Sub-sectoral Environmental Guidelines HEALTH SERVICES AND CLINICAL WASTE DISPOSAL

PROCESS DESCRIPTION

The activities considered in this guidance note are the management and disposal of clinical waste (health care risk waste) from hospitals, clinics and other health care premises. This note does not consider the management and disposal of non-clinical waste, ie domestic-type waste, which also arises at these premises, other than the interaction between clinical and non-clinical wastes within segregation practices.

Clinical waste can arise wherever a patient treatment or nursing activity is carried out which produces:

- a waste which consists wholly or partly of human or animal tissue, blood or other body fluids, excretions, drugs or other pharmaceutical products, swabs or dressings, or syringes, needles or sharp instruments, which unless rendered safe may prove hazardous to any person coming into contact with it;
- any other waste arising from medical, nursing, dental, veterinary, pharmaceutical or similar practice, investigation, treatment, care, teaching or research, or the collection of blood for transfusion, which may cause infection to any person coming into contact with it.

The principle sources of clinical waste are hospitals and clinics, particularly those providing acute services, ie offering Operating Theatres, Maternity, Accident & Emergency, Mortuary, Intensive Care, Isolation Wards, cancer treatment facilities (Chemotherapy), Pharmacy, Pathology Laboratories and other research facilities.

Other, secondary sources of clinical waste are ambulance services, public health laboratories, blood donation centres and blood banks, doctors, dentists, veterinary surgeons, immunisation/vaccination clinics and hospitals, clinics and nursing homes providing community care, care of the elderly and services related to mental health and learning disabilities.

It should also be noted that clinical wastes may be generated by private, commercial activities involving cosmetic and medical treatments, including tattooists, acupuncturists, chiropodists, etc, and funeral homes.

Clinical Waste Management

Clinical waste has the potential to cause harm to individuals and offense to the senses. The major risks and liabilities which may arise from clinical waste are as follows:

Harm to individuals (workers, patients, visitors or the general public): The potential for harm arises from the following:

- injuries and wounds from sharp materials contained in the waste, such as hypodermic needles, broken glass, etc;
- cross-infection from contaminated waste materials, particularly those containing blood, tissue or other body fluids (often associated with injuries or wounds, eg from contaminated hypodermic needles);
- intake and poisoning by drugs and other pharmaceutical contained in waste;
- exposure to radiation where nuclear medicine is carried out (ie where low level radioactive substances are used for medical investigations or larger radiation sources are employed for the treatment of cancer);
- encouragement of vermin, such as rats, flies and birds, and associated transmission of disease by these vectors;
- cross-infection from contaminated waste materials which are deliberately scavenged either for reuse as a means of income generation, eg recyclable materials, or deliberate illegal use, eg hypodermic needles for illegal drug-taking (which are often later discarded in places accessible to the public and represent a public health risk).

Offense: The potential for offense to the senses arises from the following:

- odour, especially due to the decomposition of biological materials during prolonged waste storage;
- litter from waste spillages;
- unpleasant visual appearance, particularly of blood, tissue and body fluids, which can be visible in open bags, through the sides of bags or in the event of spillages.

These risks/liabilities occur during the handling, collection, storage, transport and disposal of wastes at waste producers and during transportation to the treatment/disposal site.

Clinical Waste Treatment and Disposal

Treatment/Disposal Options

The technologies for clinical waste treatment which have been established and proven at a commercial scale are as follows:

- incineration (all clinical wastes);
- pyrolysis and gasification (all clinical wastes);
- steam sterilisation/autoclaving (excluding wastes containing large items of human tissue);
- microwaving (excluding human tissue, pathology/laboratory wastes, radioactive wastes and metallic items);

- gas sterilisation (applied to specialist reusable medical equipment only);
- discharge to sewer (applied to liquid wastes only).

It should be noted that other technologies which are promoted for clinical waste treatment, but which have not been proven on a commercial scale at this time, are chemical disinfection, electron beam treatment and irradiation.
Landfilling is a necessary final component of the disposal of clinical waste, to dispose of the residues and/or remaining waste materials resulting from the treatment processes indicated above, eg for disposal of ash from incineration. Although landfilling may be used as an interim measure for direct disposal of clinical waste under exceptional circumstances and with the application of special controls, and it is currently used in many developing countries where modern alternative technologies are inappropriate or impractical, it is not recommended for direct disposal of clinical wastes. In particular, waste containing human tissue or infectious material is unsuitable for direct landfilling.
Currently, incineration is the most widely applied treatment method for clinical waste and is generally accepted as the preferred method of treatment of all categories of clinical waste. It represents the **only** proven treatment method which results in the destruction of human tissue, infectious material, sharps (hypodermic needles, etc) and pharmaceutical wastes.

Clinical Waste Incineration

To ensure that all potentially infectious material is destroyed and that all the waste is completely burnt-out, a purpose-built and specially designed incinerator is required which operates to standards higher than those applied to incinerators burning non-clinical, domestic-type wastes.
Alternatively, clinical wastes may be burnt in a hazardous waste incinerator or, after pretreatment (such as by steam sterilisation), in a municipal waste incinerator. In both cases, special controls need to be adopted to ensure safety during the handling, feed and co-incineration of the clinical waste, due to its different characteristics compared to hazardous or municipal wastes.
The major environmental risks/liabilities of clinical waste incineration are as follows:

- General operations: An incineration plant handling clinical waste will normally require a permit covering its operation as a waste treatment facility. The permit may specify the types and quantities of wastes which are acceptable and the required provisions for waste handling, storage, operational management and monitoring. It is illegal to operate an incinerator without a permit or to contravene the specified conditions.

- Atmospheric emissions: Incineration gives rise to emissions of combustion gases to the air from a stack. The key substances of concern in these emissions are SO_2, NO_x, particulates, hydrogen chloride, heavy metals, carbon monoxide and organic compounds, such as dioxins. The operation of a clinical waste incinerator will normally require a permit, which will typically stipulate limits on the concentrations of the pollutants, combustion conditions which should be achieved in the furnace (eg temperature, residence time, oxygen levels) and the monitoring of the process. Pollution control equipment to clean the gases prior to emission will normally be

required. It is illegal to operate without a permit or to contravene the specified conditions.

- Ash: Incineration generates two types of ash residue - bottom ash, which is biologically sterile, essentially inert material, and fly ash, which contains higher levels of heavy metals and organic compounds, such as dioxins, filtered out of the combustion gases. Bottom ash is considered non-hazardous, whereas fly ash is categorised as a special (hazardous) waste. Both types of ash are normally disposed by landfilling (although the bottom ash can be recycled as a road construction material), with the disposal operation controlled by a permit for the landfill site. The permit typically specifies the quantities of ash which can be disposed, the method of landfilling and any special controls which are required. It is illegal to operate a landfill without a permit or to contravene the specified conditions.

For a modern clinical waste incineration plant, there is no reason for a wastewater discharge to be required. However, if an incineration technology produces an effluent, its discharge will normally be subject to a permit (consent) for releases to the sewer or a surface watercourse. The permit will typically specify the volume, composition and other key parameters of the discharge, and it is illegal to make a discharge without a permit or to contravene the specified conditions.
It should also be noted that a similar permitting framework will apply (covering general operations, atmospheric emissions, disposal of residues and effluent discharges) if non-incineration treatment methods are adopted. In some cases, the permitting system may be integrated into a single, comprehensive licensing system based on Integrated Pollution Prevention and Control (IPPC).

FINANCIAL IMPLICATIONS

Clinical Waste Management

The potential financial implications of clinical waste management are as follows:

- costs of in-house waste management;
- liabilities of injuries to staff, patients, visitors or the general public caused by failure in waste management practices.

Providing for the safe handling, collection and storage of clinical waste requires the provision of suitable equipment and infrastructure for this purpose, including:

- packaging, eg plastic bags, sharps containers, plastic drums;
- bag-holders;
- collection facilities, eg wheelie-bins or dedicated cupboards and stores;
- staff to collect waste;
- central storage facility, possibly including mechanical handling equipment.

The operation of a safe, hygienic and effective clinical waste management system within a hospital can be expensive.

