
PP	*5*	*215 000*	*26 543*	*12,3%*
PS	*6*	*33 100*	*3570*	*10,8%*
PS (expanded)	*6*	*11 400*	*530*	*4,6%*
Other	*7*	*80 200*	*2059*	*5,8%*
Totals		***1 018 300***	***172 253***	***16,9%***

It must be stressed that these totals (2005) are not directly comparable to those for plastics converted and recycled presented in Table 6 (2007), as Table 6 is presented for plastic packaging (in 2007) only. However, Plasfed estimates that up to 60% of plastics converted are for packaging, which approximates 611 000 tons for 2005, compared to 655 052 tons for 2007(Table 6). Given that a total of 172 253 tons of all plastics were recycled in 2005, and 131 677 tons of packaging plastics were recycled in 2007, illustrates that over 75% of all plastics recycled are from packaging.

The plastics industry consists of three raw materials producers in South Africa, plus raw material importers, supplying over 1200 converters (any organisation with a machine that converts raw or recycled materials into a product). The plastics recycling sector consists of 162 recyclers who purchase recycled plastics and process them to raw materials for supply to the converters.

Collectors source pre- or post consumer waste on many levels, from curb-side scavenging to picking from waste dumps and landfills, through to organised collection of pre sorted plastic wastes from businesses. Collectors transport plastic wastes depending on level of collection utilising trolleys, light motor vehicles or trucks to recyclers for sale.

Recyclers sort the plastic wastes into categories, which are then granulated (shredding into small flakes), washed and dried. This is sometimes sold as is to converters or other recyclers. However, the majority of recyclers feed these granules into an extruder where it is melted and forced through a die to produce strings. Once cooled, these strings are cut into

pellets, bagged and sold to the converters. Pelletised recyclate realises a higher value as it is of uniform size and quality.

As in recycling of other materials, transport is a significant cost in the process. An interesting initiative is being tested in the Highway area of eThekweni Metropolitan area, where an existing waste paper collection system is to be used to collect waste plastics.

Buyisa-e-Bag

The promulgation of legislation regarding the specifications and levies on plastic carrier bags led to the formation of the Section 21 (not for profit) company Buyisa-e-Bag. The Board of Directors comprises of representatives of the founding members, being organised business and labour organisations. (www.buyisebag.co.za)

Funds are generated through the excise duty of 3 cents per bag payable by the plastic bag manufacturers. The levies are paid directly to the National Treasury. Buyisa-e-Bag motivates for, and receives funds from the Department of Environmental Affairs to fulfil its objectives.

Their Mission states: "*To implement a convenient, safe and cost effective collection and recycling programme that will promote efficiency in the use, re-use, collection, recycling of plastic bags and related waste materials from disposable matter*".

Their objectives are:

- Facilitate and execute public education and awareness programmes.
- Establishment of new multi-recycling Buy Back Centres through the assistance of local municipalities.
- Ensure continuous sustainable clean up campaigns.
- Support existing multi-recycling Buy Back Centres through the allocation of functional resources.
- Play a pivotal role in alleviating poverty by creating jobs.
- Facilitate and support SMME development projects.
- Support existing and selected garden refuse site recycling.
- Facilitate rural development projects on recycling.

Issues:-

- Recyclers need to be registered with the NWIS, and quantities etc. need to be reported in order to manage the effectiveness of recycling operations and impact on the waste stream.
- Education of consumers in the recyclability and types of recyclable plastics needs emphasis.
- The cost of collection and transport of recyclable plastics is significant, and further consideration should be given to co-operation between the different organisations to share loads etc. wherever possible.
- The formation and activities of the various associations promoting and supporting recycling initiatives for the various plastics categories is encouraging, however, the implications of further possible regulatory and economic instruments need to be considered carefully before implementation.

3.1.6 Waste Recycling (other)

3.1.6.1 Window Glass

Window glass differs from bottle glass in its composition, which complicates the issue of recycling glass. Bottle glass recycling can utilise a limited amount of window glass in its process, but window glass can only use recycled window glass cullet in the manufacturing process.

A major manufacturer of window glass, or float glass, PFG, undertakes recycling. A number of "hubs" in the main centres accept broken glass from the group companies, and this is transported to Johannesburg for recycling. They undertake the recycling of windscreens and safety glass, where the non glass fraction is separated prior to recycling.

PFG manufacture approximately 200 000 tons per year of building products (windows) and automotive products (windscreens). PFG receives the following back for recycling:-

- Building glass (including flat "unprocessed" automotive glass from windscreen manufacture):- approximately 10 800 tons per year.
- Automotive glass (broken windscreens) :- approximately 3 950 tons per year.

It must be noted that the majority of PFG's production, particularly in building products, is utilised in new development and is not immediately available for recycling.

3.1.6.2 Scrap Metal

The scrap metal recycling industry is well developed, with nearly 100 scrap metal dealers belonging to the Metal Recyclers Association of South Africa, who process over 80% of all scrap metal for beneficiation by downstream industry.

The industry is typified by:-

- **Peddlars** – individuals who collect or purchase scrap for re-sale to bucket shops, scrap merchants or scrap processors.
- **Bucket Shops** – typically 2 to 4 employees who buy scrap from peddlers and transport small quantities using a bakkie, for resale.
- **Scrap Merchants** – purchase scrap and perform basic sorting into metal types, then sell to scrap processors.
- **Scrap Processors** – handle large volumes of scrap, then sort and process them for beneficiation by local foundries, steel mills or export.

(At the time of finalisation of this draft, information from recycled figures from MRA was still awaited, and will be included in a subsequent version.)

3.1.7 Sewage Sludge

Extensive research has been done in South Africa on the characterisation and classifying sewage sludge, and their suitability for certain applications, but little information is available on expected quantities of sewage sludge generated and disposed of.

A survey undertaken in 2001 of 72 wastewater treatment works from all provinces in South Africa (including cities through to small towns) indicated that approximately 670 tons per day may be generated. Just for these 72 facilities this equates to nearly 245 000 tons per year.

The same survey indicated that at 40% of the facilities the dewatered sludge is stockpiled until utilised by farmers, the municipality or disposed of in landfill (or composted). A further 40% is disposed of by application (in liquid or dewatered state) on dedicated land disposal sites. The sludge is regularly applied at high rates to the surface soils. The land is only used for the disposal of sewage sludge, and not for specific crop growth.

Impacts from the presence of heavy metals in sewage sludge, groundwater contamination and other issues arising from these practices has resulted in much research leading to the recent publishing of "guidelines for the Utilisation and Disposal of Wastewater Sludge" (Volumes 1 to 5, DWAF 2006).

Although large volumes of wastewater sludge are generated, it is expected that the rigorous application of these Guidelines will help address issues surrounding the utilisation and disposal of wastewater sludge.

Issues:

- The measurement and reporting on wastewater sludge quantity generation and quality to the NWIS;
- Reporting on the effective utilisation and disposal of wastewater sludge;
- Effective verification of the information; and
- Effective enforcement of any licenses issued, and legislation covering the treatment or disposal of sewage sludge.

3.2 Hazardous Wastes

3.2.1 Industrial & Mining Hazardous Wastes

3.2.1.1 General

The Waste Act defines hazardous waste as:

"any waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment."

Currently there are two classification systems in use in South Africa, essentially based on similar characteristics:

- South African SANS 10228: The Identification and Classification of Dangerous Goods for Transportation
- Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste (Draft 3rd Edition, September 2005).

Essentially both systems classify hazardous wastes into 9 classes depending on its chemical, physical or toxicological characteristics, and defines how the substance is handled, transported, treated and/or disposed of.

The hazardous classification is currently being reviewed in order to possibly rationalise and streamline the classification process.

An extensive survey was undertaken on hazardous waste generation as part of the baseline study for the first National Waste Management Strategy (NWMS) for South Africa (DWAF, 2001a). The data for 1997 is summarised below.

Three Provinces have completed Provincial Integrated Hazardous Waste Management Plans since then:-

- Western Cape (December 2006)
- Gauteng (September 2007)
- North West Province (October 2006)

A summary of estimated hazardous waste generation, treated and landfilled is presented in Table 14.

Table 13 - Overall hazardous waste generation per Province 1997 (DWAF 2001a)

Province	***Hazardous Waste***		
	Volume of Waste generated as m^3 / annum		***Waste disposed in landfills t/annum***
	Landfill	**Other**	
Eastern Cape	19 719	17 869	*81 000*
Free State	14 707	15 823	-
Gauteng	168 758	1 619 885	*232 000*
Kwa-Zulu Natal	43 896	1 637 038	*115 000*
Mpumalanga	2 923	3 413 950	-
Northern Cape	937	212	-
Northern Province	1 491	4 323	-
North West	1 889	1 495	-
Western Cape	76 786	203 101	*131 000*
Totals	***331 106***	***6913 696***	***559 000***

Table 14 - Hazardous Waste Generation per Province (IHWMP's)

Province / Year	***Hazardous Waste***		
	Waste generated (t/a)	**Waste treated recycled or other (t/a)**	***Landfill (t/a)***
Gauteng (2006)	446 200	48 000	*385 000*
Western Cape (2006)	55 810		*11 162*
North West (2005)	*+/- 20 0000*		*+/- 4 000*

In 2007 DEAT undertook a survey of 5 significant waste management companies handling hazardous wastes in four provinces – Eastern Cape, Gauteng, KwaZulu Natal and Western

Cape. The total amount of 710,000 tons of hazardous waste was disposed of in 2007, of which 117,500 was organic.

