Annex 2: Typical Impacts and Mitigation Measures

Small Irrigation Schemes

Scope of Projects

Small irrigation schemes can serve a few families or an entire community. They can involve new irrigation for existing rain-fed agriculture, the development of uncultivated areas, and changes or expansions to existing schemes. Water may be pumped from lakes, ponds or underground, or be diverted from streams or rivers. Pipes, channels or ditches carry the water to farmers' fields where it is distributed to crops by gravity on the soil surface, by hand, or by other means.

Irrigated agriculture involves complex soil-water-plant relationships, and should not be undertaken without thorough, informed planning, even at a small scale. While the benefits of irrigation can be obvious and impressive, the adverse environmental effects can be significant, long-term, and perhaps permanent.

The most significant environmental issues with small irrigation schemes concern threats to human health and soil productivity. Health effects arise from stagnant water in canals, ditches or fields that provide habitats for water-borne disease carriers. Losses of soil productivity result from over-irrigation or poor soil drainage. These lead to waterlogging and salinization of the soils, and a reduction or complete loss of their usefulness for cropping. Salinization is the build-up of mineral salts in the soil as water evaporates from the soil surface.

Environmental Concerns

Human Environment

Concerns about:
- Community management relationships
- Land tenure system
- Security of livelihoods
- Gender division of labour

Health effects of water-borne diseases and infections, and agro-chemicals

Conflicting demands on surface or groundwater supplies

Natural Environment

Groundwater supply for other crops and vegetation

Quality of surface and groundwaters receiving excess irrigation water; or drainage carrying nutrients, agro-chemicals, salts and minerals

Soils:
- Waterlogging
- Salinization
- Erosion

Wetlands affected by irrigation or drainage, and threats to their environmental services, biodiversity, and ecological productivity

Potential Environmental Effects	Mitigation Measures
Human Environment	
Upsetting existing social and economic community management relationships, land tenure system, security of livelihoods, and gender division of labour	Avoid sites that require: Resettlement Displacement of other important land uses, or Encroachment on historical, cultural, or traditional use areas Locate and size irrigation schemes:

Potential Environmental Effects	Mitigation Measures
Conflicting demands on surface or groundwater supplies	Where water supplies are adequate and the scheme will not conflict with existing human, livestock, wildlife or aquatic water uses, especially during dry seasons So that withdrawals do not exceed “safe yield” from groundwater resources Encourage crops with lower water demands Ensure effective community organization for equitable distribution of water
Human Health	
Creating habitats in canals and ditches for disease carriers such as mosquitoes and snails responsible for spreading diseases such as malaria and schistosomiasis (bilharzia)	Assess ecology of disease carriers in the project area, and employ suitable prevention and mitigation measures, e.g.: Site and orient water works, fields and furrows to ensure adequate natural drainage of surface water Use lined canals and pipes to discourage vectors Avoid unsuitable gradients, and creating stagnant or slowly moving water Construct straight or only slightly curved canals Install gates at canal ends to allow complete flushing Ensure adequate sub-surface drainage of fields Avoid over-irrigation Maintain water works, and clear sediment and weeds, regularly
Spreading infection and disease through the inappropriate use of irrigation canals for water supply, bathing or human waste disposal	Provide/ensure alternate facilities for domestic water supply, bathing and human waste disposal
Health effects from improper storage, handling, use or disposal of agro-chemicals (pesticides, herbicides)	Provide education and training for farmers and other community members on: Irrigation health risks Efficient use of irrigation water Maintenance of irrigation and drainage works Proper storage, handling, use and disposal of agro-chemicals Integrated pest management
	Monitor disease/infection occurrence and public health indicators, and take corrective measures (e.g. physical changes to irrigation scheme, education, medical) as needed
Soils	
Waterlogging	Thoroughly assess project soils and their management needs under irrigated agriculture Apply water efficiently. Consider drip or dawn/evening sprinkler irrigation. Install and maintain adequate surface and sub-surface drainage Use lined canals or pipes to prevent seepage
Salinization	Avoid waterlogging (above) Mulch exposed soil surfaces to reduce