The waste producer will typically have a duty under health and safety legislation to safeguard the health of employees and other persons affected by their work (patients, visitors and the general public). The risks/liabilities of injuries caused by clinical waste due to poor management are very high. Injuries involving hypodermic needles ("needle-stick" injuries) are common worldwide, and there is a proven risk of infection from hepatitis B, AIDS and other diseases. The potential liability associated with an incident involving cross-infection from waste materials due to negligence, particularly where the injured party is a patient, visitor or the general public, is very high.

Clinical Waste Treatment/Disposal

Disposal Costs

Commercial charges will be levied on the waste producer for the treatment and disposal of clinical waste. These charges will be designed to cover the costs of operation of the treatment facility, eg incineration plant, and final disposal of the treatment residues, eg by landfilling. The development of a modern and environmentally sound clinical waste treatment/disposal facility, such as an incinerator, is expensive, and disposal costs are typically high.

Permitting

The permitting of clinical waste treatment/disposal will require the following:

- installation of pollution control equipment and measures;
- monitoring of the process;
- monitoring of emissions to the atmosphere, solid residues and effluent.

The specific requirements will depend on local legislation and regulatory authorities, but the costs of implementing pollution control and monitoring may be significant.

Permitting of clinical waste treatment/disposal may also be subject to charges. These charges may be based on the administrative costs of permitting, such as the costs of regulatory staff to prepare and review permits, undertake site audits, etc, or be related to the parameters of the discharges to the environment (to air or water). Higher costs may result from greater technical complexity of the permitting or greater emissions in terms of the quantity or higher concentrations of pollutants. These costs will be passed on by the treatment/disposal facility to the waste producer.

Illegal Disposal

Illegal disposal may occur through fly-tipping of clinical waste, use of a facility which is not permitted to handle clinical waste or the failure of the chosen facility to meet the conditions and standards of its permit(s).

Depending on local legislation, the clinical waste producer may have a "duty of care" to satisfy itself and demonstrate that the selected treatment/disposal facility can adequately and safely dispose of its waste. As a result, the producer may be liable for all or part of any pollution of the environment or harm which occurs from illegal disposal of its waste where it has not met its obligations under the duty of care.

ENVIRONMENTAL IMPROVEMENTS

Potential environmental improvements will include the following:

- minimisation of clinical waste through implementation of segregation practices which separate clinical waste from non-clinical materials;
- segregation of certain categories of clinical waste from each other in order to apply special controls to those which present the highest risks, eg packaging of hypodermic needles in special, puncture-proof containers;
- establishment of clear guidance and specifications for the packaging, labelling and sealing of clinical waste;
- implementation of a collection system which minimises the length of time clinical waste is present in areas accessible to patients, visitors or the general public;
- implementation of wheelie-bin systems for waste collection which minimise manual handling and contact with clinical waste;
- development of dedicated and specially-designed central storage and transfer facilities to securely store clinical waste prior to disposal;
- establishment of a tracking and record-keeping system to record the types and quantities of waste arising and their disposal;
- identification of a Responsible Person to manage waste collection and disposal;
- checking and auditing of the clinical waste treatment/disposal facility to confirm that it holds the necessary permits and is operating within the standards and conditions specified;
- training of staff, who play the key role in implementing safe segregation.

ENVIRONMENTAL ACTION PLANS

Environmental action plans should focus on the following:

- minimisation of clinical waste and ensuring its segregation from other types of waste;
- implementation of waste management systems which are safe, hygienic, secure from scavenging and minimise manual handling;
- establishment of clear, effective and practical waste management procedures through a Code of Practice, Procedures Manual or equivalent;
- training of staff to ensure strict adherence to the procedures;
- monitoring of waste arisings;
- regular checking and auditing of the waste treatment/disposal facility to ensure that it complies with the required permits and conditions of operation.

During the initial site visit, it is important to assess the following:

- types of packaging used for clinical waste and evidence of its suitability (size, strength, etc);
- means of collecting and temporarily storing clinical waste where it is generated (at Ward/Department level), eg bag-holders, wheelie-bins, store cupboards, etc, the level of hygiene and the accessibility to the public;
- method of segregating clinical waste from non-clinical waste, and the opportunity/risk of mistakes and cross-contamination;
- amount of manual handling of bags or other containers of clinical waste from the point of arising through to disposal, particularly the effects on the integrity of the packaging;
- level of hygiene and security provided by the central clinical waste store and transfer facility;
- general housekeeping;
- availability of clear instructions and waste management policies/procedures;
- designation of Responsible Person(s) for waste management;
- evidence of staff training;
- documentation and record-keeping indicating tracking of clinical waste and proper, legal treatment and disposal;
- clinical waste disposal contractual arrangements.

Sub-sectoral Environmental Guidelines
VEHICLE REPAIR, SERVICES AND PARKING

PROCESS DESCRIPTION

Service stations dispense diesel and petrol to motor vehicles. These fuels are delivered to the service station by road tankers into bulk storage tanks which are usually positioned underground. Transfer to motor vehicles takes place through lines running from the storage installation to the motor vehicle via a pump.

Additional processes may also take place on the site. These may involve use of fluids such as antifreeze, brake fluids, motor oils and paints during maintenance and repair of vehicles. Related waste products, such as waste oils, are usually collected at the site and require appropriate disposal.

SUMMARY OF KEY ENVIRONMENTAL RISK/LIABILITY FACTORS

Contaminated land

Land may be contaminated by current or previous operations at or near the site. Contamination can arise principally through:

- seepage of spilled fuel into the soil;
- overfilling of USTs;
- leaking UST and underground pipes;
- on-site disposal of hazardous wastes such as paints, oil and brake fluids.

Atmospheric emissions

The main atmospheric pollution arising from service stations is through evaporation of fuel. Petrol is a volatile organic compound (VOC). VOCs lead to ozone creation at ground level which is known to play a major role in the foundation of photochemical smog and has been linked to respiratory disorders. VOC emissions which include carcinogenic compounds, such as benzene, are the subject of national and international environmental legislation. Evaporation of petrol, resulting in VOC release, can occur when bulk storage tanks and individual motor vehicles are being filled with petrol. Solvent emissions may also be generated by car paint spraying operations.

Wastewater

Discharge of pollutants to water may arise where fuels and oil are washed away in rainwater run-off from vehicle bays and parking lots or when forecourt areas of service stations are washed down. This may result in contamination of drainage systems and land. Wastewaters will also arise from car washes, kitchens and public toilets.

Fire and explosion

Motor fuel and oil are flammable so there is a major risk of fire and explosion at service stations and vehicle repair depots. A fire risk is also presented by the collection/storage of waste oils etc.

FINANCIAL IMPLICATIONS

- Product loss, replacement of USTs if old/leaking.
- Contamination of the soil at petrol stations and vehicle repair depots may reduce the value of the land and could result in expenditure for clean up operations.
- Compliance with environmental standards and health and safety regulations may require capital investment. For example, control of petrol evaporation during the filling of storage tanks can be achieved by returning displaced vapours through a vapour-tight connection line to the tanker which is delivering the petrol. Control of emissions from paint spraying booths may also require additional investment.

OTHER POTENTIAL ENVIRONMENTAL ISSUES

- Odour and noise may exceed statutory nuisance levels and generate local complaints.
- The collection/disposal of oil wastes will need to be undertaken by licensed waste contractors.

ENVIRONMENTAL IMPROVEMENTS

- Dedicated drainage systems for collection and removal of contaminated waters from the site.
- Installation of oil-water separators, sediment traps.
- Dedicated, fully equipped area for paint spraying, incorporating system to capture particulates and VOCs (water curtain and VOC incineration).
- Steps to minimise escape of vapours during refuelling processes.
- Appropriate methods of disposal for potentially hazardous waste such as waste oils and solvents and car batteries. Options for recovery and recycling should be explored.
- Minimise water use (car wash; etc).

ENVIRONMENTAL ACTION PLANS

Develop an Environmental Action Plan (EAP) to include:

- clear roles and responsibilities for environmental management;
- financial plan or budget for environmental management and performance improvement;
- knowledge of, information on and monitoring of environmental performance;
- setting of environmental performance targets to meet regulation and best practice;
- clear programme to meet performance targets;
- schedule for revising and updating the EAP.