The data obtained for Gauteng appears to reflect an increase in hazardous waste disposal to hazardous landfill of 67% in 9 years, while the Western Cape appears to reflect a significant decrease from 131 000 tons per year in 1997 to 11 162 in 2006.

It is apparent that very different definitions of what to include in the hazardous waste streams have been used in the studies. It is also not clear if health care risk wastes, sewage sludge, and other potentially hazardous waste streams have been included or excluded from the various studies.

The lack of reliable hazardous waste information for the 6 Provinces that have not completed IHWMP's make quantifying a mass balance for hazardous wastes difficult, but the data obtained in 2007 appears to represent best current knowledge.

3.2.1.2 Transportation

The formal transportation of hazardous wastes appears mostly to be undertaken by commercial waste management companies to treatment facilities, recycling or disposal.

The transport of hazardous substances is governed by legislation. Transport Emergency Cards (Tremcards) must be carried to supplement Hazchem information that must be displayed on the vehicle. The vehicles must be fit for its intended use.

In some instances the generator of the hazardous waste undertakes the transport of the waste. However, it is evident that transportation is also sometimes undertaken with inadequate safeguards and procedures by those undertaking the transport.

3.2.1.3 Re-use / Recycling

It is reported in Gauteng that on site minimisation and re-use of hazardous wastes is prevalent in organisations that are signatories to the Responsible Care initiative. Other wastes generators are also reported to actively pursue waste minimisation and re-use due to business optimisation and regulatory pressures.

Recycling appears to be practiced to varying degrees across most hazardous waste generating sectors. The recycling opportunities appear very material specific, and frequently require physical and / or chemical treatment before recycling.

Specific quantities of hazardous wastes re-used or recycled are difficult to determine from available information.

Significant opportunities appear to exist for hazardous waste minimisation, re-use and recycling through cleaner production technologies, green purchasing programs and waste exchanges.

Issues noted that influence re-use and recycling were:-

- The high cost of raw materials most often drives current waste avoidance, re-use and recycling.
- Availability of cost effective technology for recovering materials for re-use or recycling needs to be researched further.
- Ability to process materials for re-use or recycling on-site or off-site significantly affects the economics of the operation.
- Transport cost and distances involved significantly influence re-use and recycling.
- Health, safety and environmental aspects also may influence re-use and recycling options.
- Availability of hazardous waste treatment / disposal facilities.

3.2.1.4 Treatment

Hazardous waste volumes and toxicity may be reduced by treatment technologies, for example:-

- Biological treatment
- Chemical treatment
- Physical treatment
- Encapsulation
- Immobilisation
- Thermal Process
- Solidification

In Gauteng, it is reported that a number of industries practise on-site treatment of hazardous waste streams, prior to removal of disposal. However, it appears that this is mostly limited to chemical treatment, mostly PH control for neutralisation of acid or alkali waste streams. In most other cases where hazardous waste treatment occurs, it is generally removed and performed by a waste management contractor before disposal to landfill as part of the service.

Other off-site hazardous waste treatments used in Gauteng appear limited to thermal processes, chemical treatment or encapsulation. Only two hazardous waste treatment facilities were identified, a thermal treatment facility in Olifantsfontein and a chemical treatment plant in Germiston that treats and reclaims metals from effluents generated by the metal finishing industry and precious metal refiners. A third identified treatment facility in Germiston was awaiting licensing at the time of the Gauteng Integrated Hazardous Waste Management Plan (2007).

3.2.1.5 Disposal

A comprehensive assessment of the available hazardous landfill capacity was made in 1997 for the first NWMS (DWAF, 2001b). The assessment indicated that there were 9 licensed hazardous landfill sites at the that time, with the distribution being 3 in the Western Cape, and 2 each in Gauteng, KwaZulu Natal and the Eastern Cape. There were no licensed hazardous landfills in the remaining 5 Provinces.

The Western Cape Hazardous Waste Management Plan (2006) indicated that there were 3 licensed hazardous landfills, with the following estimated remaining airspace (lifespan);

- City of Cape Town Hazardous Waste Facility (Vissershok) – Remaining lifespan 8-10 years
- Vissershok Waste Management Facility – Remaining lifespan 10-13 years
- Petro SA Hazardous Waste Disposal Facility - Remaining lifespan 7 years.

It must be noted that the Petro SA facility is a private landfill catering only for Petro SA hazardous wastes, while both Vissershok facilities near Cape Town are utilized by industry.

The Gauteng IHWMP (2008) does not comment on the number of available hazardous waste disposal facilities, or their remaining lifespan. It is apparent that there are still 2 hazardous waste landfills, but their remaining lifespan probably needs to be re assessed due to the current rising quantities of hazardous waste generated.

The North West Province Hazardous Waste Management Plan (2006) noted that hazardous wastes were transported to the Holfontein hazardous landfill in Gauteng, while delisted wastes (hazardous wastes treated and permitted to be disposed of on suitable general landfills) were transported to the Rosslyn and Reitfontein GLB^+ landfills in Gauteng. Further, specific hazardous wastes (permitted by the authorities) were being incinerated in the Holcim Cement Kiln (Dudfield) and the PPC Cement Kiln at Dettoek in the North West Province.

3.2.1.6 Issues

The issue raised in the various studies are summarised as follows:-

- Industry specific and provincial integrated hazardous waste management plans must be compiled and updated as a priority.
- There is a critical lack of reliable data on hazardous wastes with respect to;
    - types
    - quantities generated
    - quantities re-use or recycled
    - quantities treated and / or disposed
- Insufficient compliance monitoring and enforcement of all aspects of waste management, health and safety, and environmental legislation
- The minimisation, re-use and recycling of hazardous wastes is not actively practised and needs to be encouraged.
- The storage and transportation of hazardous wastes needs attention and active enforcement of regulations.
- Alternative waste treatment and destruction / disposal facilities are required.
- A critical assessment of hazardous waste landfill available airspace is required.
- While the major hazardous landfills are generally located in regions of greatest hazardous waste generation, more hazardous waste disposal facilities are required in other regions.
- Cleaner production technologies, green procurement, waste exchanges etc need to be encouraged throughout the industrial sectors.

3.2.2 e Waste

3.2.2.1 General

Electrical and electronic waste is a growing concern in light of increasing standards of living and consumerism. It is generally considered to include white goods (fridges, stoves, washing machines, microwaves etc), consumer electronics (TV's, hi-fi's, music centres, appliances, etc) and IT (PC's, laptops, printers, mobile phones). Due to the presence of electronic components, batteries, cathode ray tubes etc., these wastes are considered potentially hazardous.

The e-Waste Association of South Africa (eWASA) has been established as a Section 21 company to implement an environmentally sound management system for all types of e-waste generated in South Africa (www.ewasa.org).

3.2.2.2 Quantities

A survey undertaken by eWASA in November 2008 estimated the following total quantities of goods distributed in 2007. As these figures are based on specific tracer products, it is considered that these estimates are conservative. Also included are industry forecast growth rates.

Table 15: Estimated goods distributed (2007)

Type	***Quantity (t)***	***Expected Annual Growth (%)***
White Goods	74,130	*10-20%*
Consumer Electronics	23,100	*10-20% +*
IT (new)	36,171	*(variable depending on product)*
IT (Imported 2nd hand)	2,700	*Unknown*
Total	***136,101***	

3.2.2.3 Collection

The collection of e-waste already occurs both formally and informally. Informal collection, often using hand trolleys, occurs along streets on waste disposal day, in industrial areas and at municipal collection points such as landfills etc. Materials collected are sometimes disassembled, smashed or broken up to obtain recyclable materials for sale into the formal recycling markets, or sold to the formal collectors.

Collection of white goods for re-cycling of metals has been continuing for decades. Formal collection of e-waste has been done by few specialised companies since the early 1990's. These companies, however, are not generally interested in domestic e-waste, and have worked mostly through contracting with large businesses and government, or won tenders for the removal of e-waste from sites.

More recently, government and private sector initiatives have resulted in public drop off points for e-waste, focussing more on consumer electronics, IT wastes and related items such as batteries and compact fluorescent lamps (CFL's). Sites have included garden refuse transfer stations, shopping centres, retailers and refurbishment centres. Typically these collection initiatives involve a contract or arrangement with a recycler or waste management company to collect the e-waste for recycling.

Little medium or long term information on collection quantities exists, but records show quantities of between 100kg and 1 575kg being collected at Pickitup Garden Sites in an 8 week period.

