USAID
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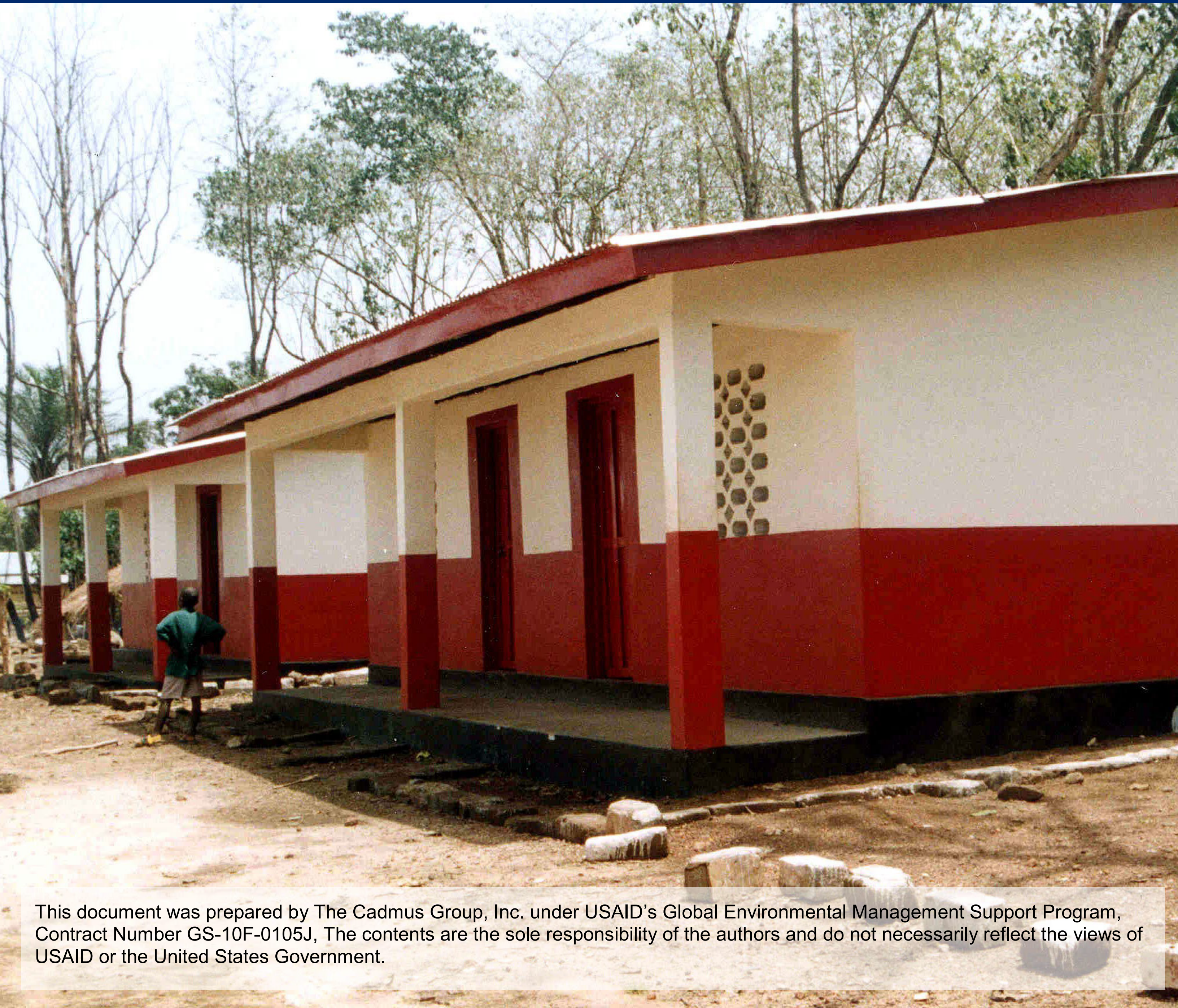
SECTOR ENVIRONMENTAL GUIDELINES

SMALL-SCALE CONSTRUCTION

November 2013



This document was prepared by The Cadmus Group, Inc. under USAID's Global Environmental Management Support Program, Contract Number GS-10F-0105J, The contents are the sole responsibility of the authors and do not necessarily reflect the views of USAID or the United States Government.

Cover Photo: USAID spent $3.5 million in Kailahun to help resettle and reintegrate displaced communities, and to rehabilitate schools, markets, roads, courts, clinics and a major hospital.

About this document and the *Sector Environmental Guidelines*

This document presents one sector of the *Sector Environmental Guidelines* prepared for USAID under the Agency's Global Environmental Management Support Project (GEMS). All sectors are accessible at www.usaidgems.org/bestPractice.htm.

Purpose. The purpose of this document and the *Sector Environmental Guidelines* overall is to support environmentally sound design and management (ESDM) of common USAID sectoral development activities by providing concise, plain-language information regarding:

- the typical, potential adverse impacts of activities in these sectors;
- how to prevent or otherwise mitigate these impacts, both in the form of general activity design guidance and specific design, construction and operating measures;
- how to minimize vulnerability of activities to climate change; and
- more detailed resources for further exploration of these issues.

Environmental Compliance Applications. USAID's mandatory life-of-project environmental procedures require that the potential adverse impacts of USAID-funded and managed activities be assessed prior to implementation via the Environmental Impact Assessment (EIA) process defined by 22 CFR 216 (Reg. 216). They also require that the environmental management/mitigation measures ("conditions") identified by this process be written into award documents, implemented over life of project, and monitored for compliance and sufficiency.

The procedures are USAID's principal mechanism to assure ESDM of USAID-funded Activities—and thus to protect environmental resources, ecosystems, and the health and livelihoods of beneficiaries and other groups. They strengthen development outcomes and help safeguard the good name and reputation of USAID.

The Sector Environmental Guidelines directly support environmental compliance by providing: information essential to assessing the potential impacts of activities, and to the identification and detailed design of appropriate mitigation and monitoring measures.