Potential Environmental Effects	Mitigation Measures
	evaporation Flush irrigated land regularly Cultivate crops having high tolerance to salinity
Erosion	Design and layout of furrows appropriately Avoid unsuitable gradients Avoid over-irrigation Install sediment traps in fields and canals to capture sediment for return to fields Minimum tillage, contour cropping, terracing and other methods of conserving soil moisture
Water Bodies and Aquatic Ecosystems	
Loss or damage to wetlands and their environmental services, biodiversity, and ecological productivity	Avoid Locating irrigation schemes on or near important wetlands Developing irrigation water sources that may reduce wetland water supply Draining irrigated fields into wetlands
Reduced quality of surface and groundwaters receiving excess irrigation water or drainage (nutrients, agro-chemicals, salts and minerals)	Follow *Soils* mitigation measures (above) to minimize risks of waterlogging and salinization Use agro-chemicals appropriately (see *Human Health* above) Prevent surface drainage of fields into nearby water bodies (streams, ponds, etc.)

Environmental Standards	Environmental Quality Indicators
National legislation on protected areas (natural, cultural and built environments) National legislation on protecting natural resources (e.g. fish, wildlife, forest cover) International environmental protection conventions (e.g. heritage, wetlands) National water quality standards and controls National controls on storage, handling, use and disposal of agro-chemicals	**Pollution** Water quality (nutrients, agro-chemicals, salinity) in water supply and drainage canals, and wells Physical and chemical properties of irrigated soils **Environmental Health** Water table levels in project area Rate of occurrence of disease carriers Human Wellbeing Incidence of human and animal illness or disease Poverty levels

Community Forestry

Scope of Projects

Community forestry projects may be undertaken for a variety of reasons including timber and fuelwood production, soil and water conservation, and micro-watershed protection. They may also include tree nurseries or elements of agro-forestry that yield forest products besides wood (e.g fruits, nuts). They typically involve afforestation and not existing forests. Reforestation, upgrading and management of existing forests and forestry operations are not considered in this resources sheet.

Clearly, such projects can provide substantial economic and environmental benefits. At the same time, if they are not planned and carried out sensitively, they can also create environmental problems, particularly soil erosion and conflicts over land use and the distribution of project benefits.

Environmental Concerns

Human Environment

Human settlements in or near project site
Existing land tenure and uses (legal or illegal) (e.g. agriculture, grazing, recreation)
Common lands
Sites of cultural, religious or historical importance
Security of local and traditional livelihoods, and cash income generation

Natural Environment
Protected species
Protected areas (e.g. watersheds or water basins, nature reserves, parks)
Areas supporting:
- Critical habitats for rare or ecologically important species, or significant biodiversity (e.g. wetlands)
- Commercially or domestically important species (e.g. fish, locally hunted wildlife)

Wilderness areas (habitats for indigenous animal species)
Soil structure, stability, susceptibility to erosion
Surface water quantity and quality (e.g. streams, rivers, ponds, lakes)

Potential Environmental Effects	Mitigation Measures
Human Environment	
Displaced human settlements	Avoid areas that require significant or involuntary resettlement Prepare RAP which provides guidance and standards for compensation for resettlement families and lost livelihood opportunities
Conflicts over: Land tenure and use (legal or illegal) Security of local and traditional livelihoods, and cash income generation	Avoid existing land use areas that are economically productive or important for subsistence or traditional livelihoods Consider use of already cleared or barren lands for tree planting Consider sites currently used unsustainably (e.g. agriculture, grazing) and prepare RAP for compensating people using the site Plan and operate the forest to ensure an equitable distribution of benefits to all community members, and to not exacerbate economic disparities within the community Account for differing tree product needs between women and men Provide for intercropping, agro-forestry and other measures that will accelerate the flow of benefits to, and support of, a range of local people Train and use local labour in the development and operation of the forest
Disruption of sites of cultural, religious or historical importance	Avoid such sites, or incorporate them in the project sensitively and to local people's satisfaction
Terrestrial Environment	
Loss of natural areas, important habitats, biodiversity	Avoid infringing on: Protected natural sites, watersheds and wilderness areas