3.2.2.4 Refurbishment

The repair of white goods, consumer electronics and IT also happens both formally and informally, resulting in second hand goods available for sale.

The most organised area of refurbishment occurs in the IT sector, where several large IT refurbishers are operating in South Africa. This industry refurbishes PC's, monitors, laptops, printers and scanners amongst other IT equipment, sourcing equipment from large organisations, institutions and government departments, as well as importing from Europe and the USA. A number of refurbishers also obtain, refurbish and resell mobile telephones with one large player reportedly supplying as many as 720,000 units per year.

Refurbished products are in turn sold back to the private sector and individuals, and are used in non-profit projects at schools and in disadvantaged communities.

3.2.2.5 Recycling

There are a number of e-waste recyclers operating in South Africa, with varying degrees of specialisation. The recycling processes employed are not uniform, and are dependent on the targeted materials.

Some employ manual dismantling, which adds value in that it allows for sorting into specific fraction, and even allows for removal of working parts for resale. Obviously this can be labour intensive and time consuming. Alternatively mechanised shredding, followed by mechanical sorting using water separation, magnets, extractors etc. can be used followed by granulation, shearing and baling for despatch to recycled material markets. Obviously a combination of these can be used, for example, where one company dismantles and sorts what it wants, and sends the residual to a second company that shreds and sorts this mechanically.

Targeted recyclable materials are mainly the ferrous and nonferrous metals, and certain plastics.

Unrecyclable fractions include some plastics, batteries and monitors (or CRT's). Batteries and CRT's are particularly problematic as they contain hazardous materials. In some instances these are responsibly disposed of. Batteries are stockpiled and then sent to a hazardous landfill, and CRT's are crushed and either smelted or disposed of at a hazardous landfill. However, a number of recyclers appear not to remove CRT's or batteries from the crushing or shredding process.

The quantities of recycled materials arising from e-waste is unknown.

3.2.2.6 Disposal

There is little information of the quantities of e-waste entering landfills in South Africa, as there is no systematic monitoring of e-waste quantities, mainly as it is a relatively newly recognised waste stream.

Anecdotal evidence suggests that of the e-waste placed out on the curb side, little or none of it reaches landfills. Much of this is likely to be informally or formally collected before landfilling due to its recycled material value. Smaller consumer electronic goods and old mobile phones included in domestic waste streams are unlikely to be detected before landfilling due to their small size.

3.2.2.7 Issues

- Market growth forecasts (made before the current downturn) indicate ever increasing amounts of white goods, consumer electronics and IT entering the waste stream.
- Informal collectors may be exposed to a range of threats, including health hazards, exploitation and crime. Some informal collectors also "process" the material to add value, e.g. burning to remove insulation to obtain metal, and are exposed to health risks, and causing environmental impacts.
- An unknown portion of hazardous wastes from e-waste are not disposed of correctly, either in a hazardous landfill or authorised thermal process, and potentially hazardous e-waste is being disposed of in general landfills, or illegally dumped.
- The scaling up of collection programmes, including logistics needs to be encouraged.
- There are numerous business opportunities in the refurbishment and recycling of e-waste sectors, but this must be supported by effective compliance with health, safety and environmental legislation of existing as well as new operations.
- Many recyclers do not treat effluents/leaching or water, or test landfilled fraction for toxicity.

3.2.3 Tyres

At present the total mass of new pneumatic tyres entering the South African market (2008) is approximately 175 00 tons per year. Once used this mass is reduced to approximately 150 000 tons per year that require recycling, treatment or disposal.

There are limited avenues at present to legally dispose of waste tyres. Disposal at landfill sites is problematic due to their physical properties. Many landfills do not accept waste tyres, while some charge a higher rate. Tyres are often burnt in the open veld, causing potential health hazards due to smoke, and residuals in soil can cause environmental damage.

Tyre recycling is currently limited to one plant producing rubber crumb (in Cape Town), and approximately 11 other recyclers making mats, sandals etc. There are a number of smaller recycling operators who produce cut, stamped and punched items, but this is limited as they can only use waste tyres that do not contain steel belts. Some waste tyre collectors are accumulating stockpiles of waste tyres.

Vast numbers of waste tyres are being disposed of illegally. The majority are illegally dumped, while some are “refurbished” by repairing or re-grooving tyres for sale as part-worn tyres.

Current levels of recycling of waste tyres are unknown. In 2002 the South African Tyre Recycling Process Company (the SATRP Company) was formed as a non-profit company by a number of concerned tyre suppliers in South Africa. The SATRP Company and its stakeholders worked closely with (the then) Department of Environment Affairs and Tourism to develop the Waste Tyre Regulation, which came into effect on 30 June 2009 (the waste Tyre Regulations, 2009, Government Gazette No R9032). With immediate effect, tyre dealers in South Africa have to sort all used tyres into:-

- Retreadable casings
- Part worn tyres (complying with Road Regulations)
- The balance as waste tyres (all passenger and light commercial waste tyres must be rendered unusable).

Waste tyres may only be disposed of to end users for recycling, or to landfill.

The SATRP Company has submitted an Integrated Industry Waste Tyre Management Plan to the authorities for consideration. The plan notes the following options available for the management of waste tyres:-

(i) Product recycling - Waste tyres are used in whole, cut or stamped, taking advantage of their shape, sound and impact absorption properties and / or material characteristics;

(ii) Material recycling - Waste tyres are shredded and used as secondary fuel for incineration; or

Granulated (mechanically or cryogenically) and then separated into rubber granulate, steel and textile. The steel and textile can be sold and the rubber granulate can be used in many product applications.

Rubber reclaim can be produced by the chemical processing of a mixture of rubber granules, oil, water and chemicals. The resultant compound is submitted to a further thermo-mechanical process where additives can be incorporated depending on the final product requirements. Reclaim rubber blends in with virgin compounds and can be used in a wide range of moulded articles.

Pyrolysis is the chemical conversion or breakdown of organic compounds by heating in the total absence of oxygen. Carbon black, oil and steel can be obtained from the pyrolysis of waste tyres. (Both the carbon black and oil are highly contaminated with other chemicals).

(iii) Energy Recovery

Waste tyres represent an alternative supplementary non-fossil fuel. They provide the same heat energy commonly achieved by coal. Whole or shredded waste tyres can be used as principal or secondary fuel source in the production of steam, electricity, cement, bricks, lime, paper, steel and in the incineration of garbage.

The addition of waste tyres is environmentally safe and does not release additional emissions in the atmosphere of sulphur oxides or nitrogen oxides when appropriate emission control devices are properly installed and maintained.

(iv) Landfill

Landfill should only be adopted when no viable alternatives exist. The Waste Tyre Regulation limits the disposal of waste tyres to landfill sites.

Issues:-

- Although regulations are now in effect, effective monitoring and enforcement of these regulations is required.
- Tyre recyclers need to register on the NWIS and report quantities etc. to measure effectiveness of the regulations, and impact on the waste stream.
- Recycling plants need to be established country-wide, and markets developed for recycled materials.
- The beneficial use of tyres in thermal processes (e.g. cement kilns) must be carefully considered. Thermal processes must comply with air emission standards etc.

3.2.4 Domestic/Commercial

3.2.4.1 Batteries

Some estimate that over 50 million batteries are consumed annually in South Africa. The vast majority of these are non rechargeable "ordinary" batteries which are used once and discarded into the domestic waste stream. This may equate to approximately 2,500 tons of batteries disposed to landfill per year. (Environmental Management Jan/Feb 2009)

It is not known what portion of these contain heavy metals, notably mercury and cadmium which may effectively classify these as hazardous wastes.

Commonly used batteries include:

- Alkaline batteries – these batteries used to contain mercury, but this has been phased out and are generally alkaline manganese batteries. Although these can be disposed of in domestic waste, they can be recycled to recover steel and zinc, but is not actively done in the world yet.
- Rechargeable batteries – these consist of nickel-cadmium (Ni-Cd) batteries, and the now more common nickel metal hydride (NiMH) batteries. NiCd batteries contain cadmium, hence are considered hazardous waste when disposed. Both types are recyclable for the recovery of nickel, iron, zinc and cadmium.
- Lithium-ion batteries – these high performance rechargeable batteries are typically found in mobile phones and other specialised consumer electronics. These are recyclable to recover valuable metals.
- Silver oxide batteries – these are small non rechargeable "button" shaped batteries used in hearing aids, wristwatches etc. These may contain mercury, so are considered hazardous when disposing.

An international supplier of rechargeable batteries is initiating a recycling programme for batteries in South Africa. Recycling bins are being placed at large retail outlets. The recycler will collect these bins and sort them at a plant in Gauteng. Recyclable rechargeable

batteries will be containerised and sent to their recycling plant in France, while non recyclable batteries are to be concrete encased and disposed to landfill. (www.uniross.co.za)

Issues:

- An education and awareness campaign needs to be generated.
- The use of rechargeable batteries is to be encouraged.
- Synergy between battery recycling and other e-waste recycling initiatives needs to be explored further.
- Once economies of scale have been established, local recycling for materials recovery should be considered.