However, the Sector Environmental Guidelines *are **not** specific to USAID's environmental procedures. They are generally written, and are intended to support ESDM of these activities by all actors, regardless of the specific environmental requirements, regulations, or processes that apply, if any.*

Region-Specific Guidelines Superseded. The *Sector Environmental Guidelines* replace the following region-specific guidance: (1) *Environmental Guidelines for Small Scale Activities in Africa*; (2) *Environmental Guidelines for Development Activities in Latin America and the Caribbean*; and (3) Asia/Middle East: *Sectoral Environmental Guidelines.* With the exception of some more recent Africa sectors, all were developed over 1999–2004.

Development Process & Limitations. In developing this document, regional-specific content in these predecessor guidelines has been retained. Statistics have been updated, and references verified and some new references added. However, this document is not the result of a comprehensive technical update.

Further, *The Guidelines* are not a substitute for detailed sources of technical information or design manuals. Users are expected to refer to the accompanying list of references for additional information.

Comments and corrections. Each sector of these guidelines is a work in progress. Comments, corrections, and suggested additions are welcome. Email: gems@cadmusgroup.com.

Advisory. *The Guidelines are advisory only. They are not official USAID regulatory guidance or policy. Following the practices and approaches outlined in the Guidelines does not necessarily assure compliance with USAID Environmental Procedures or host country environmental requirements.*

CONTENTS

SMALL-SCALE CONSTRUCTION

Pakistan: Learning to Build Stronger Homes

Mohammed Bashir, a carpenter from Kaleri village in Pakistan's northeastern Bagh district, learns to make struts to support a wooden post for a house. He is among hundreds of craftsmen trained in earthquake-resistant construction by USAID.

Photo: USAID, Kaukab Jhumra Smith, March 2007

BRIEF DESCRIPTION OF THE SECTOR

Virtually all small-scale development activities—housing, sanitation, water supply, roads, schools, community centers, storage silos healthcare, energy—involve construction. This sector briefing is intended for these types of activities and any similar small-scale construction. Construction is one or more of a set of diverse activities: demolition; site-clearing; grading, leveling, and compacting soil; excavating; laying pipe; installing equipment; or erecting structures. The development benefits of construction come not from the construction itself, but from the buildings and infrastructure that are its result.

The details of the construction carried out in support of any particular development activity or site will have a number of specific characteristics. Construction activities in general, however, share a set of common features and potential adverse environmental impacts. The sector briefing addresses a number of these common elements.

In recent years, many communities have been stressed by changing temperatures, rainfall patterns, and extreme weather events indicative of a changing climate. Climate change is requiring a focus on adaptation, defined as adjustments in natural or human systems in response to actual or expected climate change stresses, which moderate harm or take advantage of beneficial opportunities. This *Guideline* also provides information on the relationship between climate change and the

What is small-scale construction?

USAID uses a working definition of small-scale construction as construction or repair of facilities where the total surface area of the disturbed environment is under 10,000 square feet and less than $200,000 total cost. Projects of this size and cost are unlikely to cause significant adverse environmental impacts.

Construction up to several times larger than this "rule of thumb" may still be small-scale, but significant adverse impacts become more likely and require more rigorous consideration and mitigation.

This rule of thumb does not hold when complicating factors are present—e.g., the site is an environmentally sensitive area, or the activity involves rehabilitation of a structure containing toxic materials.

construction sector. By focusing on adaptation, project managers can improve the likelihood of long-term success in their projects. Project managers can also do their part to minimize the project's contribution to climate change by identifying cost-effective ways to minimize greenhouse gas emissions.

USAID constructed facilities, structures, and infrastructure must be designed and constructed to appropriate engineering standards to minimize risk to humans and the natural environment. This briefing is only intended to identify key issues and illustrate potential mitigation measures associated with the construction process. Detailed guidelines for the specific type of project should also be consulted (e.g., the "Housing" or "Water Supply and Sanitation" sections of these *Guidelines*).

POTENTIAL ADVERSE IMPACTS

Construction projects may cause both direct and indirect potential adverse environmental impacts. An example of a direct impact is the filling of a wetland to use as a project site. Indirect impacts are induced changes in the environment, population, and use of land and environmental resources. Examples of indirect impacts include:

- In-migration of population to take advantage of new infrastructure such as schools or health posts;
- Effects on fish spawning associated with siltation of streams from soil erosion at a construction site; or
- The spread of disease from insect vectors breeding in flooded and abandoned quarries and borrow pits (areas from which construction materials were excavated, or "borrowed").

Another example could be a construction project's use of unsustainably extracted timber. Direct impacts often receive more attention, but indirect effects can be just as significant.

Direct and indirect impacts of **associated or ancillary** activities also need to be considered. For example, construction of a small-scale irrigation system may require construction of a new road or improvement of an existing road so that materials and equipment can reach the project site. The road is an associated or ancillary activity, with its own set of environmental impacts. The size and scope of both indirect and ancillary effects may be magnified over time, or through the cumulative effects of building many small facilities.

All potential impacts should be considered and mitigated to the extent possible, but the most significant impacts should be addressed first. As with any project, the best way to accomplish this is by careful planning and incorporation of mitigation measures into project design.

Environmental impacts of special concern include:

- **Damage to sensitive or valuable ecosystems.** Construction in wetlands, estuaries or other sensitive ecosystems may destroy or significantly damage exceptional natural resources and the benefits they provide. This damage may reduce economic productivity, impair essential ecosystem services (such as flood control, which may become increasingly important in some areas as climate change impacts precipitation patterns, or breeding habitat for fish that are caught for food), or degrade the recreational value of these resources.
- **Compaction of the soil and grading of the site** may alter drainage patterns and water tables, changing access to water by animals, people and vegetation, and may degrade water resources as

well. Improper extraction of construction materials such as wood, stone, gravel, or clay may damage terrestrial ecosystems (e.g., wood may come from relatively undegraded forests).[1]

- **Sedimentation of surface waters.** Removal of natural land cover, excavation, extraction of construction materials and other construction-related activities can result in soil erosion. Erosion can, in turn, lead to sedimentation in receiving waters. Sedimentation may reduce the capacity of ponds and reservoirs, increasing flood potential, or substantially alter aquatic ecosystems by changing streambed, lakebed and estuary conditions.