Potential Environmental Effects	Mitigation Measures
	Critical wildlife habitats or areas with significant biodiversity (e.g. wetlands)
Unsustainable forest production	As much as possible, use a variety of multipurpose and fast-growing indigenous tree species to enhance: Effective use of site micro-climates and soil conditions The diversity and flow of benefits to local people Soil and water conservation Resistance to significant outbreaks of disease and pests Wildlife habitat and species diversity Draw upon local cultural knowledge and values in planning and operating the forest Adapt imported technology (e.g. erosion control, forest management and harvesting) to local conditions, rather just adopt it Use low impact equipment and methods for forest management and harvesting, and minimize skid trail distances Select sites where the benefits from the new forest can help reduce illegal or unsustainable uses of nearby forests If a heavy reliance on cash crops is anticipated, ensure that a thorough market analysis is carried out during project planning
Soil erosion	Avoid areas of fragile or unstable soils/slopes Avoid any project activities within 20-40 metres of streams, ponds, etc. unless they are for rehabilitation and conservation of the riparian zones Leave existing grass/shrub cover on lands that are very steep or have shallow soils Use techniques such as bunding to strengthen control of surface water flows and erosion, and enhance infiltration Harvest trees in small, unconnected blocks to minimize exposed soils and enhance opportunities for natural regeneration from adjacent forest Road and track development (also see *Rural Roads* resources sheet): Construct during the dry season Keep gradients low but sufficient for natural drainage Locate as far away from waterbodies as possible Leave vegetated strips along roadsides, and reseed disturbed areas Coordinate development schedule with overall plan for forest development and operation
Water Quantity and Quality Reductions in down-slope water supplies	Avoid watercourses

Potential Environmental Effects	Mitigation Measures
	Retain existing tree and grass/shrub cover, and harvest selectively, sustainably and carefully, where down-slope water supply is a critical concern
Pollution of groundwater, and of surface waters and habitats	Avoid overusing fertilizers, herbicides and pesticides Avoid any use near waterbodies

Environmental Standards	Environmental Quality Indicators
National and local planning regulations (e.g. land use, forestry, watersheds) National legislation on protected areas (natural, cultural and built environments) National legislation on protecting natural resources (e.g. fish, wildlife, forest cover) International protection conventions (e.g. heritage, wetlands) National water quality standards and controls National controls on use of fertilizers, pesticides and herbicides Alternatively, internationally recognized standards (e.g. World Health Organization, United Nations Environment Programme)	**Pollution** Concentrations of suspended sediments and contaminants (e.g. pesticides) in surface waters **Environmental Health** Degree of biodiversity (numbers of plant, fish, animal, and bird species) in the watershed Extent of critical habitats **Human Wellbeing** Poverty levels

Small-Scale Aquaculture

Scope of Projects

Aquaculture projects raise aquatic organisms in fresh, brackish or salt marine waters for part or all of their life, and then harvest them for human consumption. The organisms may be fish (e.g. trout, salmon, carp, tilapia), crustaceans (e.g. fresh water crayfish, shrimp, prawns), or molluscs (e.g. oysters, mussels, clams).

Culture methods vary considerably. Intensive methods raise high-value organisms in large numbers in man-made structures. With ponds, fresh or seawater is channelled or pumped in, and old water is discharged through ditches or canals. Use of groundwater may lower water tables. Artificially produced seed, specially made feed, antibiotics to control disease, chemicals to inhibit plant growth, and high initial costs are typical. Waste water and bottom sludge can become toxic and, if not properly treated and managed, can contaminate soil, water and marine resources.

At the other end of the scale are extensive methods that tend to use traditional, low-technology cultivation methods, wild seed stock and naturally available feed. Input and output levels, and start-up costs, are much lower than with intensive methods. Extensive aquaculture is frequently developed to satisfy local fish protein needs rather than commercial markets, and is the focus of this resources sheet. The products may be distributed fresh or dried.