3.2.4.2 Fluorescent Lamps

Fluorescent lamps are of pertinence due to their mercury content, which is classified as hazardous waste upon their disposal. At present most fluorescent lamps are disposed of in the domestic/commercial waste stream and are not disposed of in a hazardous landfill.

Eskom estimates that in 2005/2006 some 137,857,000 mercury containing High Intensity Discharge Lamps (HID), Linear Fluorescent Lamps (LFL) and Compact Fluorescent Lamps (CFL) were imported. It is expected that due to the "energy crises", the number of CFL's imported has increased significantly. (www.eskom.co.za)

Currently a comparable number of LFL's tubes probably enter the waste stream annually, the number of CFL's entering the waste stream will increase significantly in the coming years.

A private company has been established to recycle mercury bearing lamps and other mercury bearing products, is a member of eWASA, and is supported by key lighting suppliers, retail chains, etc.

3.2.4.3 Other Hazardous Materials

Although other domestic hazardous substances such as solvents, pesticides, pharmaceuticals etc. enter the domestic waste stream, normally in small amounts, not much is known about types, quantities and impacts.

3.2.5 Oil

The ROSE Foundation (Recycling Oil Saves the Environment) was started as a Section 21 company in 1994, representing the main lubricant suppliers in South Africa. It manages the environmentally acceptable collection, storage and recycling of used oil in South Africa.

Approximately 270 million litres of new lubricating oil is sold annually in South Africa. Research has shown that through use, 40 to 45% of this new oil becomes used oil.

In 2005 the ROSE Foundation together with a core group of key stakeholders in the oil recycling industry, facilitated the formation of the National Oil Recycling Association of South Africa (NORA-SA). NORA-SA is responsible for the environmental management of the collection, transportation, storage, recycling and utilisation of used oil.

Currently approximately 80 million litres of used oil is collected annually. Recyclers re-refine motor oils for resale and re-use, or it is processed to become an industrial fuel oil.

Issues:

- Large quantities of used oil are disposed of illegally into the environment, or used indiscriminately as an industrial fuel releasing contaminants into the atmosphere.
- ROSE's stated objective is to promote the collection of at least 80% of collectable used oils by 2010.

3.3 Construction and Demolition Wastes

3.3.1 General

The building and construction industry generates a considerable amount of waste during the various stages of construction, demolition and renovation activities. Data on quantities of construction and demolition wastes appears to be limited to some weighbridge equipped landfills, which only record the mass entering the landfill. This obviously does not include wastes generated, but utilised or disposed of elsewhere. The information presented below is summarised from "Developing a Self-Sustaining Secondary Construction Materials Market in South Africa" (D.S. Macozoma, 2006).

Construction and demolition wastes may be defined as non-hazardous wastes resulting from the construction, remodelling, repair or renovation and demolition of structures or infrastructure. These wastes may include concrete, bricks, masonry, ceramics, metals, plastic, paper, cardboard, gypsum drywall, timber, insulation, asphalt, glass, carpeting, roofing, site clearance and sweepings, excavation materials etc.

An issue is that such wastes should not include hazardous wastes, putrescible wastes, tyres appliances and containers with residues, but often does contain trace amounts of such substances.

There is limited published information on the composition of construction and demolition waste in South Africa. However, observations indicate that construction and demolition sites generate commingled wastes (mixtures of concrete, masonry, ceramics, metals etc) from building sites (i.e. little or no separation of material types); asphalt, concrete and excavated materials from road construction, maintenance and rehabilitation; and site clearance and excavation waste from "Greenfield" developments.

3.3.2 Quantities – Generation and Disposal

Studies performed in 2002 estimated that 5 to 8 million tons of construction and demolition wastes were generated in South Africa per annum. Of this, nearly 1,4 million tons was disposed of in landfills.

Using the growth in value of buildings completed from StatsSA as a basis, it is estimated that construction and demolition waste has possibly grown to between 8 and 12 million tons per year in 2007.

3.3.3 Transport and Disposal

Construction and demolition waste is collected and transported by:

- Municipal waste collection service (often incurring a special tariff)
- Private collection service
- Contractor's own vehicles.

Disposal methods in South Africa include:

- Disposal at landfill sites
- Use as fill material (quantities unknown)
- Recycling/processing
- Illegal dumping.

There is a significant problem of illegal dumping of construction and demolition waste in South Africa. Some of the reasons are:

- Transport costs,
- Disposal charges (some landfill operators do not charge for construction and demolition waste, as it is useful cover and stabilisation material), and
- Shortage of law enforcement capacity.

In view of the above, it is cheaper to dump illegally than to transport and dispose of it legally, with little risk of being caught and paying a fine.

It is expected that the generation of construction and demolition waste is directly related to economic conditions in South Africa, hence quantities will rise during periods of intense development.

3.3.4 Re-use and Recycling

Certain construction and demolition wastes have been made available through secondary construction material outlets for decades, e.g. door and window frames, wooden flooring, plumbing and sanitary fittings etc. However, this is generally been an ad-hoc and un-coordinated commercially driven activity. Further, much use has been made of certain construction and demolition wastes by the informal sector and poor communities to build shelters.

There has, however, been growing occurrence of formal recycling of certain materials from construction and demolition wastes.

Concrete, brick and rubble recycling

These materials may be crushed and sieved to various grades to form aggregates and sand for use in new concrete or brick making. The process may also include ferrous metal removal using electromagnets eg. for reinforcing bar removal, and handpicking stations for non-ferrous metal and other material removal. These may also be sold into their respective recycling streams.

Commercial recycling plants have been established in Johannesburg, Cape Town and Durban. Actual quantities being recycled are not known, but prices for recycled aggregates are normally less than for "new" materials.

If properly co-ordinated, cost savings can be considerable as the vehicle used to deliver suitable demolition wastes can be used to transport suitable recycled aggregates or sand back to the demolition / construction site.

These operations are small at present compared to the waste stream, and there is considerable opportunity to expand.

Metal Recycling

The secondary markets for metal recycling are well established in South Africa, and an extensive network exists from informal scavenging through to specialist metal recyclers.

The quantity of metals available in construction and demolition wastes is unknown, as is the quantity being recycled.

Wood Recycling

The recycling of wood products in construction and demolition wastes is a mature market in South Africa. Useable timber products such as doors, door and window frames, flooring, roofing timber etc. is normally stripped formally or informally before demolition. Timber is also usually scavenged for use as a fuel.

Asphalt Recycling

Asphalt recycling is becoming an integral part of pavement construction in South Africa. Asphalt is a mixture of bitumen and aggregate (typically 5% bitumen and 95% aggregate).

South Africa consumption of bitumen has increased rapidly due to increased construction and rehabilitation of roads. In 2008 approximately 383,000 tons of bitumen was manufactured (a by-product of oil refining). Of this, approximately half was used for other applications eg. emulsions, liners, etc, and the remaining half to create approximately 3,1 million tons of asphalt for road construction and rehabilitation.

When roads are rehabilitated the asphalt surface may be milled off for recycling. Recycled asphalt still contains approximately 5% bitumen and 95% aggregate, both of which are high value renewable resources. Recycled asphalt can be used for base layer construction or for surfacing layers. The South African Bitumen Association (SABITA) has published a Draft TRH21:2008 – Hot Mix Recycled Asphalt as part of their technical recommendations for Highways, to promote procedures for recycling asphalt. (www.sabita.co.za)

In 2005 it was estimated that 5% recycled asphalt was used in the manufacture of hot mix asphalt. It is not known what quantity of recycled asphalt was used in base layer

construction. It is expected that the total amount of asphalt being recycled has increased significantly.

Other Recycling Activities
Although other materials such as glass, plastic, paper and cardboard are recovered from construction and demolition wastes their relative quantities are unknown, but are expected to be small in comparison to other construction and demolition wastes.

3.3.5 Issues

The following issues were identified:

- Due to the significant quantities generated, a suitable consistent definition and classification system of construction and demolition waste is required in order to manage the reduction being disposed of.
- There is a need to investigate the quantity and characterisation of construction and demolition wastes in order to facilitate suitable management interventions and to determine waste minimisation opportunities and secondary construction materials market development.
- Apart from use as fill material and illegal dumping, the disposal of construction and demolition waste in landfills is still predominant. Although limited quantities of such materials are useful for land management, excessive quantities occupy valuable landfill space.
- Promotion of the technical and economic value of recycled construction and demolition wastes, particularly of crushed concrete, brick and rubble is required to promote the secondary materials market.
- There is a need for continuous research into ways of improving the quality and performance of secondary materials, and their potential applications.

3.4 Mining and Power-station Wastes

3.4.1 Mining Waste

It appears that the latest reliable data on mining wastes was compiled by the Department of Minerals and Energy (DME) in 1997 (DWAF 2001). The breakdown in mine waste per mine type is presented in Table 17.