Review associated management systems such as health and safety, accident and fire precautions and emergency procedures.

GUIDE TO INITIAL DUE DILIGENCE SITE VISITS

- Make an inspection of all parts of the site, preferably accompanied by someone familiar with all the activities that take place.
- Look for evidence of the spillage of motor fuels, particularly in the vicinity of the storage tank refilling.
- Look for other signs of poor housekeeping such as spillages of motor oils and paints. Discuss the procedures for routine disposal of these substances and ensure that such disposals are well documented.
- Ask for evidence that there is regular testing of the storage tanks, lines and valves by a qualified expert.
- Establish the history of the site and consider whether any contamination is likely to have arisen from previous activities.
- Review site drainage systems and examine measures that are in place to prevent oils and fuels being washed from the site by cleaning operations or by rainwater.
- Inspect nearby land and watercourses for signs of the escape of fuels and oils. Determine whether the site drainage system leads to a wastewater treatment centre or discharges directly to a watercourse.
- Determine whether an emergency recovery plan exists to cope with a major explosion or escape of fuel.
- Assess the level of health and safety awareness among staff and determine whether procedures are well documented and adhered to.
- Establish with local regulatory authorities the precise nature of local standards and determine whether the business has a history of non-compliance.
- Determine whether complaints have been received from the local population regarding activities at the site.
- Fire Safety/smoking of attendants while refuelling etc.

Sub-sectoral Environmental Guidelines PHOTOGRAPHIC STUDIOS

PROCESS DESCRIPTION

In the context of these guidelines, photographic studios are taken to be small to medium sized enterprises that have the capacity to take and develop various photographs as a service to industry as well as to households. This definition includes passport photographic booths and computerised photo-processing, but does not cover medical photographic facilities.

While the taking of photographs is environmentally benign, there could be environmental issues involved with the developing of photographs and the handling, storage and discharge of associated materials.

The developing of photographs utilises a succession of developer reagent baths, a bleaching bath, a fixing bath a stabiliser rinse. Some process also call for a series of washing baths. The quality of these baths is continuously maintained by the addition of concentrated reagent solutions. The chemicals used in this process are usually discarded or recycled on a batch basis. In automated photo booths and processing machines the same steps are involved, although the machines are calibrated to minimise the use of each chemical.

Steps involved in the commercial colour film development process are as follows:

- Developers are used to convert any silver halides in the film which have been exposed to light into visible black metallic silver. During this process the developing fluids are oxidised;
- The oxidised developing agents combine with a coupler in the film to form complimentary three dyes (yellow, magenta and cyan);
- The bleach solution is added to stop development (by lowering the mixtures pH), to convert the metallic silver back to silver halide and to complete the generation of the cyan die;
- An ammonium thiosulphate fixing solution is used to dissolve the remaining silver halide from the film; and
- Finally the film is rinsed with a chemical stabiliser which protects the dyes against ageing and fading.

Development of photographic paper positives from the processed negatives is accomplished by a similar method following exposure of the photo-reactive paper to an image projected from the negative

The areas of potential environmental concern in this process derive from negatives, photographic paper and chemical use. The chemicals used to develop the negatives (as well as the film negatives and photographic paper) all contain silver. Because of this, in some countries they are designated as hazardous waste (in the USA and Cananda).
Whilst digital image capture and printing systems are undergoing rapid advances they can not yet match the image quality provided by traditional photographic techniques.

Water Usage & Effluents

The photographic industry traditionally uses large volumes of potable water and processing chemicals are often discharged into wastewater streams. The principal contaminant of concern in relation to photographic development is silver, which, in its ionic form, is highly toxic to aquatic fauna including fish.

Waste developing fluids (fixers, bleaches and developers) can contain concentrations of silver up to 1,000 times higher than would typically be acceptable for discharge to municipal sewage treatment systems. Other characteristics of effluents, such as their pH or the presence of bleaches, may also render them unacceptable for discharge through normal methods. Such effluents therefore tend to require either on-site treatment, specialist disposal methodologies or preferably, recovery.

As a result of its high intrinsic value, the recovery of silver (and silver solutions) may represent a substantial financial benefit to film processing facilities. It should also be noted that automated processing facilities and photo booths are very economical with regard to chemical use and that film and chemicals are designed to be used at the same rate.

Solid Waste

Film processing facilities have the potential to generate substantial quantities of solid waste. Such waste typically takes the following forms:

- Photosensitive scrap (films, negatives and photographic paper);
- Film packaging;
- Disposable cameras;
- Packaging materials and paper; and
- Chemical containers.

Whilst the majority of these materials can be considered to be inert, photosensitive wastes contain high concentrations of silver and silver salts and may therefore be considered hazardous. Again, it should be noted that automated processing facilities and photo booths produce a reduction in the types and volume of wastes.

Materials Storage and Handling

The principal issues in relation to materials storage on photographic studios relate to liquid chemical solutions. In many cases, proper storage of these materials is not heavily enforced and the potential often exists for spillages to enter into stormwater drains or municipal sewer systems. Poor labelling of materials and inadequate segregation of incompatible materials may also represent a hazard to human health or the environment.

Storage of film may pose some hazards in relation to fire risks. The use of the highly unstable cellulose nitrate films has virtually ceased, however quantities of such film for archival or other purposes still exist in storage and some photographic studios offer this service. If this is the case then special

arrangements may have to be made with a permitting authority for the storage of such film.

This also applies to automated processing facilities and photo booths where materials storage is often remotely located to the booth. These bulk stores should always be checked for the points discussed above.

Environmental Impacts

Losses of photoprocessing chemicals or wastes to the environment may have direct impacts. In particular, the introduction of ionic silver into surface water bodies is likely to reduce the viability of aquatic organisms. Spillages to soil, whilst not benign, are likely to have a minor impact unless migration of the spilled material into neighbouring surface water bodies occurs. Regardless of the immediate impact, remedial measures may be necessary to address contamination of soil and/or groundwater.

FINANCIAL IMPLICATIONS

The principal financial implications of environmental issues on photographic studios are as follows:

- Requirement for permits for chemical storage;
- Requirements for waste disposal permits and charges;
- Fines and prohibitions arising from failure to meet the conditions imposed under the permits; and
- Remedial costs associated with environmental impacts such as soil contamination or unplanned discharge of silver rich materials into surface water bodies.

If a chemical spill affects the local environment and/or public health, this could result in civil liabilities and damage to public perception of the operating company.

OTHER POTENTIAL ENVIRONMENTAL ISSUES

Polychlorinated Biphenyls (PCBs) & Asbestos

Neither PCB's nor asbestos are likely to be principal issues of concern in relation to automotive dealers, however either material may be present and may therefore pose some potential for environmental impact.

With respect to these materials, particular attention should be paid to facilities constructed prior to the 1980's. Typically PCBs may be present as constituents of hydraulic oils or dielectric fluids in electrical switchgear, transformers and fluorescent light starters. Asbestos may be encountered in a wide range of forms including asbestos cement boards, as fire retardant gaskets in pipework and as fire retardant insulation around boilers and furnaces. The likelihood of the presence of such materials is very low even in the largest photographic studios and storage facilities.

Waste Minimisation

Conversion of older wash based processing procedures with newer washless methods (such as those used in automated development) will substantially reduce the volumes of water required and therefore the quantities of waste water which may be generated. The concentrations of contaminants within the effluent streams created by washless processing are, however, typically much higher than those found in wastewater generated by wash based processing. Increased focus and expenditure in relation to effluent treatment and disposal may therefore be required in association with washless processing facilities.