Environmental Concerns

Human Environment

Existing or planned land uses (legal and illegal)
Community water management practices and relationships
Conflicting demands on surface or groundwater supplies
Human health concerns for water-borne diseases and infections

Quality of surface and groundwater supplies

- Natural aquatic environments, especially wetlands and mangrove forests

Potential Environmental Effects	Mitigation Measures
Human Environment **Land use conflicts**	Avoid project sites that require: Resettlement Displacement of other important land uses, or Encroachment on historical, cultural, or traditional use areas Encourage use of existing depressions, hollows and ditches Limit areas converted to ponds Good pond design, construction and maintenance to avoid premature abandonment and digging of new ponds Ensure adequate community participation in the planning and operation of the project
Water supply conflicts: Social and economic disruptions to existing community water management practices and relationships Conflicting demands on surface or groundwater supplies	Site ponds to avoid disrupting existing/traditional uses of water (e.g. drinking, washing, animal watering) Develop ponds with other activities to combine water uses (e.g. pond water used for irrigation of crops) Develop supply sources: Where water quantities are adequate and the project will not conflict with existing human, livestock, wildlife or aquatic water uses, especially during dry seasons So that withdrawals do not exceed “safe yield” from groundwater resources
Human Health Illness or disease due to pollution of water sources from aquaculture wastes	See *Water Quality* below
Creating habitats for disease carriers such as mosquitoes and snails, and increasing the prevalence of water-related diseases such as malaria and schistosomiasis (bilharzia)	Assess ecology of disease carriers in the project area Employ suitable prevention and mitigation measures, including education of local people, e.g.: Good surface drainage around project water supply, ponds and drainage works Use fish species that feed on disease carriers Monitor disease occurrence and public health indicators, and take corrective measures as needed (e.g. change project works, improve maintenance, education, medical)
Terrestrial Environment Loss of ground cover and erosion at project site	Restrict area cleared for ponds Construct ponds during dry season Stabilize exposed soil with grasses and other ground cover Ensure good drainage and erosion control around ponds

Potential Environmental Effects	Mitigation Measures
Depletion of local fuelwood to dry fish	Careful project planning and management to ensure sustainable source of fuelwood Consider the need for a small, complementary forestry project (see *Community Forestry* resources sheet)
Water Quality	
Pollution of surface waters with aquaculture wastes	Keep fish densities at moderate levels to reduce disease risk and need for antibiotics Pump air through the water to speed up decomposition Release pond water into water body with adequate dilution and dispersal capability Dilute pond water prior to release Time releases with period of high water levels or flows Use shorter retention time of water in ponds – i.e. more frequent exchange and flushing of pond water Consider using pond bottom sludge as agricultural fertilizer if properly decomposed and non-toxic
Aquatic Environments	
Deterioration of water quality from aquaculture discharges causes contamination or decline of aquatic habitats and resident species	Ensure adequate pollution control (see *Water Quality* above)
Loss of wetlands, especially mangrove forests	Site project well away from wetlands Design project features to prevent disturbing water flows to and from wetlands (e.g. flow regulating works, access road crossings on trestles or pilings) Enhance or protect other nearby wetlands to offset losses at project site
Accidental or deliberate release of aquaculture stock leads to decline in wild species important for local food supply or restocking and improvement of domestic stock	Use local, wild species rather than introduced species as seed stock Ensure aquaculture stock is kept healthy
Effects of the Environment on the Project	
Contamination of aquaculture operations, and deterioration of culture environment, from poor source water quality due to: Pollution (e.g. pesticides, heavy metals) Suspended sediments from upstream erosion Nutrients from agricultural run-off and livestock, detergents, sewage	Analysis of source water quality and threats Careful location of the project within the community and watershed

Environmental Standards	Environmental Quality Indicators
National legislation on protected areas (natural, cultural and built environments) National legislation on protecting natural resources (e.g. fish, wildlife, forest cover) International environmental protection conventions (e.g. heritage, wetlands) National water quality standards and controls	**Pollution** Water quality (nutrients, chemicals, salinity) in pond drainage **Environmental Health** Surface water flows and groundwater table levels in project area Incidence of disease carriers

Human Wellbeing
Amount of human and animal illness or disease
Poverty levels

Leather Processing

Scope of Projects
The processing of hides (tanning) from domestic animals such as cattle, pigs and goats is often associated with meat processing operations. Though it is often illegal, skins from wild animals may also be processed.