Table 16 Mining Waste Generation, 1997 (DWAF, 2001)

Type	*Mining Waste (t/y)*
Antimony	*525 000*
Asbestos	*87 000*
Base Metals	*70 000 000*
Coal	*42 000 000*
Diamonds	*31 000 000*
Gold	*221 000 000*
Industrial Minerals	*43 500 000*
Phosphate	*4 000 000*

Type	*Mining Waste (t/y)*
Platinum Group	*56 000 000*
Zinc	*50 000*
Total	***468 162 000***

It is expected that waste generation rates of coal, industrial minerals (aggregate limestone, sand quarries etc.) and platinum group mines have increased significantly in the intervening 12 years. However, using StatsSA indices for Mining: Production and Sales as a basis for estimating the growth in mining waste since 1997 to 2007, it is estimated that approximately 510 000 000 tons of mining waste was produced in 2007.

It must be noted the Waste Act defines waste as follows:

"any substance, whether or not that substance can be reduced, re-used, recycled and recovered:
(d) that is identified as waste by the Minister by notice in the Gazette and includes waste generated by the mining, medical or other sector"

However, Section 4(1) states that:

This Act does not apply to (b) residue deposits and residue stockpiles that are regulated under the Mineral and Petroleum Resources Development Act 2002 (Act No. 28 of 2002).

In terms of the above, the 510 million tons per year (2007) does not constitute waste in terms of the Waste Act, but other waste generated during mining and processing that is not a "residue deposit" or "residue stockpile". The quantities and types of waste generated in the mining sector are not known.

Mine dumps are, however, of major concern due to their significant impact on the environment, due to their massive extent and the chemical constituents of rainfall and seepage from them.

Issues:

- All mines are waste generators, and should register and report regularly to the NWIS.
- Consideration should be given to undertaking industry waste management plans for mining, particularly where hazardous wastes are generated.
- More consistent application of environmental legislation and enforcement is needed to address the impacts of mining residue deposits or residue stockpiles. Consideration should be given to include these as waste.

3.4.2 Power-station Wastes

Eskom's audited quantity of ash produced for 2007 was 34,16 million tons. Of this amount 2,16 million tons was sold for recycling, representing a recycle rate of 6,32%. The balance of the ash, 32,0 million tons, is transported to ash facilities situated close to each coal fired power station.

Almost 90% of the ash produced in the generation process is called fly ash or pulverised fuel ash. The reason for this is that the coal is pulverised into a very fine dust before being fed into the boilers to ensure efficient combustion. Larger particles of ash, called coarse ash, which make up the rest of the ash produced at the power station, drop down the furnace and collect at the bottom in the ash hopper of the boiler. The fly ash is removed from the flue gas stream by means of electrostatic precipitators or bag filter systems.

The majority of this ash is transported hydraulically through pipelines, with the water being recovered in recovery dams for re – use in the ash handling system. A few of the coal fired power stations use dry ash conveyors for transport to the ash facilities.

The ash consists of very fine, spherical particles and has an almost zero carbon content, high pozzolanic activity (or reactivity), and unusually high consistency. Fly ash is successfully used to enhance the quality and economy of concrete. The ash sold for recycling mostly goes to the cement industry where it is used as a cement extender while a very small portion goes to brick making. The amount used for recycling could grow significantly, however the, cost of transport of ash is an issue.

An example of the beneficial use of ash as a cement extender was the export of approximately 250 000 tons of ash from the Lethabo Power Station for use in the construction of the Katse Dam in Lesotho.

All power stations have a program in place for the rehabilitation and maintenance of ash disposal sites.

The quantity of ash produced is likely to increase by approximately 5,3 million tons per year in 2012 when an additional 4800 MW coal fired power station is commissioned, and a further additional 5,3 million tons per year in 2013 as a second new power station is commissioned. (Eskom Annual Report (2002), www.eskom.co.za)

3.5 Agricultural Wastes

An area of concern in the agricultural industry is the issue of obsolete or expired pesticides, normally stored on farms, distributors, warehouses etc. Pesticides include herbicides, insecticides, fungicides, seed treatments and plant growth regulators.

The total market for agricultural pesticides in 2008 was approximately 49 970 tons. This represents the total amount of product, not the total amount of the active ingredients. It must be noted that the vast majority of these are consumed through use.

South Africa and six other African countries form part of Project 1 of the Africa Stockpiles Programme (ASP), formed to address the accumulation of obsolete pesticide stockpiles in Africa. As very little was known on the extent of the problem in South Africa, a pilot project was launched to locate and collect obsolete pesticides in Limpopo Province. As much as 80 tons of obsolete pesticides were collected in Limpopo Province, leading to estimates of approximately 700 tons being stockpiled throughout South Africa.

Due to their toxicity, potential to pollute and threat to human health, obsolete pesticides are considered hazardous and must be transported, treated and disposed of accordingly.

Based on the experience obtained during the Limpopo Province pilot project, the programme is being rolled out in two further provinces.

Issues:

- The classification of obsolete and waste pesticides must form part of the Review of the Hazardous Waste Classification System.
- The relatively small quantities (in waste management terms) involved make the location, collection and transport of such wastes time consuming and expensive.
- Acceptable methods of treatment, destruction and/or disposal must be determined.

3.6 Health Care Wastes

3.6.1 Background

A survey in 2005 on Health Care Risk Waste (HCRW) indicated that available HCRW treatment capacity exceeded generation by 35%. The criteria used at the time was that the HCRW treatment facility had to be permitted under the old Air Pollution Prevention Act.

Since then the new Air Quality Management Act has been promulgated. Industry attention on generation, transport and treatment/disposal issues resulted in the regulating authorities commissioning a comprehensive "Survey of Generation Rates, Treatment Capacities and Minimal Costs of Health Care Waste in the 9 Provinces of RSA" (Kobus Otto and Associates in association with John Clements, January 2008). This survey is summarised in the following sections.

It must be noted that by the time of the survey all 9 provinces had outsourced all, or significant portions, of their Health Care Risk Waste Management services to private organisations. Typically these specialist organisations provide a system of disposal containers, collection, transport, treatment and disposal.

3.6.2 Health Care Waste (HCW) Categories

The health care waste stream consists of:

- Health Care General Waste (HCGW)
- Health Care Risk Waste (HCRW)
- Health Care General and Health Care Risk Liquid Waste

HCGW is the non hazardous component similar to domestic and commercial wastes, primarily consisting of:

- Packaging materials
- Kitchen wastes
- Office wastes
- Solid wastes from patient wards (non hazardous – similar to domestic waste)
- Non-infectious animal bedding
- Garden waste

It must be noted that all HCW generated in Isolation and Tuberculosis wards is to be treated as HCRW.

HCRW represent the hazardous component and is generated at small and large health care facilities. HCRW primarily consists of:

- Infectious waste
- Sharps – any needles and sharp objects
- Pathological waste
- Chemical waste – discharged chemicals and pharmaceuticals
- Radio-active waste.

The safe management of radio-active heath care wastes is the responsibility of the Directorate of Health Technology, Department of Health, and not considered further.

Liquid HCW falls into three major categories:

- Infectious and possibly infectious waste
- Effluents that are possibly chemically hazardous
- Radio-active waste (see above).

3.6.3 HCW Generators

The primary sources of HCW are hospitals, clinics, blood transfusion services and laboratories, and small sources are general practitioners, dentists, vets etc. Old age homes, beauty clinics, tattoo artists, residential properties etc. may also generate limited quantities of HCW. Major generators usually generate all categories of HCW, whilst smaller generators may only generate some categories of HCW.

Previous surveys have indicated that 10% of HCRW generators (hospitals, clinics etc.) generate approximately 90% of the HCRW stream, while the minor HCRW generators (laboratories, pharmaceutical industry, healthcare practitioners, vets etc.) make up 90% of generators and account for approximately 10% of HCRW.

However, the HCRW from minor generators may still cause significant risk as these wastes are often poorly managed and disposed of into the domestic waste stream. With such a large number of small HCRW generators it is difficult to register and monitor them.

3.6.4 HCW Generation

3.6.4.1 HCGW

General wastes generated at health care facilities are usually disposed of into the domestic/commercial waste stream, hence are incorporated into the waste quantities reported in Section 3.1.

3.6.4.2 HCRW

It is estimated that approximately 42 200 tons of HCRW were generated in South Africa in 2007.

Table 17: HCRW Generation 2007

Province	***HCRW Generation 2007 (t)***
Eastern Cape	*4 500*
Free State	*1 900*
Gauteng	*9 900*
KwaZulu Natal	*7 980*
Limpopo	*2 150*
Mpumalanga	*1 840*
Northern Cape	*2 210*
North West	*1 820*
Western Cape	*5 050*
(Mining Hospitals)	*1 680*
Small Generators	*3 122*
TOTAL (rounded up)	***42 200***

The breakdown in estimated HCRW generation per province is of importance when comparing with treatment capacities in the various provinces, and the resulting collection and transportation issues.