- **Contamination of ground and water supplies.** Toxic materials are often used in construction. Examples include solvents, paints, vehicle maintenance fluids (oil, coolant), and diesel fuel. If these are dumped on the ground or wash into streams they may contaminate ground or surface water supplies. This may harm the health of the local community, as well as populations living down gradient and downstream. Aquatic and terrestrial ecosystems may also be damaged. Where sanitary facilities for construction crews are inadequate, human waste may contaminate water resources.

Construction of a school near Tayaseer in the West Bank. Are local materials being used, and if so, is this creating beneficial or adverse environmental impacts?

Standing water in quarries and borrow pits may become sources of contaminated water and disease-bearing insects.

- **Adverse social impacts.** Construction may displace local inhabitants, or reduce their access to environmental resources. Construction on or near culturally important sites (cemeteries, worshipping areas, meeting places) may generate conflict with the local community. If the new facility provides a valuable service not available elsewhere, it may cause migration to the area. Noise and dirt from the site may disturb neighbors. If local labor is not used, this may also generate resentment.

- **Spread of Disease.** An influx of construction workers from other regions or construction of a new road may introduce new diseases to the local population or increase the incidence of local infection. This is a particular concern with sexually transmitted diseases, such as HIV/AIDS. Specific types of facilities such as those for healthcare, sanitation, and solid waste can also increase the spread of a variety of diseases unless they follow proper waste-handling procedures (see the *Health Care Waste* and *Sanitation Sector Environmental Guidelines* in this series).

[1] Undegraded forests are those that have not been severely impacted by disturbances such as mining, fires, or overgrazing. These impacts typically inhibit forest regrowth. (Center for International Forestry Research. Degraded Forest Land. 2003. http://www.cifor.org/rehab/_ref/glossary/Degraded_Forest_Land.htm)

- Damage to aesthetics of site/area. If the structure is too large, the architectural style is not consistent with local architectural customs, or it is sited without adequate attention to existing aesthetic and scenic characteristics, the facility may harm the visual quality of the area.

Potential Adverse Impacts on Workers. Worldwide, construction is a dangerous occupation. Out of all economic sectors in the US, construction has the second-highest rate of significant injury and illness, the largest number of fatalities in absolute terms, and the third highest rate of fatal injuries (9.7 per 100,000 full-time workers in 2009).[2] In developing countries overall, construction is estimated to be on average *10 times more dangerous* than in developed economies.[3]

Typical health and safety risks to construction workers in developing countries include falls and falling objects, crush injuries from collapses and heavy equipment, flying debris, and exposure to toxics such as solvents, cement dust, lead and asbestos. Increased temperatures due to climate change may also lead to more health impacts on workers due to extreme heat stress.

Occupational injuries and illnesses can permanently deprive construction workers of the ability to earn a livelihood – and are often fatal.

Asbestos building materials

Asbestos refers to a group of related silicate minerals characterized by long, thin fibrous crystals. Asbestos-cement roofing sheets are very common in developing countries, particularly in Africa. Linoleum floor tiles often contain asbestos. Facilities like hospitals that have or had centralized hot water systems may also have asbestos insulation on pipes and boilers. In some areas, asbestos-cement pipe and canal liners were used in irrigation systems.

Inhalation of asbestos fibers can cause malignant lung cancer, mesothelioma (a terminal cancer of the tissue that lines the chest cavity), and asbestosis, a debilitating and sometimes fatal build-up of fibrous scar tissue in the lungs. Higher concentrations and prolonged exposure make these effects more likely. These effects may occur up to 30 years after exposure stops.

Asbestos is only dangerous when it can release free-floating fibers into the air. Asbestos that is "locked in" to a material like roofing sheets or linoleum is not dangerous, except when these materials are cut, scraped, or broken up—as in renovation activities.

Asbestos-containing products should never be used in new construction.

For more information, see Annex 3: Rehabilitation Works Involving Asbestos

Microscopic Asbestos Fibers. Image: US EPA.

[2] Bureau of Labor Statistics, US Dept. of Labor. 2009 Survey of Occupational Injuries and Illnesses. Oct. 2010. http://www.bls.gov/news.release/osh.toc.htm

[3] ILO, SafeWork program.

SECTOR PROGRAM DESIGN

GENERAL PRINCIPLES, INCLUDING RESPONSIBLE CONSTRUCTION CONTRACTING

Apply best practices. All environmentally sound design best practices apply to project construction.

Practice Environmentally and Socially Responsible Construction Contracting. Achieving environmentally sound design and implementation of any development activity is far more likely when the contract or agreement governing the activity mandates good environmental practice and compliance, and appropriate capabilities are required of activity implementers.

This principle is particularly important in construction. Small-scale construction activities are frequently undertaken as one component of larger projects by local construction firms on a subcontracted basis. The environmental and safety record of the construction sector in developing countries is often poor, as is the underlying capability of the sector to manage environment, safety and health issues.

Mandating environmental compliance/good practice. The solicitation and the contract itself should

> **Responsible Contracting Language**
>
> When construction is undertaken by subcontractors within a larger project, responsible contracting needs to start at the top. That is, it needs to be mandated in the contract or agreement governing the overall project.
>
> The lead implementing organization then "pushes" responsible contracting down to the subcontracts it executes with construction firms.
>
> Basic responsible construction contracting language in the contract or agreement governing the overall project could take the following form.
>
> 1. Construction subcontractors must comply with applicable host country environment, health and safety requirements.
> 2. In no case, however, shall health and safety requirements be less stringent than the minimum recommended practices for general construction health and safety, lead, and asbestos in Annexes 1–3 of this guideline.
> 3. To be awarded construction work under this project, prospective subcontractors must demonstrate a record of environment, health and safety (EHS) compliance and evidence of commitment and capability to implement good EHS practice. Compensation must be tied in part to EHS performance.
> 4. The lead implementing organization must actively monitor subcontractor EHS performance

mandate compliance with (1) relevant host country environmental requirements and (2) any donor environmental management requirements.