Leather processing involves several steps from initial soaking of the raw hides through removing hair, chrome tanning and finishing. It can produce highly unpleasant odours. It also requires large amounts of water that becomes contaminated and perhaps toxic with high concentrations of chemicals and organic matter. If disposed of on land, liquid wastes can contaminate soils and groundwater. When released to watercourses, the wastes can deplete oxygen levels, poison and disrupt aquatic ecosystems, and cause fish kills. They can also lead to serious health problems for workers and local people.

Tanneries can evidently place a quite heavy burden on the environment if not developed properly. Sensitive plant location and effective management of water use and liquid and solid wastes are key to mitigating adverse environmental effects. Sound waste management and pollution control methods at tanneries can require strong technical knowledge not covered in this resources sheet[1]. The sheet does give direction on the kind of environmental effects that need to be considered, and approaches to addressing them.

Environmental Concerns
Human Environment
Existing or planned land uses (legal and illegal)
Community water management practices and relationships
Conflicting demands on surface or groundwater supplies
Worker sensitivities to chemicals
Human health sensitivities to:
- Polluted water
- Odours
- Water-borne diseases and infections

Natural Environment
Quality of surface and groundwater supplies
- Natural aquatic environments

Potential Environmental Effects	Mitigation Measures
General Measures	
Overall planning, design and management approaches and measures can address a number of different potential environmental effects. These include:	Locate tannery well away from: Residential and commercial areas to minimize odour complaints Water courses to minimize water pollution risks
Minimize *water use* (and processing costs)	Reuse water from "cleaner" stages of the process in "dirtier" stages (e.g. use final rinse water for initial soaking or washing of next batch of raw hides) Turn off water between batches, or while transferring hides between baths Install nozzles on hoses to increase spraying

[1] See, for example, UNIDO publications for information on cleaner production in tanneries

Potential Environmental Effects	Mitigation Measures
	efficiency Prevent baths from overflowing (e.g. monitor levels closely, use automatic shut-offs) Use dry cleanup methods (cloth wipes, brooms, shovels, etc.) before water rinsing
Minimize *odours,* and *solid and liquid wastes*	Operate tannery within its design capacity Minimize water use (see above) Separate liquid from solid waste Screen liquids to remove coarse solids Install grease traps and skim tanks Drain liquid wastes into a settling tank. Air dry sludge and dispose as solid waste Separate and sell uncontaminated wastes to farmers as fertilizer Avoid dumping solid waste. Use a proper landfill or bury it in a pit (away from water sources) Do not let sludge stagnate in or around tannery site. Collect, dry and dispose of as solid waste Provide good drainage around the tannery to avoid standing pools of liquid (and potential habitat for disease carriers) If several tanneries are located close to each other, consider common treatment facilities for both solid and liquid wastes Processing methods that increase the efficient use of chemicals (e.g. higher bath temperatures, good measuring equipment)
Minimize *chemical use* (and processing costs)	Good storage and handling to reduce waste and spills (e.g. sturdy and easily secured containers) Consider alternative and less hazardous chemicals (e.g. vegetable-based chemicals and dyes) Filter and reuse chemical bath solutions Train workers to use correct chemical amounts, and provide measuring equipment
Human Environment	
Land use conflicts due to odours	Follow *General Measures* above to minimize potential for odours
Water supply conflicts: Negative social and economic effects on existing community water management practices and relationships Conflicting demands on surface or groundwater supplies	Minimize water use (see *General Measures* above) Develop supply sources: Where water quantities are adequate and the project will not conflict with existing human, livestock, wildlife or aquatic water uses, especially during dry seasons So that withdrawals do not exceed “safe yield” from groundwater resources
Human Health Illness or disease due to pollution of water sources from tannery wastes	Follow *General Measures* above to minimize water use and provide good management of solid and liquid wastes