3.6.4.3 HC Liquid Wastes

Generally these are discharged into the sewer, with small quantities of specific HCRW liquid effluents separated for inclusion in HCRW reported in Section 3.6.4.2.

3.6.5 HCRW Treatment/Disposal

Generally HCRW are treated in thermal processes (incineration and non-burn technologies) rendering the residual insert and suitable for disposal. Specifically pathological waste (parts that are removed from a body) must be incinerated at a facility with air emission controls.

The following table represents the current operational capacity of commercial facilities in South Africa.

Table 18: HCRW Treatment Capacity Commercial Facilities (January 2008)

Province	Incineration			*Non-burn technologies*			
	No air emission control – capacity available Jan. 2008	**With air emission control – capacity available Jan. 2008**	**New capacity coming on stream – within 1 year**	**Capacity available Jan. 2008**	**Current through-put**	**New capacity coming on stream – within 1 year**	***Total capacity – Jan. 2008***
Eastern Cape	1,560		3,740			3,650	*1,560*
Free State	1,680					4,830	*1,680*
Gauteng	6,640	5,770	6,810			29,200	*12,410*
KwaZulu Natal				11,520	10,310	1,640	*11,520*
Limpopo							*0*
Mpumalanga							*0*
Northern Cape							*0*
North West	7,480		3,740				*7,480*
Western Cape	3,300		1,170	14,400	2,640		*17,700*
Grand Totals	***20,660***	***5,770***	***15,460***	***25,920***	***12,950***	***39,320***	***52,350***

The table indicates that the current capacity of "acceptable" commercial facilities (ie. incineration with air emission control plus non-burn technologies) is 31 690 tons per year. The current capacity of incineration with no air emission control is an additional 20 660 tons per year.

The reported total current throughput is 32 450 tons per year (2007). With current (2007) HCRW generation estimated at 42 200 tons per year, it is estimated that up to 5 130 tons per year of HCRW is being treated "on site" at public health-care facilities. This leaves a balance of approximately 4 620 tons per year either being treated on-site or disposed of in an unspecified manner.

It is reported that new treatment capacity of up to 36 860 tons per year is already in place and due to be commissioned (2008), and 6 640 tons per year of incineration with no air emission control is to be decommissioned. A further 17 920 tons per year capacity is planned to be installed in the following 2-3 years.

3.6.6 Collection/Transport

Collection and transport to treatment facilities has effectively been outsourced to private contractors. As can be seen from the imbalance of HCRW generation and treatment capacities in each of the provinces, HCRW are often transported long distances across South Africa.

The transport and treatment situation has become complex, resulting in the following issues:-

- HCRW are often not treated in the nearest facility, but rather at a facility belonging to the holder of the removal contract. This results in the HCRW often being transported long distances, and frequently across provincial boundaries.
- The lack of treatment capacity in many of the provinces results in the transport of HCRW long distances to appropriate facilities.

3.6.7 Issues

Pertinent issues are briefly summarised as follows:-

- There is a lack of uniform standards for HCRW on a national level, along with a lack communication and co-ordination at national, provincial and local government levels.
- There is a lack of capacity throughout the sector, from effective enforcement, skills within the departments outsourcing the services, and skills in the health departments requiring the services.
- Lack of awareness of HCRW generators of the risks associated with HCRW management.
- Fierce competition between service providers often results in inefficient use of resources, and long transport distances and associated risks.
- Lack of appropriate HCRW treatment facilities in many provinces.
- Lack of appropriate and readily accessible treated HCRW residues disposal facilities.
- Lack of appropriate and financially viable HCRW management systems for rural communities and minor HCRW generators in rural and urban areas.
- Registration with, and reporting of, HCW with the NWIS must be enforced.

3.7 Illegal Dumping/Disposal

Little information appears to be available on quantities of waste being illegally dumped or disposed of, and various attempts by the author to model illegal dumping in the domestic and business waste stream have not resulted in any meaningful data. However, visual and anecdotal evidence suggests that illegal dumping and disposal is highly significant, and results in significant impacts on human health and environment.

There are a number of aspects that result in illegal dumping:

- The lack of an effective waste collection service results in the accumulation of waste in convenient or “out-of-site” locations. This is mostly evident in informal urban and peri-urban areas with nonexistent or erratic service levels, resulting in significant impacts.
- Perceived high cost of collection and/or disposal resulting in engaging a low cost “unscrupulous” collection contractor who illegally dumps the waste or the waste generator transports and illegally dumps waste.
- The illegal dumping of hazardous wastes and health care risk wastes does occur, again as a result of perceived high cost of transport and proper treatment or disposal. The illegal dumping of such wastes occurs both in “vacant” land and in inappropriate unlicensed dump sites and landfills. The impacts on human health and the environment of such illegal dumping may be significant.

- Technically the disposal of waste in any unlicensed facility is illegal, and represents a significant challenge for authorities. Generally unlicensed facilities are not designed, constructed or operated in accordance with the "Minimum Requirements" and result in significant impacts.

The issue of illegal dumping needs to be addressed at all levels of waste management. Methods used should consist of both education and enforcement.

Education could consist of national campaigns publicising the effects of all forms of illegal dumping, possibly co-ordinated with waste minimisation campaigns. At local levels such educational campaigns should be allied to local contact details of enforcement agencies, and procedures to be followed.

Enforcement entails ensuring that a consistent approach by legislation, regulation and municipal by-laws ensures an adequate deterrent to illegal dumping, and in particular of hazardous wastes and health care risk waste. Larger towns, cities and metropolitan areas should form focussed task units to investigate and prosecute illegal dumping offenders.

A waste manifest system that should be incorporated into the SA WIS or provincial WIS' should provide an audit trail of waste generated, through transport to re-use, recycling and/or disposal.

4 National Waste Information System (NWIS)

4.1 Introduction

Pollution is often described as the introduction of a substance, where by a property of which results in direct harmful effects on humanity or the environment. This is most often the result of a lack of effective waste management.

The Bill of Rights (Chapter 2 of the Constitution, Act 108 of 1996) guarantees the people of South Africa the right to an environment not detrimental to human health or well being, and to protect the environment for the benefit of present and future generations. With the shift in national policy towards pollution prevention and waste minimisation, it is crucial that a reliable database is established and maintained on the generation of waste through to its ultimate re-use or disposal.

This information is critical to the management of waste and minimising its impact on the environment. It should by implication track waste from generation through to its ultimate state to ensure that it is not inappropriately handled or disposed of, such that it causes pollution. Such information would also be invaluable to assist in planning and implementing appropriate waste management strategies, co-ordinating efficient minimisation, re-use and recycling initiatives and managing the monitoring of compliance and enforcement.

Chapter 6 of the Waste Act, 2008, requires that the Minister must establish a national waste information system (NWIS) for the recording, collection, management and analysis of data and information. The objectives of the NWIS are to:

- Store, verify, analyse, evaluate and provide data for the protection of the environment and management of waste;

- Provide, information for the development of any required IWMP; and
- Provide information to organs of state and the public.

The need for a NWIS was recognised in the 1999 NWMS, since then the Department of Environmental Affairs and Tourism spent considerable time and resources in the development of such a system.

Similarly, the Gauteng Department of Agriculture, Conservation and Environment also developed a provincial WIS. The Western Cape has developed an Integrated Pollutant and Waste Information System.

4.2 Requirements of the NWIS

4.2.1 The Waste Act

Chapter 5: Licensing of Waste Management Activities

The Waste Act requires that waste management activities as detailed in Schedule 1 of the Waste Act must be licensed. These are summarised as follows:

- Storage and transfer of waste
- Recycling and recovery of waste
- Treatment of waste
- Disposal of waste on land
- Storage, treatment and processing of animal waste
- The expansion of decommissioning of such facilities included above.

Chapter 6: Waste Information

The Waste Act requires that the NWIS must include data on the quantity of waste generated, stored, transported, treated, transformed, reduced, re-used, recycled, recovered, disposed of, and the type or classification of waste. The NWMS must also include a register of: licensed waste management activities, the holders of the waste management licenses, and the locations of the licensed waste management activities.

The NWIS may include information on:

- the levels and extent of waste management activities provided by municipalities
- information on compliance of the Waste Act
- any other information necessary for the effective administration of the Waste Act.

Chapter 6, section 60 (3) allows the NWIS to be implemented incrementally, and does not stipulate any time limits.

4.2.2 Draft Waste Information Regulations

Draft Waste Information Regulations were published for comment in Government Gazette No 32220 of 8 May 2009. The draft regulations give effect to section 60 of the Waste Act, and regulates:-

- The procedures for registration
- The submission and process of the required information
- Any other matters.

The waste management activities that are required to be registered in terms of the draft regulation are included in Annexure 1 of the draft regulations, and are summarised as follows:-

- Waste disposal facilities receiving more than 150 tons per day of general waste (i.e. Medium landfills)
- Waste disposal facilities receiving hazardous waste
- Recycling facilities handling general wastes (paper, plastic, glass, cans, tyres and scrap metal), electronic waste or used oil
- Facilities treating general or hazardous waste
- Any exportation or importation of hazardous wastes
- Recovery of energy from waste

Of pertinence in the draft regulations is that a registered person may submit the required information that is based on estimations of weight for a period of 2 years from the date of the regulations, but thereafter must be based on actual weight.