Effluent Treatment

Common approaches to the issues associated with highly contaminated effluents from film processing activities include:

- Silver recovery, which is typically achieved through electrolysis of silver rich solutions on a batch basis. The cathodes (negative electrodes) are periodically removed and taken off-site to specialist treatment facilities where the metallic silver is recovered. Typically electrolytic recovery will leave residual silver concentrations in the effluent of between 30 and 600 mg/l. Such concentrations are likely to preclude direct disposal of the effluent to sewers or water bodies without a secondary phase of treatment;
- Replacement of silver in the effluent with a more active but less toxic metal. Due to their electrochemical characteristics, silver ions will displace many of the common metals from their solid state. Because of its low cost and ease of availability the most common material used in this application is iron in the form of steel wool contained within commercially manufactured silver recovery cartridges. In order to achieve suitable concentrations for disposal to municipal sewer systems it is usually necessary to employ two such cartridges in series, with the secondary cartridge providing a final polishing of the waste water. Spent cartridges can be recycled;
- Volume reduction through evaporation or distillation. These processes can reduce the effluent volume by up to 90% but may have an impact on local air quality. Under poorly controlled conditions (high temperature, low pH) noxious gases such as sulphur dioxide and hydrogen sulphide can be generated by these processes. Although it may contain high concentrations of ammonia, condensed distillate can be recycled and used to mix non-developer chemicals within the facility.
- Off-site disposal at appropriate facilities may be necessary for some materials. Such materials include waste slurry generated by evaporation/distillation, spent silver recovery cartridges and waste chemicals. In some cases it may be economically advantageous for the entire volume of effluent to be removed from site for treatment and disposal elsewhere.

Waste Recycling

Measures can include:

- Regeneration of bleach and bleach-fix solutions;
- Return of used chemicals to the manufacturers for recycling;
- Film container recycling;
- The setting up of a returnable drum program;
- The recycling of photo-chemical containers;
- Waste segregation and recycling of negatives and photosensitive paper; and
- Recycling of water to reduce volume usage, subject to quality constraints.

Recovery of the silver from the colour negative film fixer solutions and paper fixer solutions can result in a very large percentage reuse of the fixer solution.

Bromide contamination can also be removed from the colour developer when is regenerated using an ion exchange system. Once treated, the developer can be readjusted to the required concentration and returned to the process tanks, resulting in a large recovery of the colour developer solution.

ENVIRONMENTAL ACTION PLAN

Any actions to address environmental, health and safety issues identified during environmental due diligence should be presented in an Environmental Action Plan. Typically, this should also identify the costs, timeframe for implementation and responsibility for implementation:

- A financial plan and budget for environmental management and performance improvement;
- Clear roles and responsibilities for environmental issues;
- Setting of environmental performance targets to meet regulatory standards and industry best practice;
- Timescales for the achievement of performance targets;
- Plans and procedures for managing environmental issues including waste generation, waste disposal, materials storage, materials handling and emergency response procedures;
- A training plan for site personnel to ensure environmental awareness; and
- A schedule and procedure for review and updating of the environmental action plan.

A review of associated procedures such as hygiene and industrial health and safety procedures may also be of benefit.

GUIDE TO INITIAL DUE DILIGENCE SITE VISITS

The following general issues should be reviewed during environmental due diligence site visits of facilities such as photographic studios:

- The condition and quality of materials storage facilities;
- Source, quality and nature of raw materials (including water) used in site processes;
- Permitting requirements and the presence/duration of appropriate permits;
- Any history of breaches of statutory or regulatory requirements;
- Any history of public complaints relating to the facilities operation;
- Waste management and disposal procedures (in particular in relation to effluent processing and discharge);
- Effluent monitoring data;
- Statutory or other land use restrictions (particularly for new plants);
- The surrounding land uses and the potential for impacts associated with these uses;
- The condition and cleanliness of film processing and handling areas; and
- Odours and air emissions.

It is recommended that contact should be made with local regulatory agencies to determine the compliance record and public complaints history of the facility.

Sub-sectoral Environmental Guidelines DRY CLEANING

PROCESS DESCRIPTION

There are two basic types of dry cleaning systems: transfer and dry-to-dry. In transfer systems, garments are immersed in a non-aqueous solvent and then transferred by the operator to a separate drying machine. Under the dry-to-dry cleaning process, the garments are immersed in a non-aqueous solvent, the solvent is then extracted and the garment is dried all in the same machine.

Tetrachloroethene (otherwise known as perchloroethylene or PCE) and 111-Trichloroethane (1,1,1-TCA) are the main cleaning agents used by dry cleaners. The U.S. Environmental Protection Agency (EPA) considers PCE a suspect carcinogen and there is an ongoing debate about this issue. In addition, chlorinated solvents and their breakdown products are suspected of having hormone-mimicking characteristics. Solvent pollution of soil and groundwater, air pollution and occupational health and safety are the main environmental risks of the dry cleaning process.

Specialised wet cleaning processes are gradually replacing traditional dry cleaning processes for sensitive fabrics. The environmental issues associated with wet cleaning are not discussed in this guideline.

SUMMARY OF KEY ENVIRONMENTAL RISK/LIABILITY FACTORS

Materials Storage And Use

The principal concern is the storage of chlorinated solvents and solvent wastes in bulk, in particular in underground storage tanks. Such storage has a high potential to impact air, soil and groundwater and its use has implications for worker health and safety. These materials are typically classed as hazardous and their storage may require a permit.

Due to the toxicity of the solvents in use, all areas where personnel could be exposed to solvent vapours should be well ventilated, preferably with dedicated extractor units. Similarly, all such areas should be provided with the relevant hazard warning signs and personnel protective equipment.

The widespread use and storage of flammable and combustible dry cleaning liquids can present an important fire hazard. Equipment must be designed, operated and maintained to avoid common causes of fires, such as electrical malfunctions, hot surfaces and smoking.

Waste Storage And Disposal

Key issues are as follows:

- Generation, storage and disposal of wastes containing chlorinated solvents, including sludges generated by the cleaning process, may require permitting;
- Inadequate storage or waste disposal conditions have the potential to result in soil and groundwater contamination;
- Wastewater generated during cleaning of the plant has the potential to be contaminated with chlorinated solvents and may therefore require specialist treatment or disposal measures;
- The detergents used in machine wet cleaning contain surfactants to remove non-water soluble material. The local water authority may impose limits to discharge for wastewater containing surfactants, oils or grease; and
- The operator may have to establish specialist disposal procedures to deal with hazardous solvent wastes.

Hazardous waste storage and transfer arrangements should be checked to ensure the use of adequate containers, that are correctly labelled and sited. Waste consignment records can be checked to ensure responsible disposal.
It should be checked that staff coming into exposure with these wastes are properly equipped with personal protective clothing (PPE) and have clear operating procedures. Ideally, training should be given to workers in the use and handling of these waste products.

Air Emissions

PCE and 1,1,1-TCA are highly volatile solvents. If incorrectly stored or spilled they will readily evaporate leading to potential human exposure through inhalation or skin contact. Evaporation rates are particularly high from open vessels. Adequate ventilation measures should be taken and checked regularly.

FINANCIAL IMPLICATIONS

The principal financial implications of environmental issues associated with dry cleaning facilities are as follows:

- Possible soil and groundwater remediation costs arising from chlorinated solvent use and storage. Remediation costs relating to these compounds are typically high and full remediation is often difficult to achieve.
- Waste disposal costs are likely to be considerable and inappropriate disposal of hazardous materials may lead to either criminal or civil liabilities;
- Water consumption for wet processes;
- In some instances the operator may be required to install air emission abatement equipment.
- The long term use of chlorinated solvents could represent a direct risk to human health. The development of medical conditions attributable to exposure to chlorinated solvents may lead to compensation claims against the company.

OTHER POTENTIAL ENVIRONMENTAL ISSUES

Nuisance

In rare cases odour problems may be an issue if the facility is located in close proximity to residential areas. If this is the case consideration should be given to odour control equipment e.g. activated carbon filters.

ENVIRONMENTAL IMPROVEMENTS

In most cases the modernisation of cleaning equipment and procedures offers the greatest potential for environmental improvement. Replacement of the traditional chlorinated solvents with the more benign wet cleaning approach would usually overcome the principal environmental hazards associated with the industry. Wherever possible, the surfactants used in wet-cleaning should be pH neutral and biodegradable.

Where the adoption of wet cleaning approaches is not appropriate, the following measures should be considered:

- Improvement of solvent storage facilities and the provision of secondary containment bunding around all storage areas;
- If underground storage tanks and lines are necessary, they should be subject to regular integrity testing.
- Improvement of stock reconciliation procedures for solvents to gauge solvent losses;
- Improvement of control systems and metering to optimise the use of solvents;
- Development of a waste management plan to ensure that hazardous materials are appropriately stored and disposed of; and
- Improvement of recycling procedures for solvents.