Potential Environmental Effects	Mitigation Measures
Damaging worker health	Provide safety equipment (e.g. face masks, rubber gloves, boots) Ventilate processing areas well Train workers in safe chemical storage, handling, use and disposal
Aquatic Environments Deterioration and contamination of aquatic habitats and resident species from tannery discharges	Ensure adequate pollution control (see *General Measures* above)

Environmental Standards	Environmental Quality Indicators
National/local standards and regulations for the discharge of industrial wastewater to i) sewers and ii) streams and rivers National water quality standards and controls Workplace health and safety regulations Regulations on the storage, handling, use and disposal of toxic chemicals	*Pollution* Quality (nutrients, chemicals, salinity) of tannery effluent and receiving waters ***Environmental Health*** Surface water flows and groundwater table levels in project area *Human Wellbeing* Incidence of human illness or disease

Food Processing

Scope of Projects

Small-scale food processing may be home-based or small enterprises that use a wide variety of processes and technologies to convert animal and plant products into human food.

Food processing of all kinds can create environmental problems if not managed properly. Solid and/or liquid wastes can be highly polluting and create offensive odours. Water use can place excessive demands on local supplies. Wastewater containing organic and other wastes can degrade streams and rivers, and contaminate groundwater. Stagnant pools of polluted water can be highly odorous and provide breeding grounds for mosquitoes.

Environmental Concerns

Human Environment

Existing or planned land uses (legal and illegal)
Community water management practices and relationships
Conflicting demands on surface or groundwater supplies
Human health concerns sensitivities to:
- Polluted water
- Odours
- Water-borne diseases and infections

Worker health and safety due to:
- Dust
- Machinery noise and vibration
- Exposed wires and overheating of electric equipment

Natural Environment

Quality of surface and groundwater supplies
- Natural aquatic environments

Potential Environmental Effects	Mitigation Measures
General Measures	

Potential Environmental Effects	Mitigation Measures
Good overall planning, design and management can address a number of potential environmental effects[2]:	Use "dry cleanup" (e.g. sweeping, wiping down) of solid wastes before washing
Minimize *water use* (and processing costs)	Regulate water flows (e.g. valves, high pressure nozzles) Reuse water
Minimize *liquid waste*	Minimize water use (see above) Separate fats, grease and other solids from wastewater before reuse or disposal (e.g. use oil separators/traps) Drain stagnant pools of liquid or water from holding pens and working areas Consider treatment ponds to decompose waste and reduce disposal costs. Ensure ponds are large enough for effective decomposition and odour control
Minimize *solid waste* (and lost product)	Improve processing methods to recover more product and reduce waste (e.g. better meat trimming and food cutting) Reuse organic wastes (e.g. as animal fodder or fuel) Compost organic waste for fertilizer Air dry waste in controlled area then dispose in approved landfill or safe burial Minimize product spoilage by using secure, screened, and well-ventilated storage areas
Human Environment	
Water supply conflicts: Negative social and economic effects on existing community water management practices and relationships Conflicting demands on surface or groundwater supplies	Minimize water use (see above) Develop supply sources: Where water quantities are adequate and the project will not conflict with existing human, livestock, wildlife or aquatic water uses, especially during dry seasons So that withdrawals do not exceed "safe yield" from groundwater resources
Human Health Illness or disease due to pollution of water sources from food processing wastes	Follow *General Measures* above to minimize water use and provide good management of solid and liquid wastes
Damaging worker health	Provide/strengthen health and safety training, accident prevention and equipment (e.g. face masks, rubber gloves, boots, ear plugs, good ventilation) Practice good housekeeping (e.g. clean floors regularly, install drip trays) Repair and maintain machinery for safe and quiet operation

[2] See also *Rural Water Supply and Sanitation* and *Solid Waste Management* resource sheets.