(In the case of USAID projects, this would usually include compliance with the conditions specified by the project's IEE or EA.) Donor requirements and any host country environmental review already in hand should be provided at the time of the solicitation.

Mandating occupational health and safety compliance/good practice. The contract should mandate compliance with relevant host country occupational health and safety requirements for construction. If these do not exist or are unclear, mandating the minimum practices in Annex 1 to this *Guideline* is strongly recommended.

Requiring evidence of capability and commitment. As part of the proposal, prospective contractors should provide evidence that they have the *capability and commitment* to comply with environmental and occupational health and safety requirements. Adequate capability and commitment should be basic criteria for contract award.

Evidence of capability and commitment usually includes: (1) a written policy regarding worker health and safety and compliance with host country requirements; (2) an environmental/occupational safety management plan that outlines keys steps and responsible parties; and (3) budgets and construction schedules that provide for the entailed tasks and costs of environmental and safety management; and (4) where available, compliance status (i.e. any fines, citations or warnings received from environmental and occupational health and safety authorities).

Monitor environment, health and safety performance. Responsible contracting also extends to performance monitoring. In addition to performance against budget and schedule, environmental and safety compliance/performance should be part of performance monitoring and oversight. Project proponents or lead implementing organizations are rarely experts in environmental, health and safety management in construction, but during field visits they can at least verify that the minimum safety practices annexed to this *Guideline* are being followed. The *ENCAP Visual Field Guide: Construction* is a simple field monitoring tool based on these minimum practices.

Consider the full range of impacts. When planning a construction project, in order to properly evaluate their options, project developers must examine all the classes of impacts described above, direct, indirect ancillary, cumulative, and socio-cultural. Assessment of indirect effects is especially important for large infrastructure development projects, but must also be considered for small-scale activities. Ancillary, cumulative, and socio-cultural effects can occur with any size project. The magnitude of impacts is likely to be proportional to the size of the project.

KEY QUESTIONS FOR CONSTRUCTION ACTIVITIES[4]

The following questions, categorized by project phase, are intended to stimulate consideration of the full range of impacts. Consult the mitigation and monitoring tables at the end of this *Guideline* for measures to address these impacts. Please note: not all impacts will apply to all projects, nor are all possible mitigation measures incorporated in these tables.

SITE SELECTION

1. What are the current uses and activities at the proposed project site? Will anyone be displaced?
2. How close are neighboring residences?
3. What types of environment, landscape, flora and fauna are present in the area? Are any species of particular biological, medicinal, cultural, historical, social or commercial value—and, if so, could the project damage them?
4. Is the site itself of cultural, archeological, historical, or social value?
5. Are there any bodies of water, wooded areas, slopes, wetlands or other vulnerable sites nearby?

[4] Incorporates material from "Additional Resources: Building Construction: Tools for the Identification of Environmental Effects Appropriate Mitigation Measures, and Guidelines for Specific Sectors of Activity" (2007), Environmental Handbook for Community Development Initiatives. Canadian International Development Agency. http://www.acdi-cida.gc.ca/acdi-cida/acdi-cida.nsf/eng/EMA-218123618-NNH

6. Is the area and/or site prone to landslides, flooding, heavy rainfall, earthquakes and other disasters? Are extreme weather events expected to become more frequent or severe due to climate change?
7. Is the site steeply sloped? Is the soil sufficiently stable? What is its thickness, texture, drainage and topographical features?
8. How distant is the site from the intended users? Would use of the site require construction or improvement of a road?
9. Are water and sanitary facilities readily available or would they need to be provided?
10. Are historical and projected data available on precipitation, surface water flows and climatic conditions?
11. Can the extent and quality of groundwater supplies be determined? Are historical and seasonal data available? How is groundwater quality and quantity expected to change according to demand scenarios and climate change projections?

PLANNING AND DESIGN

1. What are the local zoning, building, and permit requirements?
2. Is the proposed design constructed of materials appropriate to the climate and site?
3. Are erosion and flood protection measures incorporated?
4. Is this a small, isolated project, or one of many similar projects?
5. Will ancillary or associated infrastructure development be necessary?
6. What indirect effects are possible? For example, if a new facility is to be built in a forest, will the road servicing the facility encourage illegal logging and poaching?
7. What are the types, quantities and source of construction materials? Where does the material come from, e.g., quarries, borrow pits, relatively undegraded forest?
8. Where will workers sleep? What types of water supply, sanitation and solid waste disposal will be provided for workers? Have steps been taken to ensure that there is adequate safe drinking water, sanitation facilities that will not impact water supplies, and that solid waste is handled appropriately during the construction phase?
9. If water supply and sanitation facilities are to be constructed, will they be designed according to the "Water Supply and Sanitation" sector briefing in this volume?
10. If healthcare facilities are to be constructed, will their waste streams be handled as described in the *Healthcare Waste Guideline*? For example, is there a waste storage room, an incinerator (if rural), a space for encapsulation and a plastic/clay-lined pit for safe burial? How will gray water from bathing and washing of bedding, etc., be disposed of? What system of human waste disposal will be provided to prevent undue health risks? Will water be provided to the facility in a manner that minimizes risk of contamination for patients and nearby communities?
11. If the facility will generate solid waste, does the design include space and features for source separation of recyclables and organic waste, as described in the *Solid Waste Guideline*?
12. If hazardous chemicals, radioactive waste or other types of hazardous materials will be produced in operation, does the design include appropriate storage, handling and disposal facilities, as described for some sectors in the *Activities with Micro and Small Enterprises (MSEs) Guidelines*? (These materials could include heavy metals, oil, lubricants, batteries, dyes, glue, solvents, acids, etc.)

13. If cooling waters, soaking waters, or water containing suspended matter, mercury, lead, soaps or other previously mentioned products are likely to be generated, does the design include provision for appropriate treatment, storage and discharge, as described for some sectors in the *Activities with Micro and Small Enterprises (MSEs) Guidelines*?
14. What kind of public health education will construction workers receive? Will it include information about HIV/AIDS?