4.3 The Existing South African Waste Information System (SA WIS)

4.3.1 Evaluation in terms of the Waste Act

Members of the authorities administering the current SA WIS were interviewed to determine its effectiveness in meeting the requirements of Chapter 6 of the Waste Act.

The SA WIS was developed and ready for pilot implementation in 2006. By necessity it was initially developed to register waste generators and to record waste generated and disposed of per classification. However, it was designed such that it could be expanded in future to add the registration and reporting of the waste management actions listed in the Waste Act.

The SA WIS was implemented in Mpumalanga and the Eastern Cape and 3 municipalities – Mbombela Local Municipality, Buffalo City Municipality and Nelson Mandela Metropolitan Municipality as a pilot project in 2006. A comprehensive Pilot Project Review was undertaken which identified issues and shortcomings. The project was subsequently rolled out to KwaZulu Natal, North West Province and Free State in 2007/08. Gauteng and Western Province were in the process of developing their own provincial waste information systems.

Currently only 133 waste management facilities are registered with the SA WIS, and although most initially reported regularly, reporting has diminished during 2007-2008. This reflects the current “voluntary” nature of registration with, and reporting to the NWIS. This urgently needs to be addressed by finalising, promulgating and implementing the Draft Waste Information Regulations.

The current SA WIS meets the requirements of Chapter 6 of the Waste Act in the following respects:-

- It allows for the registration of licensed waste management activities, including details of the holders of the license and the location of the licensed waste management activity.
- It enables the recording, collection, management and analysis of data and information of:-

    - quantity of waste generated
    - type of classifications of waste
    - quantity of waste disposed

The current SA WIS does not at this time, meet the requirement of the Waste Act in the following respects: the recording, collection, management and analyses of data and information of quantities of waste: stored, transported, treated, transformed, reduced, re-used, recycled or recovered.

It is evident, however, that the SA WIS has been designed such that it can be incrementally expanded to included the above data and information, and in this sense it does comply with Chapter 6 of the Waste Act. Further, it is evident that the SA WIS may be adapted to include information on the level of services provided by municipalities and information on compliance with the Waste Act.

At present it is apparent that the SA WIS only contains a register of those activities registered with the SA WIS and does not include a register of waste management activities that have been licensed, as required in terms of Section 60(b) of the Waste Act. Currently one may access a spreadsheet of licensed waste management facilities on the South Africa Waste Information Centre website (www.sawic.org.za).

While it may be argued that in a sense this does comply with the requirements of Section 60(b) of the Waste Act, it is certainly not integrated into the SA WIS. It is recommended that the NWIS be upgraded such that this information is contained in one database and is consistent for the purposes of waste management under the Waste Act. The possible integration as recommended would result in three scenarios:-

Existing licensed waste management facilities:-
As the Department already has all the required details in the relevant license applications, the Department should enter all the details required to register with the SA WIS, and notify the license holder accordingly (ie. licensed facilities are automatically registered and then need to report).

New waste management license applications:-
At present all the information required for registration forms part of the information required for the license application. In order to decrease the bureaucracy involved, it is evident that applicants for waste management licenses should not also have to separately submit the same registration information for the SA WIS (different Directorates of the same Department.) The registration process should be integrated into the licensing process as the first step of the process. It is further recommended that applicants be registered and be compelled to commence reporting even before a license may be issued.

Existing waste management facilities requiring licensing:-
There are a significant number of waste management facilities currently operating without a license, but are required to be licensed in terms of the Waste Act, and also will be required to register with the SA WIS. In these instances enforcement of registration with the SA WIS in terms of the Waste Information Regulations should be regarded as a first step in the licensing process.

It is further considered necessary that the SA WIS be able to report on ongoing compliance with license conditions, reporting requirements etc. for purposes of enforcement.

4.3.2 Evaluation in terms of the Draft Waste Information Regulations

At present the current SA WIS allows for the registration and recording of waste type of classification, quantity generated and disposed. The draft regulations contemplate this being extended to:-

- Recycling facilities for the following waste types; paper, plastic, glass; cans; tyres and scrap metal;
- Facilities treating general or hazardous waste;
- Importation and exportation of hazardous waste; and
- Recovery of energy from waste.

The current SA WIS would need to be expanded to register, store analyse etc the above data. However, it is evident that the system was designed with such expansions in mind, such that the system maybe implemented incrementally in terms of the Waste Act.

4.3.3 Assessment

It is evident from this assessment of the current SA WIS, that the system, if continually developed as planned, could meet the requirements of Chapter 6 of the Waste Act. The then DEAT undertook a comprehensive review of the Pilot Project, identified issues, made recommendations and implemented these where possible in the roll out to other provinces, and much valuable “start up” experience has already been gained.

The NWIS needs expansion as noted above to include for registration and reporting of waste management activities contemplated in the Draft Waste Information Regulation.

In terms of reporting, there are basically three levels of access to information contained in the NWIS:

- Registered waste management activities: - these have access to summaries of their own data submitted and can generate various reports;
- The general public:- have limited access and are able to generate reports of a general nature, eg. total waste of different classification disposed in a certain time period. The public is not able to access data submitted by a particular entity eg. a specific private company generating hazardous waste.

- The provincial and national waste management authorities:- the relevant provincial official(s) has full access to all data submitted in their province, and the relevant national official(s) has full access.

This reporting system is considered adequate for the management of waste at local and district municipal levels, but could be expanded to allowing municipalities to generate reporting on all registered waste management activities within their area, and reporting on compliance with their license and reporting conditions.

It is noted that tonnages of certain wastes generated etc. may be confidential.

Reporting requirements for provincial and national level are also adequate as these departments have full access to the SA WIS. However, in order for the SA WIS to start fulfilling its vital role in waste management the regulations requiring registration and reporting need to be promulgated, implemented and enforced.

The methodology adopted for the flow of data into the SA WIS is that data submitted to the SA WIS by registered entities has to be "verified" by the provincial department before acceptance by the SA WIS. Once the Waste Information Regulations are in effect, it is expected that registration of activities and data submission verification will require significant increase in capacity at provincial and national levels. Identifying, recruiting, training and retaining of such key staff is seen as a significant challenge into the future, and is crucial to the full implementation of the SA WIS.

4.4 Provincial WIS

4.4.1 Alignment of Provincial and National WIS

The Waste Act (Section 62) allows a MEC to establish a provincial waste information system, but requires that it must at least include the information required by the SA WIS. It further allows the Minister to exempt persons who must supply information to a provincial waste information system from supplying the same information to the SA WIS.

In effect it appears that the approach to be adopted by the national authorities is that if a provincial waste information system exists, then the provincial system must report to the SA WIS. It is not clear what level of detail is to be reported to the SA WIS, but it is evident that the national authorities must have full access to the provincial waste information systems in detail.

4.4.2 Gauteng (GWIS)

The Gauteng Waste Information System (GWIS) has been in existence for 5 years, since the publishing of the GWIS regulations in 2004. An official of GDACE completed a questionnaire regarding the GWIS, and its findings are summarised below:

- The system allows for the registration of waste generators, transporters, recyclers, treatment facilities, and landfills. The registration information required is in accordance with the Waste Act.

- The system records the amount of waste transported, re-used / recycled and disposed of.
- It allows for the distinction between categories of waste ie. general, industrial and commercial, hazardous and HCRW.
- Under recycling it records different materials – paper, plastic, glass, cans scrap metal, tyres, electronic waste and used oil.
- It records hazardous wastes imported and exported.

Approximately 346 facilities are currently registered as follows;

- generators 226
- transporters 53
- recyclers 23
- treatment facilities 8
- landfills 36

It is estimated 45% of these regularly submit the required information. From the above it is evident that the GWIS is more advanced that the SA WIS in many respects, and has been aligned with the requirements of Section 60 of the Waste Act.

Meetings have been held between the Department of Environmental Affairs and GDACE regarding alignment of GWIS with the NWIS, and as a result GWIS is already being upgraded accordingly.

4.4.3 The Western Cape Integrated Pollutant and Waste Information System (IPWIS)

It is apparent that the Western Cape Department of Environmental Affairs and Development Planning undertook the development of the Integrated Pollutant and Waste Information System (IPWIS) in response to the NWMS (1999). As such it appears that the IPWIS not only includes for the registration of waste management activities but also includes for the reporting on priority pollutants. The IPWIS is still under development.

A meeting has been held between officials on aligning the IPWIS with the SA WIS. The Western Cape Department of Environmental Affairs and Development Planning has indicated that IPWIS is being developed to align with SA WIS, and will be ready by the time the Waste Information Regulations are in effect.