Potential Environmental Effects	Mitigation Measures
Water Quality Degradation of groundwater, streams and rivers from solid and liquid wastes, and consequent Deterioration and contamination of aquatic habitats and resident species from waste discharges	Follow *General Measures* above to minimize water use and solid and liquid wastes Screen waste liquids to remove solids Install grease traps and skim tanks Locate waste disposal sites away from surface and groundwater sources, watercourses, housing and town centres Ensure receiving waters for liquid wastes are able to absorb and naturally decompose the effluent Ensure waste that is stored before transport to treatment facility or landfill cannot leak into the ground

Environmental Standards	Environmental Quality Indicators
National/local standards and regulations for the discharge of industrial wastewater to i) sewers and ii) streams and rivers National water quality standards and controls Workplace health and safety regulations	**Pollution** Quality (nutrients, chemicals, salinity) of liquid effluent and receiving waters **Environmental Health** Surface water flows and groundwater table levels in project area Productivity of aquatic environments receiving liquid waste **Human Wellbeing** Incidence of human illness or disease

Community Healthcare Facilities

Scope of Projects

Community healthcare facilities can include small hospitals, health centres, clinics, surgeries, dentists, veterinary practices, laboratories and nursing/residential homes. These facilities can have the same environmental concerns as any structure or building. By far the most significant concern is the hazardous nature of many types of healthcare waste, and this resource sheet focuses on this issue alone. Types of health waste can include:

- Human tissue and blood;
- Soiled surgical dressings and swabs;
- Discarded syringe needles;
- Other contaminated sharp instruments;
- Microbiological cultures and potentially infected wastes from laboratories;
- Excretions; and
- Drugs and other pharmaceutical products.

Radioactive wastes need to be managed and treated separately from other healthcare wastes, and are not covered here.

The many different potential sources and types of healthcare wastes make it important to carefully plan healthcare projects to improve waste management, and thus minimize human exposure to the wastes and risks to public health. In particular, the sources and types of waste need to be identified, and the current waste management methods identified and assessed. In most cases, the risks of hazardous healthcare waste in communities can be greatly reduced through low-cost, affordable operational measures such as improved handling, segregation and safe storage. These measures minimize the risks of exposure. A key aspect of these measures is to carry out extensive training and awareness raising.

Environmental Concerns

Human Environment
Worker and public health and safety
Visual impacts of waste management transport, treatment and disposal practices
Odors from waste degradation
Human settlements and land uses (e.g. agriculture, grazing, forestry, recreation) near project site(s), as well as sites of cultural, religious or historical importance

Natural Environment
Potential contamination of surface water (e.g. streams, rivers, ponds) and groundwater
Impacts of facilities on important natural environments
Smoke/air pollutants and toxic ash residues from open burning

Potential Environmental Effects	Mitigation Measures
General Measures • Overall planning and design approaches and measures can address a variety of environmental concerns	• Determine the approximate **volumes of waste materials by category** (e.g. sharps, body tissues, dressings, pharmaceutical products, non-hazardous healthcare wastes, etc.), and design the management system to deal with each waste category separately as required **Assess current practices and address the priority gaps and risks**, building on any successful aspects of the current system. All measures and facilities should be planned within an overall strategy for hazardous healthcare waste management. This overall strategy will ensure consistent and efficient methods, and sharing of good practices. • Provide specialized, clearly labelled **containers** for hazardous healthcare wastes to separate them at source, manage the risks of exposure, and secure the wastes before removal for treatment or storage. • Plan, design, construct and operate a **shared treatment facility** (see below). Types of facilities include heat treatment disinfection, incineration, chemical and biological treatment. • Until a shared treatment facility is established, employ **interim measures** to ensure the safe and secure storage of wastes. In some cases, an appropriate interim measure will be to bury the waste in deep (e.g. >2m) trenches in municipal disposal sites, and ensure the trenches are immediately covered with other municipal solid waste (MSW). • Design and implement a **training programme** for healthcare workers so that they implement improved operational practices (e.g. identification of waste types, segregation, safe handling and storage). Provide printed guidance notes on procedures and methods to control health and safety risks.