In general terms, consideration should always be given to cleaner production technology before the application of pollution abatement equipment.

ENVIRONMENTAL ACTION PLAN

Any actions to address environmental health and safety issues identified during environmental due diligence audit should be presented in an Environmental Action Plan (EAP) which should list the actions required, as well as the associated costs, timeframe and responsibilities for implementation. EAPs should be included in legal agreement with the borrower or investing company. EAPs should address the following:

- Provision of a financial plan and budget for environmental management and performance improvement;
- Establishment of clear roles and responsibilities for environmental issues;
- Setting of environmental performance targets to meet regulatory standards and industry best practice;
- Setting of timescales for the achievement of performance targets;

- Development of plans and procedures for managing environmental issues including waste generation, waste disposal, materials storage, materials handling and emergency response procedures;
- Development of a training plan for site personnel to ensure environmental awareness;
- Wherever possible underground storage tanks and solvent transfer lines should be replaced with above ground alternatives;
- Development and implementation of spill response procedures for solvents; and
- Development and implementation of environmental monitoring procedures; and
- Setting of a schedule and procedure for review and updating of the environmental action plan.

For large facilities or facilities located in areas of particular groundwater sensitivity, consideration should be given to the installation of groundwater monitoring wells and the implementation of a routing programme of sampling and analysis.

GUIDE TO INITIAL DUE DILIGENCE SITE VISITS

Initial due diligence audits of dry cleaning facilities should address the following issues:

- The current and historic chemicals storage practices on the site;
- The use and sensitivity of local groundwater resources;
- Statutory or other land use restrictions (particularly for new plants);
- Any history or indications of soil or groundwater impact associated with the facility;
- Waste disposal procedures, in particular the handling and disposal of solvent wastes;
- The presence of appropriate permits and licences for the operation;
- The site history with respect to compliance with permits and licences; and
- Any history of enforcement notices or penalties imposed by regulators or service providers as a result of non-compliance with licences or permits.

It is recommended that contact should be made with local regulatory agencies to determine the compliance record and public complaint history of the facility.

Sub-sectoral Environmental Guidelines HOTELS (and other lodging places)

PROCESS DESCRIPTION

The development and expansion of hotels and resorts in areas of high natural amenity and environmental sensitivity can have a significant local impact. Once established, general activities such as administration, laundry, and food preparation and support functions such as heating, lighting, air conditioning, and leisure facilities, (swimming pool, gym, tennis courts etc.) may have an impact on the local environment. In addition, there are secondary effects of hotel developments, through the influx of tourists to the surrounding area and the development of connected service industries.

SUMMARY OF KEY ENVIRONMENTAL RISK/LIABILITY FACTORS

The direct environmental impacts associated with hotel development are limited with few significant risks. However, attention should be paid to the issues outlined below.

Site Location and Permitting Procedures

New developments are often in areas of high aesthetic/conservation value which may be unspoilt with low population densities. In urban areas these may also be impacts at the site arising from change of land use, when the project site is occupied by a stand of trees or shrubs. The development may require various infrastructure services, such as construction of roads, water pipes lines, primary pre-treatment plants for wastewater etc. which can all have a damaging impact on the environment. There are likely to be regulations governing new developments in ecologically sensitive areas, for example, environmental impact assessments will be required for major developments.

Noise and Light

In relatively undeveloped areas, hotels and resort complexes may cause significant nuisance to local residents. This may lead to litigation and curtailment of activities at night. In urban areas hotel construction or refurbishment may result in noise, dust emissions and traffic disturbance.

Waste Water and Solid Waste

The disposal of domestic and sanitary wastes can be problematic and lead to significant water pollution in coastal areas. Similarly, hotels can generate large quantities of degradable and non-degradable solid waste which must be disposed of frequently to avoid odour, fly and rodent problems.

Financial Implications

Site Location and Setting

Additional measures should be required during construction to ensure that the wildlife and habitat value of the area is conserved during development. If habitats are damaged, restoration may be required, and as a further measure wildlife havens/conservation areas may need to be established. There may me also issues resulting from change of land use, which may entail lengthy legal procedures and compensations.

POTENTIAL ENVIRONMENTAL ISSUES

Other Environmental Aspects

Impacts arising from hotels are minor in nature in that the main air emissions are from boilers, wastewater is sanitary and laundry in origin and waste materials are unlikely to have a significant effect on the local environment. Other issues may include noise and lighting which may cause local nuisance both to nearby residents and to surrounding wildlife. Health and safety aspects of the development may include the installation of fire escapes, fire doors and emergency sprinkler systems.

ENVIRONMENTAL IMPROVEMENTS

Potential environmental improvements may include:

***Conservation*:**

- development during both, construction and operation, should include measures to protect the environment in which it is situated;

***Energy Efficiency*:**

- use of construction materials with adequate insulation properties;
- re-use heated wastewater to warm cold water supply;
- pipe insulation etc.;
- energy efficient lighting;
- control of level of heating (this may depend on source of heat, for example is difficult to control if it is state supplied heat and power).

Others

- installation of primary treatment for sanitary wastewater prior to discharge off site may be required by the authorities;

- make customers aware of environmentally sensitive areas and the need to minimise wastage of water and other resources.

ENVIRONMENTAL MANAGEMENT

Recommended environmental management measures should focus on energy/water efficiency, waste management and minimising impacts on the local environment.

GUIDE TO INITIAL DUE DILIGENCE SITE VISITS

During the initial site visit to existing hotels, it will be important to assess the following:

- the impact of the hotel and its activities on the local environment/ economy;
- waste disposal practices;
- sewage disposal practices;
- complaints or litigation from neighbours;
- presence of asbestos or CFC containing materials/equipment;
- fire/safety equipment, procedures and permits.

On site visits to new hotel developments, focus upon:

- site location in relation to neighbouring villages and other sensitive areas;
- permitting procedures;
- public support/participation;
- municipal solid waste and sewage treatment capabilities;
- quantity and quality of water supply;
- energy efficiency measures in the hotel.

KEY SOURCES OF INFORMATION/TECHNOLOGY SUPPORT

World Bank Environment, Health and Safety Guidelines, **Hotels and Resorts** (1994), The World Bank.

Sub-sectoral Environmental Guidelines AUTOMOTIVE DEALERS

PROCESS DESCRIPTION

The selling of vehicles alone is typically environmentally benign. However, environmental impacts may be associated with secondary activities such as:

- Refuelling facilities and bulk storage of petroleum products;
- Wastewater generation through car washing and valeting;
- Solid waste generation from packaging materials and normal office activities.

Automotive Dealers may also have ancillary facilities such as the following:

- General vehicle servicing, maintenance and repair facilities; and
- Bulk storage of clean and used oils; and

Paint and car body repair shops

SUMMARY OF KEY ENVIRONMENTAL RISK/LIABILITY FACTORS

Wastewater

Washwaters may be expected to contain hydrocarbons, surfactants and elevated concentrations of suspended solids. On many facilities washwater and stormwater streams are not separated, and wastewater discharges may therefore be large. On-site wastewater treatment is typically rudimentary, purely comprising a multi-chambered tank (interceptor) designed to trap floating oils and allow suspended solids to settle. The presence of high concentrations of surfactants in the wastewater stream may compromise the effectiveness of the interceptor in trapping oils.

Following treatment, wastewater is typically discharged to the local municipal sewer system. Such discharges usually require permitting and monitoring. On older or more remote facilities, wastewater discharge may be achieved through injection into "soakaways", i.e. rubble filled pits designed to allow water to disperse into the surrounding soil and groundwater. Such discharges have the potential for direct impact on soil and groundwater quality

Fuel Storage and Handling

In most cases dealerships have provision for the storage and dispensing of fuel. These facilities typically comprise at least two underground storage tanks (one for petroleum spirit and one for diesel) along with associated filling lines, suction lines, vent lines and dispensers. In most cases, fuel storage and dispensing is considered to be a very minor element of the operation of a car dealership. As a result of this perception, the focus on equipment integrity and monitoring of fuel use is often much less stringent than would be expected on a facility primarily involved in fuel handling. The change to unleaded petrol in

the 1980's lead to increased incidence of fuel loss from dispensing equipment as a result of degradation of seals and flexible connectors by the more reactive fuel.