4.5 Issues

The following issues and challenges were identified:-

- The current SA WIS was initially developed to measure “end of pipe” wastes first, but planned with the future expansion of the system to include treatment, recycling, re-use, transport etc. With the publication of the Draft Waste Information Regulations, the requirements to report on the activities contemplated require the system to be upgraded in readiness for promulgation of the regulations. Consideration should be given to expanding the regulation to include the registration and reporting for transport of wastes at the same time.
- The SA WIS has been in existence since 2006, and experience has been gained in the operation of the system. As there is a critical need for the information that

should be available from the SA WIS, the finalisation, promulgation and implementation of the Draft Waste Information Regulations should be prioritised.

- Capacity needs to be developed and retained at provincial and national level to ensure the efficient and rapid implementation of the SA WIS on a national basis.
- Challenges identified by the operation of the SA WIS so far:-

    - Many landfills receiving more than 150 tons waste per day do not have weighbridges, hence data is at best an estimation.
    - Staff capacity, both of the entities required to register as well as for the authorities, training and staff turnover.
    - Many smaller municipalities do not have a reliable (or any) access to the internet. (The draft regulations allow for submissions to be effected by facsimile).
    - Adequate institutional capacity and budget to comply with the legislation.

Key recommendations are as follows:

- The Draft Waste Information Regulations must be finalised, promulgated and implemented as a priority.
- The development of the SA WIS must be accelerated to include all the waste activities, and regulations amended/updated accordingly within a 3 year period.
- Capacity to operate and maintain the SA WIS must be developed and maintained at provincial and national levels, so that the significant increase in registration and reporting resulting from the Waste Information Regulations will be accommodated.

5 Significant Issues

The following are significant issues and challenges arising from the National Waste Balance and assessment of the South African Waste Information System.

- The major cross-cutting issue arising is the lack of reliable waste management data in virtually all areas of waste management. The lack of data makes identification and prioritisation of problem areas particularly difficult, and generally hampers proper planning of strategic interventions etc. The implementation of the Waste Information Regulations should be prioritised so that a meaningful national database can be established accordingly.

- Although the future focus of waste management is to significantly reduce waste disposal to landfill, properly planned, constructed, operated and maintained landfills will still be required for the foreseeable future. The high cost of providing and operating licensed landfills is beyond the financial capabilities of many municipalities.

- Although most large landfills and many medium landfills have weighbridges, a significant number of landfills do not have weighbridges, and budgetary constraints may prohibit their installation. A consistent methodology for measuring waste

disposed must be developed for landfill sites not equipped with weighbridges, such that reliable data is generated.

- The information and activities of the various associations promoting and supporting recycling initiatives is encouraging, and significant results are already being achieved in some sectors. The implications of further possible regulatory, economic instruments or extended producer responsibility need to be considered carefully before implementation.

- Provincial integrated hazardous waste management plans need to be compiled or updated for all provinces. The hazardous waste classification review needs to be finalised, and industrial hazardous waste generators identified and prioritised in terms of the requirement to compile industry specific IHWMPs. Such planning will guide the requirement for further hazardous waste treatment or disposal facilities, and highlight opportunities to reduce, reuse and recycle hazardous waste.

- Although the Tyre Regulations are in effect, recycling plants and markets for recycled materials need to be established throughout South Africa.

- Significant quantities of construction and demolition waste is illegally dumped in South Africa. Consideration must be given to measures to curb this through re-use and recycling, along with effective enforcement of legislation.

- By far the largest generators of "waste" is the mining sector, but at present these fall outside the Waste Act and are regulated under the Mineral and Petroleum Resources Development Act. Due to the significant impacts these residue deposits or residue stockpiles have on the environment, and the issue that most of these residues are not inert, consideration should be given to reclassifying them as waste in terms of the Waste Act.

- There is a lack of uniform standards for regulating and managing health care risk waste (HCRW) on a national level along with a lack of communication and co-ordination at national, provincial and local government levels. Lack of specialist waste management capacity exists throughout the health sector, from the departments requiring the services to those either undertaking the HCRW services or specifying the outsourcing of the services to private contractors. This has resulted in occurrences of HCRW being inadequately handled, transported, treated or disposed of.

- Illegal dumping must be addressed through a co-ordinated education and enforcement program.

6 Recommendations

It is clear that the NWMS needs to address all aspects of waste management, particularly with the Waste Act's focus on waste minimisation through reduction, re-use, recycling and recovery. In terms of the National Waste Quantification the following recommendations are

critical to reduce the impacts of waste on the social, economic, biophysical and cultural environment.

It is a common element of researching the current National Waste Quantification that, with the possible exception of the packaging industry, the lack of reliable, accurate waste management data has hampered effective planning and implementation of waste management strategies. The key outcome therefore, is that it is imperative that the regulations contemplated by the Draft Waste Information Regulations be finalised, promulgated and implemented as a priority. An effective, functioning National Waste Information System will enable informed decision making regarding suitable waste management strategies in key waste sectors, and enable measurement of effectiveness and efficiency of policy and regulation into the future.

Effective mechanisms must be established to promote, develop and maintain waste management capacity at all levels of government. This should include education on the importance of effective waste management with key decision makers to elevate its status with respect to allocation of sufficient resources to comply with waste management legislation and policy. Consideration must be given to budgetary support mechanisms for poorer municipalities to achieve waste management objectives.

Although the emphasis is towards waste minimisation, the role of landfills in waste disposal will remain critical for the foreseeable future. The six metropolitan areas operate licensed landfills, but nearly 200 landfills owned and operated by municipalities are not licensed. It is expected that most of these, plus many of the licensed landfills do not meet the “Minimum Requirements”. This represents a significant risk of impact on the environment. Municipalities must prioritise upgrading, closing (if required) or developing new landfills in accordance with the “Minimum Requirements”, with the objective of each municipality having access to a licensed landfill, developed and operated to an acceptable standard.

Industry waste management plans are considered crucial in focussing industrial sectors efforts in finding common effective and economic solutions to industrial waste management. These plans should focus on waste minimisation actions, but also address disposal issues.

A particularly important aspect of these industry waste management plans is the elimination, reduction, re-use, recycling recovery, treatment and disposal of hazardous wastes. Aligned with this is the current review of the hazardous waste classification system which needs to be finalised and implemented as soon as practically possible.

Significant progress appears to have been made by the private sector, in some instances in conjunction with the public sector (e.g. municipality supported buy back centres).

In particular, initiatives by the packaging industry and the oil industry appear to be established and driven by economic considerations. Initiatives in the e-waste, tyres, batteries and fluorescent lamps sectors have commenced, or are being implemented. The consideration, co-ordination and implementation of any systems to support recycling initiatives, be they regulatory, target setting, economic instruments, producer responsibility and/or consumer awareness programmes, need to be very carefully considered to ensure the desired objective is achieved.

References

Buyisa-e-Bag 2006, Survey of the South African Plastics Recycling Industry in 2005, December 2006.

DACE (NWP) 2006, Development of a Hazardous Waste Management Plan for North West Province, October 2006.

DEADP 2006, Hazardous Waste Management Plan for the Western Cape Province, December 2006

DEAT 2006a, A Strategic Framework for Sustainable Development in South Africa, Draft for Public Comment, September 2006.

DEAT 2006b, National Framework Guidelines for Integrated Waste Management Planning, May 2006.

DEAT (2007), Assessment of the Status of Waste Service Delivery and Capacity at Local Government Level. Directorate: General Waste Management, August 2007, Draft 3.

DEAT (2008), National Policy on High Temperature Thermal Waste Treatment and Cement Kiln Alternative Fuel Use, COWI, March 2008

DWAF 2001a, Water Quality Management Series: Situation Analysis on Baseline Studies Regarding Waste Management in South Africa, First Edition 2001.

DWAF 2001b, Water Quality Management Series: Disposal Sites for Hazardous and General Waste in South Africa, First Edition 2001.

DWAF 2001c, Water Quality Management Series: Waste Generation in South Africa, First Edition 2001.
DWAF 2005, Minimum Requirements for Waste Disposal by Landfill, Draft 3rd Edition September 2005.

DWAF 2006, Guidelines for the Utilisation and Disposal of Wastewater Sludge Volumes 1 to 5, WRC Report No. TT261/06, March 2006.

Environmental Management, January/February 2009, UniRoss Environmental Impact Comparing Disposable with Rechargeable Batteries.

eWASA 2008, e-Waste Assessment South Africa, November 2008

GDACE 2008, First Generation Integrated Hazardous Waste Management Plan for Gauteng, Draft Final Report for Comment, October 2008.

Macozoma DS 2006, Developing a Self-sustaining Secondary Construction Materials Market in South Africa.

Otto, K and Clements, J 2008, Survey of Generation Rates, Treatment Capacities and Minimum Costs of Health Care Waste in the 9 Provinces of RSA, January 2008.

SATRP 2009, Integrated Industry Waste Tyre Management Plan, May 2009.

WRC, An Evaluation of Dedicated Land Disposal Practices for Sewage Sludge.