Potential Environmental Effects	Mitigation Measures
	Design and implement a wider **community awareness program** on the importance of safe management practices, particularly for healthcare wastes. This program should also focus on reducing poor practices such as indiscriminate dumping in open spaces or near to water sources, open burning, etc.
Human Environment	
• Cuts and infections from used needles and other sharp instruments in the facility or due to inadequate handling and disposal • Environmental contamination and public health impacts from infected wastes such as human tissue and surgical dressings • Polluted drinking water • Longer-term health impacts from exposure to toxic substances Odours from waste degradation Smoke / air pollutants and toxic ash residues from open burning Visual impacts of waste management transport, treatment and disposal practices	Provide containers and personnel protective equipment for workers, plus detailed training in operational procedures that minimize risks of exposure to hazardous wastes. Conduct a wider awareness program to a range of stakeholders on the potential risks and impacts of hazardous healthcare waste. (See General Measures above). • Where interim measures are used, ensure worker training is adequate. Store hazardous healthcare waste in containers and transport it to a municipal disposal site.
Water Quality	
Potential contamination of surface water (e.g. streams, rivers, ponds) and groundwater quality.	Wider awareness programmes to a range of stakeholders to raise awareness of the potential risks and impacts of hazardous healthcare waste. These campaigns should also focus on reducing poor practices, such as dumping near to water sources. Ensure appropriate covering, drainage control and run-off management for storage areas to reduce contamination of surface and ground water. Assess ecology of disease carriers in area of planned facility, and employ suitable mitigation measures (e.g. proper drainage of site)
Natural Environment	
• Impacts of the project on protected areas (e.g. nature reserves, parks); critical habitats for rare or ecologically important species, or significant biodiversity (e.g. wetlands); areas supporting commercially or domestically important species (e.g. fish, locally hunted wildlife); and wilderness areas (habitats for indigenous animal species)	Wider awareness programmes (see General Measures above). Careful planning and selection of sites of new treatment /disposal facilities, with appropriate mitigation measures included in the design and operational plan, to minimize potential impacts on the natural environment.
Shared Treatment Facilities	
• Contamination of surface and groundwaters • Air pollution • Adverse land use, health and visual	• Involve community in: - Locating facility site(s) and access route(s) - Developing practices and responsibilities for managing facility activities and site(s)

Potential Environmental Effects	Mitigation Measures
impacts on nearby community as well as on sites of cultural, religious or historical importance	• Locate away from, and downwind of, human settlements and sensitive land uses • Site treatment facilities with buffer zones from other land uses and water bodies to minimize land and water resource impacts, aesthetic impacts, and health risks. A dedicated collection vehicle for hazardous healthcare waste is highly desirable. • Install appropriate, effective equipment for complete combustion / sterilization and control of air pollution • Dispose hazardous ash from incineration in appropriate facility (see interim measures above) • Ensure that operational practices, including detailed worker training, are adequate • Ensure safe handling, segregation and storage into appropriate containers that are clearly labelled

Environmental Standards	Environmental Quality Indicators
• National standards and guidelines for the handling of hazardous and non-hazardous healthcare wastes, and for the design and operation of healthcare waste treatment and disposal facilities (e.g. landfills, incinerators, sterilization facilities, etc) • National water and environment quality standards and controls • Alternatively, internationally recognized standards (e.g. WHO, UNEP) • International environmental protection conventions (e.g. heritage, wetlands)	***Pollution*** • Concentrations of pollutants in air and surface and ground waters around project site(s) ***Environmental Health*** • Numbers of disease carriers (e.g. mosquitoes) ***Human Wellbeing*** • Amount of human and animal illness or disease • Incidents of illegal dumping / number of illegal dump sites • Community complaints • Numbers (or proportion of workers) participating in training courses