Losses from storage tanks and their associated fuel lines can have a substantial impact on the local soil and groundwater. Accumulation of vapours associated with petroleum losses may have direct implications for human health and safety either through exposure to toxic materials or through explosive combustion.

Waste Storage and Handling

The principal non-aqueous wastes generated by car dealerships are as follows:

- Packaging materials and temporary covers associated with new cars;
- Waste oils associated with servicing and repair facilities;
- Waste paints and solvents associated with repair and respray facilities;
- Oil contaminated solids such as oily rags and oil filters;
- Solid wastes, such as tyres or belts, generated from servicing or repair activities; and
- Office wastes principally comprising waste paper.

Oils, paints and solid wastes (particularly contaminated materials and tires) may be classified as hazardous wastes and thus require special disposal methodologies.

Atmospheric Emissions

The principal atmospheric emissions issues associated with car dealerships are as follows:

- Volatile organic compounds from fuel storage and dispensing; and
- Solvents from paintshops.

In addition, although usually prohibited under local legislation, burning of wastes, including tyres, may occur on some facilities. This practice may result in the emission of a wide variety of toxic and hazardous materials including polycyclic aromatic hydrocarbons and organic particulates.

FINANCIAL IMPLICATIONS

- Losses of fuels and atmospheric emissions from spray booths may lead to environmental degradation resulting in the imposition of fines or prohibitions on the operating company;
- Contamination of soil or groundwater as a result of site activities, particularly fuel and waste oil storage, may require the completion of remedial works and such works are typically costly;
- Activities such as the operation of spray booths and the storage of fuels may require permitting and monitoring;
- Wastewater discharges are likely to require some form of permitting, monitoring and reporting to the authorities;
- Improvement of fuel and waste storage facilities is likely to be necessary on many sites;
- The authorities may require re-direction of drains from the washing facilities to the foul sewer, meaning that containment, collection and drainage systems may need to be either upgraded or installed; and
- Interceptors, shut-off valves or other contingency arrangements may be required to be installed on the stormwater drainage system serving vehicle parking areas.

OTHER POTENTIAL ENVIRONMENTAL ISSUES

Nuisance

- Noise from vehicle manoeuvres;
- Glare from lighting of car storage compounds;
- Vehicle movements and traffic congestion, particularly if the site is operating in a residential area and open outside normal business hours; and
- particle deposition from inadequately controlled paint spraying facilities.

Polychlorinated Biphenyls (PCBs) & Asbestos

Neither PCB's nor asbestos are likely to be principal issues of concern in relation to automotive dealers, however either material may be present and may therefore pose some potential for environmental impact.

With respect to these materials, particular attention should be paid to facilities constructed prior to the 1980's. Typically PCBs may be present as constituents of hydraulic oils or dielectric fluids in electrical switchgear, transformers and fluorescent light starters. Asbestos may be encountered in a wide range of forms including asbestos cement boards (often used as roofing material), as fire retardant gaskets in pipework and as fire retardant insulation around boilers and furnaces.

ENVIRONMENTAL IMPROVEMENTS

Nuisance

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ENVIRONMENTAL ACTION PLAN

An environmental action plan may be required to address environmental, health and safety issues. Typically such plans include:

- Provision of a financial plan and budget for environmental management and performance improvement;
- Establishment of clear roles and responsibilities for environmental issues;
- Setting of environmental performance targets to meet regulatory standards and industry best practice;
- Setting of timescales for the achievement of performance targets;
- Development of plans and procedures for managing environmental issues including waste generation, waste disposal, materials storage, materials handling and emergency response procedures;
- Development of a training plan for site personnel to ensure environmental awareness; and
- Development of a schedule and procedure for review and updating of the environmental action plan.

More specific measures should concentrate on the following issues:

- Improvements to fuel storage and dispensing facilities;
- Improvement to wastewater management;
- Improvements to waste recycling operations; and
- Development and implementation of spill and emergency response procedures.

GUIDE TO INITIAL DUE DILIGENCE SITE VISITS

Initial due diligence site visits should focus on the following:

- The quality of provisions made for the storage of fuels and other hazardous materials;
- The quality of provisions made for waste management;
- The condition of waste water systems;
- Note any characteristic odour or fumes associated with the facilities;
- Any history of public complaints with respect to the facilities operations and in particular in relation to petroleum odours;
- The presence of appropriate permits and licences for the operation;
- Site history with respect to compliance with permits and licences;
- Any history of enforcement notices or penalties imposed by regulators or service providers as a result of non compliance with licences or permits;
- Site history with respect to HSE incidents, the HSE incident book should be examined;
- Any history of or indications of contaminant impact on soil or groundwater in the vicinity of the site, particularly oil and petroleum staining on hard standing and open ground;
- The quality and sensitivity of groundwater in the area of the facility;
- Statutory or other land use restrictions (particularly for new plants);
- Check compliance with hazard signs, etc. Notably the provision and application of personal protective equipment;
- The adequacy of spill and emergency response equipment;
- The adequacy of spill and emergency response procedures; and
- The presence of any sensitive neighbouring land uses.

It is recommended that contact should be made with local regulatory agencies to determine the compliance record and public complaints history of the facility.

Sub-Sectoral Environmental Guidelines
Hazardous Waste Management System

SYSTEM DESCRIPTION

Definition of Hazardous Waste

The term 'hazardous waste' is not uniformly defined; even all EU member states have a rather different definition of hazardous waste. For the purpose of these *Sub-Sectoral Guidelines*, EBRD uses the generic term 'hazardous waste', while in various individual countries terms such as chemical waste, special waste, poisonous waste and toxic waste are used to describe such wastes. Regulations in many countries provide lists of hazardous waste. These are lists of particular types of hazardous wastes, lists of industrial processes from which the waste is defined as hazardous and/or lists of substances, the presence of which is indicative of potential hazard. These may include:

- The toxicity of the waste. Toxicity is generally defined by reference to concentrations of specific substances in the extract (e.g. in the USA and Japan);
- The ignitability or flammability of the waste;
- The corrosiveness of the waste; and
- The reactivity of the waste.

Many of the national definitions have been amended to fall in line with the requirements of the UNEP's *Basel Convention on Transboundary Movement of Hazardous Wastes and their Disposal*. In fact, the following 13 countries of the Region (out of 26) have signed and ratified the Basel Convention (as of April 1999): Bulgaria, Croatia, Czech Republic, Estonia, FYR Macedonia, Hungary, Latvia, Moldova, Poland, Romania, Russia, Slovakia and Slovenia.

Most countries in the Region base their definition of hazardous waste on EU member state legislation and/or the Basel Convention. For example, hazardous waste in the Czech Republic is classified according to the European Catalogue of Wastes taking into account the Basel Convention Classification. Further, Hungary's hazardous waste legislation is in full agreement with the Basel Convention and its classification system. In Russia, the concept of a four-class hazard system describing hazardous waste impact on human health and environment has been created based on a sophisticated and computerised expert system. The system is very precise but requires knowledge of individual concentration of every chemical substance of each waste and thus is very expensive to implement. However, Russia is a signatory of the Basel Convention so its hazardous waste classification needs to be taken into account.

Generally speaking, it is advisable that hazard as a waste characteristic should be used in a hazardous waste management system only when it is related to the following functional elements: temporary storage, handling and transportation. This is under the assumption that only treated waste (when hazardous characteristics are neutralised and/or removed) are finally disposed of in an engineered landfill.

Cleaner Production

The costs of hazardous waste management are very high in countries, which have sophisticated hazardous waste management regulations and strict enforcement policy, for example EU countries, USA, Canada or Japan. These costs are becoming increasingly high in the countries of the Region. Moreover, growing public objections to the siting of hazardous waste processing facilities creates an additional impediment to addressing the issue of hazardous waste management.

Waste management legislation and especially hazardous waste regulations have not yet been passed nor strictly enforced in all the countries of the Region since their implementation requires substantial financial means which, for the time being are lacking in the majority of these countries. To avoid issues associated with hazardous waste management some countries in the Region have started to encourage and promote widespread use of the cleaner production concept in industry.