Leaded Paint and Risks to Health

Flakes and dust from deteriorating paint on window, doors and other surfaces may have a high lead content which is hazardous to young children, who may ingest it by breathing or placing their hands in their mouths. Lead poisoning can result, which reduces intelligence and causes learning disabilities and behavior problems; these problems can begin in the womb.

Rehabilitation that involves sanding and scraping can liberate large amounts of leaded dust—which is hazardous not only to children and women who use the structure post-construction, but to construction workers as well.

Lead poisoning in adults can result in high blood pressure, loss of mental acuity and memory, miscarriage and male infertility, among other impacts.

All paint used in construction or rehabilitation should be non-leaded.

For more information, see Annex 2 to these *Guidelines*: Rehabilitation works involving leaded paint.

Image: Florida Dept of Health.

CONSTRUCTION PHASE

1. Where will the construction crew come from? Will the construction schedule compete with local crop harvesting?
2. What site preparation and construction activities will be carried out? Will there be demolition, excavation, leveling, clearing, filling, backfilling or wetland reclamation?
3. What are the local occupational health and safety requirements that pertain to construction workers and sites? If none, has a provision been made to implement the minimum practices set out in this *Guideline*?
4. How will any construction and demolition debris be disposed of?
5. How will the materials be conveyed to the site and stored until they are ready for use? Is storage adequate if there are project delays?
6. What toxic materials will be used during construction? Are non-toxic substitutes available? Are measures in place to ensure that toxic materials are properly handled and disposed of?
7. For rehabilitation, does the existing facility contain asbestos leaded paint? (See annexes on these topics.) Other toxics? If yes, has a provision been made to follow local requirements—or, if none, implement minimum practices set out in this *Guideline*?
8. What measures are in place for monitoring environmental impacts and ensuring adherence to environmental guidelines?

9. What measures are in place for monitoring site health and safety practices and ensuring adherence to occupational health and safety requirements?

These new public latrines are too far from the market and have no cleaning system in place. Ease of maintenance and access and impact on the local environment are critical elements for proper planning of small-scale construction projects.

CLIMATE CHANGE

PLANNING FOR A CHANGING CLIMATE

The construction sector is affected by climate changes such as sea level rise; seasonal temperature and precipitation shifts and variability; and increased frequency, intensity, and duration of extreme events (including droughts, floods, high winds, and tropical storms). Therefore, built structures intended to last for decades need to be designed to withstand exposure to an altered climate. Specifically project aspects sensitive to weather (e.g., materials, location) need to be examined to ensure that they are appropriate.

In planning for these changes, construction projects also must ensure that mitigation measures to eliminate on-site risks do not negatively affect buildings or populations in a neighboring area. For example, drainage systems on site could increase water flowing through nearby properties, thereby increasing the chance of flooding.

In the context of EIA, mitigation is the implementation of measures designed to eliminate, reduce or offset the undesirable effects of a proposed action on the environment.

In the context of climate change, mitigation is an intervention to reduce the sources or enhance the sinks of greenhouse gases in order to limit the magnitude and/or rate of climate change.

Furthermore, greenhouse gas emissions from the construction sector can contribute to the causes of climate change, and should be reduced where possible (see *Minimizing Greenhouse Gas Emissions and Maximizing Sequestration* section below).

ADAPTING TO CLIMATE CHANGE BY MINIMIZING VULNERABILITY THROUGH PROJECT DESIGN

Adapting construction planning, design, operation, and maintenance to climate change involves ensuring that structures and the systems that sustain them are able to withstand increased variability and duration of temperature, wind, and precipitation, in order to protect vulnerable users such as children, workers, or the elderly and ill.

Architects and engineering professionals undertaking construction projects should focus on incorporating information from historical records, recent trends, and future projections. The timeframe of projects should reflect the type of investment being made. For example, housing construction projects may have a shorter timeframe than a project to construct a health facility. Future projections should also take into consideration environmental thresholds that, if surpassed, could cause rapid ecosystem change. Note that near-term projections are more reliable and less uncertain than long-term emissions and climate predictions. In many cases managing for greater uncertainty rather than specific trends may be most appropriate

From a **risk management perspective**, it is less costly to design for the potential direct and indirect impacts of climate change on construction, maintenance and operation activities and people than to continue practicing "business as usual" and have the users, businesses, and governments risk paying the full cost of damages or face the loss of service in the future.

For example, design and siting for structures near the sea should take into account potential changes in daily sea levels, sea rise, and storm surges and appropriate locations should be selected based on these considerations. The same principle applies to construction near flood plains, rivers and wetlands. In locations where annual average temperatures are rising, design of buildings, water conveyance structures, and other works will need to consider the need for additional cooling capacity. Climate change adaptation for construction also includes integrating, where economically feasible, renewable and/or back up energy systems to provide power in the event of sudden or intermittent electrical outages as a result of weather events.

POTENTIAL CLIMATE CHANGE IMPACTS THAT COULD AFFECT PROJECTS IN THE CONSTRUCTION SECTOR

DIRECT IMPACTS	INDIRECT IMPACTS	POSSIBLE ADAPTATION RESPONSES
ILLUSTRATIVE EXAMPLES	ILLUSTRATIVE EXAMPLES	ILLUSTRATIVE EXAMPLES; ADAPTATION RESPONSES SHOULD BE TAILORED TO LOCAL CIRCUMSTANCES
• Damaged infrastructure for energy, transportation, water resources, communications, housing, and other services from extreme climate events • Inundation of infrastructure from sea level rise • Damage to paved roads and rail from excess heat • Adverse impacts on worker health due to increased heat stress	• Adverse impacts on health, and lost productivity due to disruptions in piped water and sewerage services if infrastructure is damaged • Higher operating and maintenance costs and/or shorter lifetime of water systems, potential for rising water prices • Loss of transportation system efficiency • Electricity blackouts/brownouts • Change in hydropower potential • Interrupted trade and	• Design back-up transportation services • Construct storm surge barriers • Elevate driveways • Relocate infrastructure to less exposed locations • Use permeable pavement • Increase financial and technical resources for more frequent maintenance and repairs • Establish natural buffer zones on coasts • Plan for redundancy to accommodate disruptions in service (e.g., water supply); install backup systems for critical hospital, home needs • Update design standards • Incentivize the use of building materials that reflect heat and facilitate cooling efficiency • Elevate electrical equipment and structures above flood and sea levels • Purchase insurance • Prepare for disruptions by developing contingency

• Increased precipitation leading to increased storm water runoff and pollutants entering streams from impervious surfaces	industry	plans • Reconsider zoning and planning regulations to locate housing structures in "safe" or less vulnerable zones • Construct buildings with resilient designs and materials

MINIMIZING GREENHOUSE GAS EMISSIONS AND MAXIMIZING SEQUESTRATION

The construction industry can reduce greenhouse gas contributions by taking steps to improve energy efficiency and reduce equipment emissions. The activity should aim to reduce emissions immediately, but also to support sustained low-emissions through investments. Emissions reductions can be achieved through green building design and practices that conserve electricity and fuel; renewable energy sources; efficient office equipment, electrical powered equipment, and water systems; and reuse and recycling of solid and human wastes. In addition, greenhouse gas reductions from equipment can come through decreasing fuel use, reducing idling times, regular equipment maintenance, driver training, utilizing properly sized equipment, replacing or repowering equipment, and using alternatives to diesel generators. Recycling unused construction materials and demolition debris can also avert greenhouse gas emissions that would otherwise be generated from the harvesting and processing of new materials.

ENVIRONMENTAL MITIGATION AND MONITORING

Notes: Environmentally and Socially Responsible construction contracting is strongly encouraged to best assure implementation of appropriate mitigation measures in any construction activity.

Many of the problems listed in the table below may be affected by climate change, or may impact climate. The associated mitigation measures may be particularly helpful for increasing adaptive capacity, or for decreasing sensitivity or exposure to potential climate changes.

ENVIRONMENTAL MITIGATION AND MONITORING ISSUES FOR CONSTRUCTION-RELATED ASPECTS OF DEVELOPMENT PROJECTS

ISSUE OR ASPECT OF ACTIVITY	IMPACT	MITIGATION
	THE ACTIVITY MAY. . .	NOTE: MITIGATIONS APPLY TO SPECIFIED PROJECT PHASE: SITE SELECTION (SS); PLANNING AND DESIGN (P&D), CONSTRUCTION (C), OR OPERATION AND MAINTENANCE (O&M)
SITE SELECTION (SS)		
Unoccupied/ undeveloped urban site will be developed	Increase impermeable surface area Increase litter	Identify opportunities to manage stormwater through the use of permeable pavements or the use of rain gardens or green roofs (P&D) Ensure that waste/litter baskets are located on-site and that the waste generated on-site feeds into the municipal solid waste management system (O&M)
Site occupied or used by local residents	Displace untenured residents or reduce farmers' or pastoralists' lands	Find alternative location (SS). If that is not possible: Provide equivalent land and/or accommodations or fair monetary compensation, provided these are accepted voluntarily and without coercion (SS)
Dwellings located close by	Facility and/or construction disturbs neighbors, creating noise and dust Alter the erosion or flooding impacts on neighboring homes or buildings.	Build in locations pre-determined by local/community plans or in consultation with neighbors (SS) Concentrate noisiest types of work into as short a period as possible, and during least disruptive times of the day. Take measures to keep dust to a minimum (P&D)(C) Design-in to the landscaping plan the protection of existing trees on-site serving as a source of shade, windbreak, or providing other benefits (P&D) Screen facility with trees or fencing to control noise (P&D)

ISSUE OR ASPECT OF ACTIVITY	IMPACT	MITIGATION
	THE ACTIVITY MAY. . .	NOTE: MITIGATIONS APPLY TO SPECIFIED PROJECT PHASE: SITE SELECTION (SS); PLANNING AND DESIGN (P&D), CONSTRUCTION (C), OR OPERATION AND MAINTENANCE (O&M)
		Wet ground if water is abundant and/or leave natural cover intact as long as possible (C)
Site has historic, cultural, or social importance	Offend local population; damage local social fabric	Find alternative site (SS)
Site would require road improvement or new road construction (Also consult *Rural Roads Guideline*)	Cause one or more of a set of adverse environmental impacts typical of roads, including erosion, changing water tables, providing access for illegal land clearing, logging or poaching, or increasing GHG emissions due to increased transportation distances	Find alternative site. Evaluate "minimum tool" alternatives (e.g., consider whether a foot or bicycle path might suffice (SS) (O&M) Follow guidance on design, construction, and operation and maintenance described in "Rural Roads" and resources listed there
Site contains habitat for important ecosystems, animals or plants	Destroy or harm plants or animals of ecological, cultural, and/or economic importance (this could increase emissions from deforestation; it could also increase exposure to climate change impacts by removing natural buffers)	Find alternative location (SS). If that is not possible: Limit access to the site Design any infrastructure (if unavoidable) to create least impact (P&D) Minimize disturbance of native flora during construction (P&D) (C) Remove, without destroying, and relocate large plants and ground cover where possible (C) Replant recovered plants and other flora from local ecosystem after construction (C) Minimize impact to ecosystem services that may provide an important buffer to climate change impacts, especially in areas where those buffers will most be needed
Site has important scenic, archeological or cultural/historical features	Destroy or harm these sites	Find alternative location (SS). If that is not possible: Limit access to site Design any infrastructure (if unavoidable) to create least impact (P&D) Minimize disturbance of site during construction (P&D) (C) Remove important artifacts where possible (C) Provide worker incentives for discovery and safe removal of archeological or paleontological material (SS) (C)