Cleaner Production (CP) is defined as the continuous application of an integrated preventive environmental strategy to industrial processes and products to reduce risks to humans and environment:

- For production processes CP includes conserving raw material and energy, eliminating toxic raw materials, and reducing the quantity and toxicity of all releases (air emissions, wastewater and waste) before they leave the process;
- For products the strategy focuses on relating impacts along the entire life cycle of the product, from raw material extraction to the ultimate disposal of the product.

CP is achieved by applying know-how, by improving technology, and/or by changing attitudes.

Generally speaking, CP can help any industrial facility to concentrate on improving and/or optimising its production processes (in terms of improving raw material and/or energy efficiency), while at the same time reducing/minimising generation of air emissions, wastewater and/or waste. Unless and until an industrial plant has analysed and assessed efficiency of its production processes and has improved it as much as financially feasible, a company should not only concentrate on implementing its hazardous waste management system. These two jobs should be done in parallel.

Hazardous Waste Management System (HWMS)

Figure 1 schematically presents a technical system which deals with the management of industrial and/or hazardous waste and wastewater. Functional elements (waste generation, on-site temporary storage, collection, transfer and/or transport, waste processing and landfill) for managing waste are rather different from those managing wastewater. In fact, industrial and/or hazardous waste are differently defined from industrial and/or hazardous wastewater. Wastewater usually consists of water in concentration higher than 95% and

need to be treated on-site since their collection, transfer and/or transport is very expensive and therefore, inappropriate. If wastewater contains hazardous constituents, then it is defined and/or classified as hazardous. Therefore, sludge generated at the wastewater treatment facility is classified as hazardous and it should be further processed accordingly.

Waste can be processed mechanically, physically and/or chemically, thermally and biologically whereas wastewater is usually treated physically, chemically and biologically. However, after waste has been processed (e.g., stabilised, solidified, and/or incinerated), then generated residues (processed waste) from processing operations need to be disposed at a landfill as the final disposal option. If a country needs to establish a hazardous management system and if it selects to build waste processing facilities in a country, a landfill for disposal of processed waste should also always be built. Before selecting this option, a responsible governmental authority needs to make a survey of waste and wastewater generation including their quantities and characteristics and develop an adequate and affordable hazardous waste management system for a country as a whole.

In preparing HWMS, the following prerequisites need to be fulfilled:

- Legal: regulations and inspection;
- Financial: incentives
- Education: industry, general public and schools.

Without a legal framework, appropriate regulations, enforcement and adequate financial support, it is not possible to establish or introduce HWMS. Education and training in waste and wastewater management, especially in industry must be a significant part of the overall education process.

Figure 2 shows steps in hazardous waste management system in detail. It is important to understand that each of these activities (functional elements) costs substantial money to the industrial facility even if this facility has not recognised them. For example, when a HW processing facility does not exist in a country, waste/wastewater generated needs to be managed. The capacity of the available surfaces in a facility is usually very limited and after a certain period of time, temporary storage, handling (collection/transportation) and final disposal have to be provided with adequate care.

As presented in *Figure 2*, different types of hazardous waste need to be temporarily stored, collected/transported and processed accordingly. For example, liquid waste (e.g., non-halogenated and halogenated solvents, organic waste oils, etc.) can be temporarily stored in different types of containers. They can be collected and/or transported differently to the blending (mixing) facility and then, again they need to be collected/transported differently to thermal processing (e.g., incinerated in special incinerators or, for example or in cement kilns as supplemental fuels). If some residues are left over after incineration, these need to be again temporarily stored in some

containers, collected/transported and finally disposed in landfill. Each and every of this steps in HWMS cost considerably in terms of labour, equipment and/or energy. Therefore, it makes sense for the management team in any industrial facility to make an analysis of HWMS costs and compare these with costs of implementing cleaner production opportunities. Inevitably ‘doing nothing’ is the most expensive: damages caused to human health and environment are very often irreversible.

Figure 1. Industrial and/or Hazardous Waste and Wastewater Management System

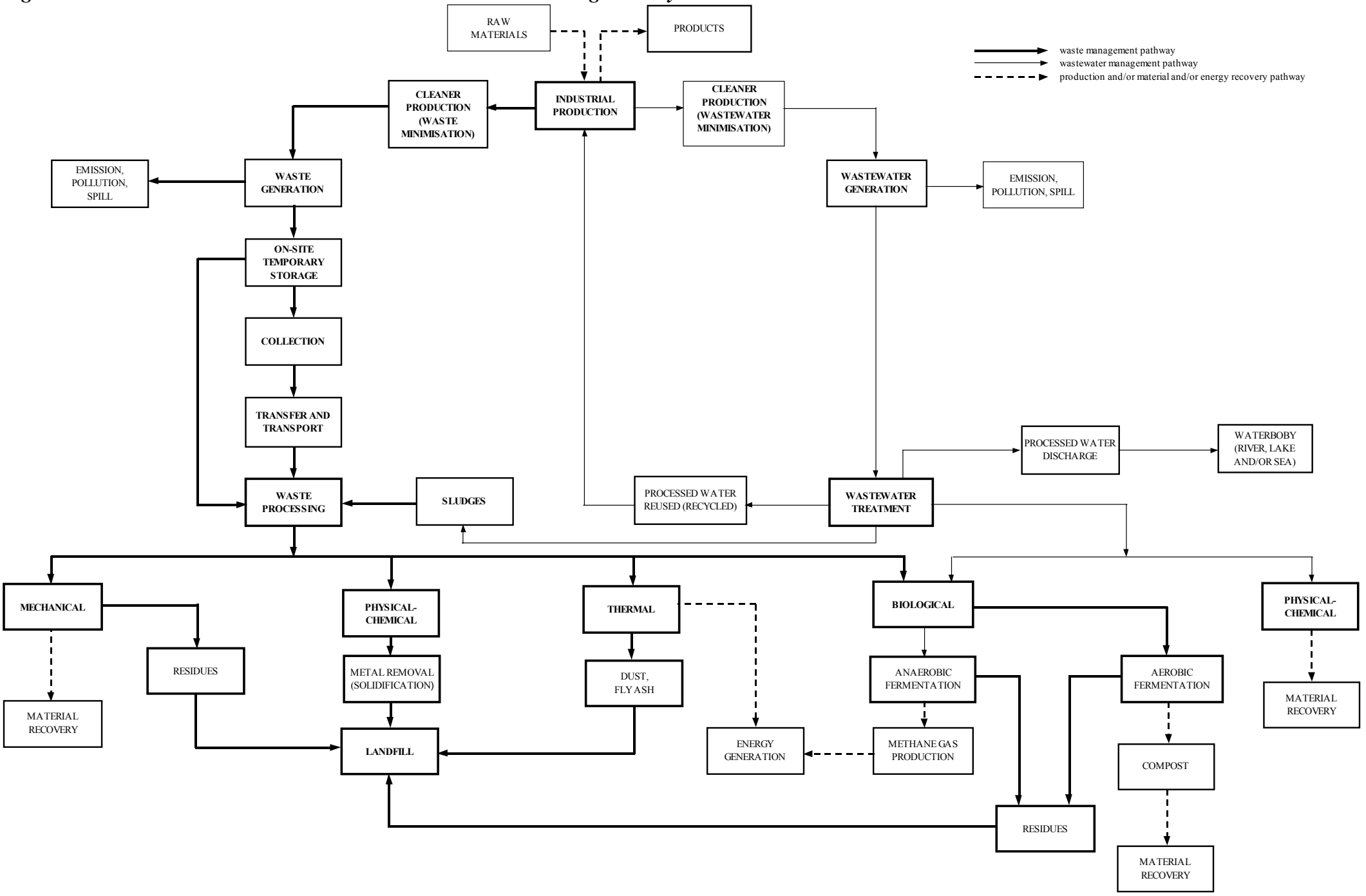
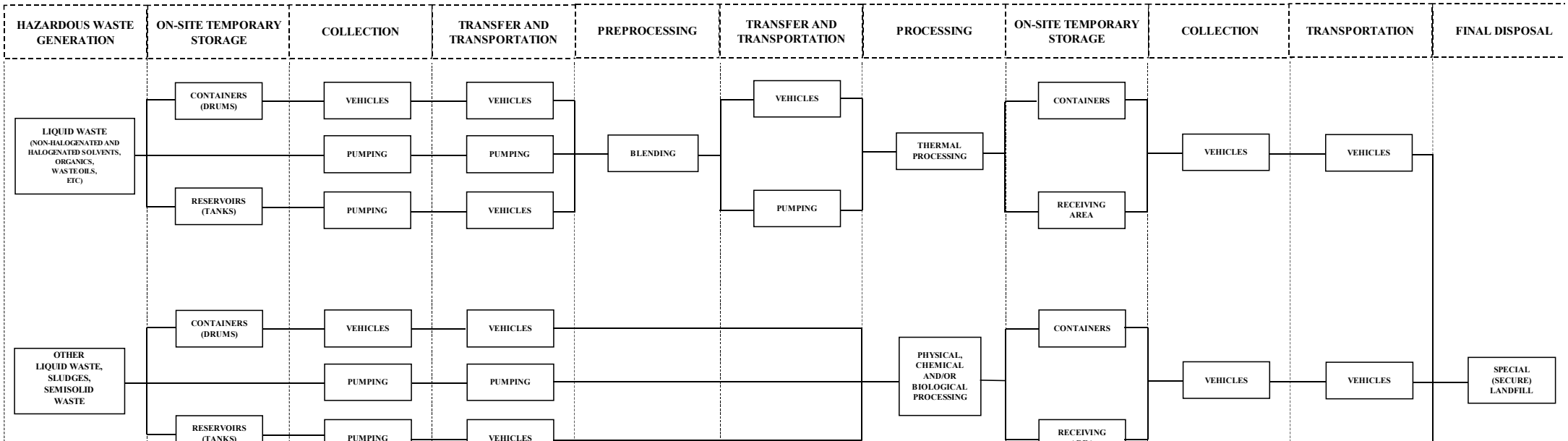