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	THE ACTIVITY MAY. . .	NOTE: MITIGATIONS APPLY TO SPECIFIED PROJECT PHASE: SITE SELECTION (SS); PLANNING AND DESIGN (P&D), CONSTRUCTION (C), OR OPERATION AND MAINTENANCE (O&M)
Site is wetland or abuts body of water	Destroy or harm valuable and sensitive ecosystems and organisms (this could increase emissions from land use change; it could also increase exposure to climate change impacts by removing natural buffers)	Find alternative site. Wetlands and *riparian* ecosystems (those sited next to a body of water) are extremely sensitive. Wetlands provide important environmental services such as water storage, bird and animal habitat, flood control, and filtering toxins and nutrients from runoff (SS). If no alternative is available: Set back any infrastructure as far as possible from the water body/wetland and minimize the amount of wetland destroyed by infrastructure footprint or construction (SS) (P&D) Revegetate as soon as possible (C) Minimize impact to ecosystem services that may provide an important buffer to climate change impacts, especially in areas where those buffers will most be needed If facility will include sanitation facility, find alternative site (SS)
Site is steeply sloped	Cause erosion and damage to terrestrial and aquatic ecosystems during construction or use. These impacts could be exacerbated by an increase in extreme events due to climate change.	Integrate climate projections into project development and operations planning Find alternative site (SS). If that is not possible: Design facility and apply construction practices that minimize risk, e.g., use hay bales to control erosion during construction. Pay particular attention to potential erosion and redirection of water flows during design and construction (SS) (P&D) (C) Re-vegetate as soon as possible (C) Maintain design features (O&M)
Area is heavily wooded	Degrade forest, contributing to flooding potential and increased GHG emissions. This could also increase exposure to climate change impacts by removing natural buffers and local climate regulation.	Find alternative location if area is old growth or relatively undegraded forest (SS). If that is not possible: Design so as to minimize clearing or disturbance (P&D) Avoid destroying rare or unique species. Consult with local populations about current use of forest and preferences for preserving historic uses (SS) (P&D) (C) Integrate climate projections into project development and operations planning

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	THE ACTIVITY MAY. . .	NOTE: MITIGATIONS APPLY TO SPECIFIED PROJECT PHASE: SITE SELECTION (SS); PLANNING AND DESIGN (P&D), CONSTRUCTION (C), OR OPERATION AND MAINTENANCE (O&M)
Site prone to flooding	Be destroyed and/or subject workers or inhabitants to risk of injury or death Cause environmental damage from accidental release of toxic, infectious or otherwise harmful material during flooding Contaminate drinking water Exacerbate flooding problems in neighboring areas These impacts could be exacerbated by an increase in extreme events or changes in precipitation patterns due to climate change. Sites not currently prone to flooding could become prone to flooding due to climate change.	Integrate climate projections into project development and operations planning, to account for projected frequency and severity of flooding Find alternative site or design infrastructure so it is raised above flood plain, if possible (SS) Design infrastructure to minimize risk, e.g., design with proper grading and drainage (P&D) Plant vegetation to reduce flooding Consider impact of flood mitigation measures on neighboring buildings and residents Maintain design features such as drainage structures (O&M) Avoid constructing sanitation or other facilities that will use and store harmful materials at flood-prone sites (SS). If that is not possible: Design storage area so that hazardous materials are above ground and/or in waterproof containers with locking lids that are kept closed. Ensure that facility operators follow these practices (P&D)(O&M) Chose dry sanitation options or closed disposal systems, instead of wet ones such as septic tanks or detention ponds (P&D)
Area and/site prone to landslides	Be destroyed and/or expose workers or inhabitants to risk of injury or death Cause environmental damage from accidental release of toxic, infectious or otherwise harmful material Contaminate water supplies These impacts could be exacerbated by an increase in extreme events or changes in precipitation patterns due to climate change. Sites not currently prone to landslides could become prone to landslides due to climate change.	Integrate climate projections into project development and operations planning Find alternative site on stable ground (SS). If that is not possible: Design infrastructure to minimize risk, e.g., plant trees all around facility (P&D) Maintain protective design features (O&M) Avoid constructing sanitation or other facilities that will use and store hazardous or bio-hazardous materials at landslide-prone sites (SS). If that is not possible: Design storage area so that hazardous materials are stored in durable leak-proof containers with locking lids, and that these are kept closed (P&D)(O&M) Chose dry sanitation options or closed disposal systems, instead of wet ones such as septic tanks or detention ponds (P&D)

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	THE ACTIVITY MAY. . .	NOTE: MITIGATIONS APPLY TO SPECIFIED PROJECT PHASE: SITE SELECTION (SS); PLANNING AND DESIGN (P&D), CONSTRUCTION (C), OR OPERATION AND MAINTENANCE (O&M)
Site is contaminated with lead, pesticides or other toxics	Liberate these toxic materials and poison workers, users, nearly communities, water resources, and ecosystems. NOTE: if the site is in a mining area and especially contains mining tailings or spoil, there is a high probability of site contamination	Choose a different site. (SS) If site contamination is suspected, obtain a professional assessment, including remediation recommendations and host country compliance requirements. Remediate contamination before beginning construction. (P&D) For soil contamination (e.g., with lead), suppress dust during construction and cap site with non-contaminated soil; plant and maintain ground cover. (P&D, C, O&M)
PLANNING AND DESIGN		
Area experiences heavy rainfall, earthquakes	Be destroyed and/or expose workers or inhabitants to risk of injury or death Cause environmental damage and/or contaminate water supplies via accidental release of toxic, infectious or otherwise harmful material Weather-related impacts could be exacerbated by an increase in extreme events or changes in precipitation patterns due to climate change. Sites not currently experiencing heavy rainfall may in the future due to climate change.	Integrate climate projections into project development and operations planning, as heat stress and the frequency and severity of heavy rainfall may change. Design infrastructure to minimize risk, e.g., in earthquake-prone areas, build structures with wood frames instead of concrete or brick (P&D) Maintain protective design features (e.g., drainage structures and vegetation on slopes). (O&M) Use material appropriate to the climate (e. g., stucco instead of adobe in areas with heavy rainfall) (P&D) (C) Design storage area so that hazardous materials are above the ground and/or in waterproof containers. Ensure that facility operators follow these practices (P&D)(O&M) Chose dry sanitation options or closed disposal systems, instead of wet ones such as septic tanks or detention ponds (P&D)
Facility is or will include a water supply improvement (Also consult *Water*	Deplete ground and/or surface water resources and damage local ecosystems or downstream/down-gradient communities. This could be exacerbated by reduced or more variable precipitation due to climate	Integrate climate projections into project development and operations planning, as climate change may affect future availability of water resources Determine safe and sustainable yield. Establish system for regulating use (P&D) (O&M)