Figure 2. Steps in Hazardous Waste Management


HAZARDOUS WASTE GENERATION
ON-SITE TEMPORARY STORAGE
COLLECTION
TRANSFER AND TRANSPORTATION
PREPROCESSING
TRANSFER AND TRANSPORTATION
PROCESSING
ON-SITE TEMPORARY STORAGE
COLLECTION
TRANSPORTATION
FINAL DISPOSAL
LIQUID WASTE (NON-HALOGENATED AND HALOGENATED SOLVENTS, ORGANICS, WASTE OILS, ETC)
CONTAINERS (DRUMS)
RESERVOIRS (TANKS)
VEHICLES
PUMPING
PUMPING
VEHICLES
BLENDING
VEHICLES
PUMPING
THERMAL PROCESSING
CONTAINERS
RECEIVING AREA
VEHICLES
VEHICLES
OTHER LIQUID WASTE, SLUDGES, SEMISOLID WASTE
CONTAINERS (DRUMS)
RESERVOIRS (TANKS)
VEHICLES
PUMPING
PUMPING
VEHICLES
PHYSICAL, CHEMICAL AND/OR BIOLOGICAL PROCESSING
CONTAINERS
RECEIVING
VEHICLES
VEHICLES
SPECIAL (SECURE) LANDFILL

SUMMARY OF KEY ENVIRONMENTAL RISK/LIABILITY FACTORS

Possible environmentally related issues at an industrial facility should be clearly identified, taking into account the following:

- Human health threats/poisoning recorded;
- Contaminated land/polluted sites exististing on site;
- Existence of hazardous waste dumping;
- Existence of stockpiling of hazardous waste;
- Involvement of industrial facility in uncontrolled import/export/transit of hazardous waste;
- Accidents/incidents in handling hazardous waste detected;
- Sources of surface and/or groundwater pollution from the industrial site easily seen;
- Toxic air emission/air pollution detected on site;
- Animals/fish killed by the releases from the site;
- Fires and/or spills of chemicals recorded on site;
- Legal waste management framework not established in the country;
- National law on hazardous waste management not existent;
- Hazardous waste processing plant(s) not existing in the country;
- Industrial companies storing hazardous waste inside their facilities because the country does not provide guidelines;
- Industrial companies allowed to dispose their hazardous waste at the municipal solid waste disposal site(s).

FINANCIAL IMPLICATIONS

- Licensing, permitting and compliance with the national, regional and/or local regulatory requirements;
- Fees and fines for inadequate hazardous waste disposal;
- Clean-up and site remediation;
- Building of a temporary or permanent hazardous waste on-site storage and/or disposal facility;
- Taking part in building central local or regional hazardous waste processing and disposal facilities;
- Workers occupational safety and health issues.

OTHER POTENTIAL ENVIRONMENTAL ISSUES

- Ozone depleting substances used as refrigerants in industrial facility;
- PCBs used in transformators at the site;
- Asbestos used in construction works at the site.

ENVIRONMENTAL IMPROVEMENTS AND ENVIRONMENTAL ACTION PLAN

Potential environmental improvements in any industrial production facility could be achieved, for example by implementing cleaner production first and end-of-pipe technologies afterwards with a goal to reduce the cost of operation and maintenance, and to achieve compliance with environmental regulatory requirements. In order to decide which environmental improvement options are more appropriate and/or feasible, cost assessment of the options should be made first and solutions accordingly prioritised.

In particular, it is important to:

- Apply appropriate measures to improve the appearance of the site to the public including landscaping, screening of operational areas and good signs/lighting;
- Install appropriate permanent waste storage/disposal facilities and/or laboratories for waste checking/analysis;
- Provide written code of practice for labelling and handling hazardous waste and the use of segregated storage/disposal sites for incompatible hazardous wastes;
- Provide a working plan which includes measures to ensure that the operation of permanent hazardous waste storage/disposal does not adversely affect the amenities of the locality;
- Provide equipment and operating procedures to reduce the amount of windblown waste, dust and mud on the road leading to the permanent storage/disposal;
- Install odour control systems/operating procedures for permanent storage/ disposal of malodorous wastes;
- Install facilities to clean the inside of tanker vehicles which have carried hazardous waste;
- Provide personal protective equipment (PPE) and respirators, and a fully-equipped medical facility at a safe location;
- Employ a qualified chemist to supervise the hazardous waste analysis process;
- Establish Quality Assurance/Quality Control procedures to cover all site operations;
- Establish comprehensive inspection and preventative maintenance programmes for the permanent storage/disposal of hazardous waste;
- Provide an environmental monitoring programme covering air, soil, groundwater and surface water in the vicinity of the permanent storage/disposal site;
- Implement annual, independent audits of site operations.

ENVIRONMENTAL MANAGEMENT

Environmental management measures should focus on the following:

- Maintenance of compliance with all permits;
- Strict adherence to waste segregation and tracking procedures;
- Minimisation of emissions, windblown waste, dust etc which may cause local nuisance;
- Minimisation of manual contact or exposure to hazardous wastes,

- Implementation of preventative maintenance programmes for any release type control equipment;
- Preparation of contingency plans for accidents and emergencies;
- Implementation of an environmental monitoring programme and regular checking and auditing of the permanent storage and/or disposal facility to ensure that it complies with its permit and conditions of operation.

GUIDE TO INITIAL DUE DILIGENCE SITE VISITS

Visits

During the initial visit to the industrial plant site, it is important to assess the following:

- Site location and potential environmental sensitivity, including proximity of residential areas and land accessible to the public, and sensitive environmental features (groundwater, surface water, ecological habitats);
- Site security and the safety of all site personnel, contractors and visitors;
- Compliance with the permits for the operation of hazardous waste management at the industrial site, including for operations and maintenance as well as atmospheric emissions, and wastewater discharge;
- Method of identifying wastes and tracking through the site, and records of their permanent storage and/or disposal;
- Means of preventing accidental mixing of wastes, including a working plan, segregation areas etc;
- Presence of odours/dust at the site and windblown waste and the overall appearance of the site;
- Method of preventing dust/odour releases from waste storage and/or disposal;
- Evidence of any run-off from the site to local water courses;
- Type and nature of complaints from the public and/or employees;
- Establishment of Quality Assurance procedures and environmental monitoring programmes;
- Measures and equipment to respond to emergencies and accidents.

Contacts should be made with the local regulation agencies to determine the compliance record and performance of the hazardous waste management at the industrial plant.