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Supply and Sanitation Guideline)	change. Poison users with natural or man-made chemical contaminants such as arsenic Spread disease with pathogenic contaminants Cause groundwater contamination	Test seasonal water quality and examine historical water quality and quantity data before building facility (SS) (P&D) Incorporate siting, design and operation and maintenance practices that minimize environmental impacts as described in the *Water Supply and Sanitation Guideline* (e.g., community participation, fee-for-service pricing, preventing livestock grazing near water supply, etc.) (SS) (P&D) (C) (O&M)
Facility is or will include a sanitation improvement (Also consult *Water Supply and Sanitation Guideline*)	Discharge untreated or insufficiently treated sewage that: Contaminates drinking water (ground and surface) Spreads diseases Degrades aquatic ecosystems The impact on drinking water or aquatic ecosystems could be exacerbated if those systems are stressed due to climate change.	Integrate climate projections into project development and operations planning, as climate change may affect ecosystems and future availability of water resources Do not site in wetland or next to stream, river, lake or well (SS) Do not site up-gradient from potable water sources such as wells, if possible (SS) Do not site where water table is high or underlying geology makes contamination of groundwater likely. Alternately, choose dry sanitation options or closed disposal systems, instead of wet ones such as septic tanks or detention ponds (SS) (P&D) Incorporate design features, education/social marketing programs, construction and operation and maintenance practices described in the "Water Supply and Sanitation" section of these *Guidelines* and resources listed there; e.g., community participation, sanitation promotion focusing on women and children, use of appropriate natural treatment systems, etc. (SS) (P&D) (C) (O&M)
Facility will provide healthcare services (Also consult the *Healthcare Waste Guideline*)	Spread disease via failure to (1) sterilize infectious waste and/or (2) prevent access to waste by waste pickers or disease vectors Expose local community to health risks via unsafe disposal of toxic, carcinogenic and teratogenic[5] materials Contaminate water supplies (ground and/or surface)	Do not site in wetland or next to stream, river, lake or well (SS) Incorporate design features and O&M procedures, described in the *Healthcare Waste Guideline*, including, but not limited to, hand-washing facilities, waste storage rooms, incinerators (if rural), spaces for encapsulation, and a plastic/clay-lined pit for safe burial (SS) (P&D) (C) (O&M). Among the most important guidelines from this section: If waste will be buried on site, avoid wherever possible siting the burial pit up-

[5] Teratogenic means causing birth defects.

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	via improper land disposal. (May also damage local ecosystems, animals or plants.)	gradient from a drinking water source such as a well. Pit must be lined with impermeable material such as clay or polyethylene (SS) (P&D) (C) If waste will be buried on site, avoid wherever possible sites where water table is high or underlying geology makes contamination of groundwater likely. If no alternative site is available, ensure that pit is lined with impermeable material such as clay or polyethylene (SS) (P&D) (C) Provide for safe disposal of gray water from bathing and washing of bedding, etc. (P&D; O&M) Ensure that the system of human waste disposal provided minimizes health risks (P&D; O&M) Ensure that water is provided to the facility in a manner that minimizes risk of contamination for patients and nearby communities (P&D; O&M)
Facility will generate solid waste (Also consult the *Management of Solid Waste Guideline*)	Spread disease Contaminate drinking water (ground and surface) Degrade aquatic ecosystems Generate GHG emissions	Include space and features for source separation of recyclables and organic waste. Consider including space and/or constructing a compost bin or worm box if facility will produce organic waste (P&D) (C) (O&M)
Facility will house automotive, laboratory or other industrial activities (Also consult the *Micro and Small Enterprises (MSEs) Guidelines*)	Expose workers or local population to toxic, carcinogenic and teratogenic materials such as heavy metals, oil, lubricants, batteries, dyes, glue, solvents, acids, etc. Contaminate drinking water (ground and surface) Damage local ecosystems, animals or plants	Do not site near wetlands or bodies of water (SS) Design with proper storage, handling and treatment facilities (SS) (P&D) (C) (O&M)
Facility will generate cooling waters, soaking waters, or water containing suspended organic mater, mercury, lead, soaps, etc.	Expose workers or local population to toxic, carcinogenic and teratogenic materials Contaminate drinking water (ground and surface) Damage local ecosystems, animals or plants	Integrate climate projections into project development and operations planning, as climate change may affect future availability of water resources Incorporate cleaner production technologies into design, operation and maintenance as described in the *Micro and Small Enterprises (MSEs) Guidelines* and resources listed there (SS) (P&D) (C) (O&M) Design with elements for storage, treatment and discharge of wastewater

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(Also consult the *Micro and Small Enterprises (MSEs) Guidelines*)		(P&D) (O&M)
Indirect effects on local populations	Damage or destroy natural resources Increase in-migration Damage local social and cultural integrity Facilitate spread of disease to both people and animals Contribute to climate change maladaptation	Research indirect effects that may be associated with the particular type of facility being built and evaluate other possible impacts of this type. If the project falls into one of the sectors covered in the *Guidelines*, the relevant sector briefing and the resources listed therein are starting points for this research (SS) (P&D) (C) (O&M)
Cumulative effects of one development project over time or many small developments built within a short time period	Cause excessive extraction of building materials, multiply impacts associated with logging undegraded forest, quarrying and obtaining sand, gravel and fill ("borrowing"). (see below for more detail)	Develop logging, quarrying and borrowing plans that take into account cumulative effects and include reclamation plans (P&D) Monitor adherence to plans and impacts of extraction practices. Modify as necessary (C) (O&M)
	Reduce the useful life of the facility, or put users of the facility at risk during extreme weather events, if improperly designed	Design for anticipated changes in climate (local level) in the near-, mid-, and long-term (P&D)
	Contribute unnecessarily to GHG emissions	Design for energy efficiency in building design and equipment selection (P&D) Greenhouse gas reductions from equipment can come through decreasing fuel use, reducing idling times, regular equipment maintenance, driver training, utilizing properly sized equipment, replacing or repowering equipment, and using alternatives to diesel generators. Recycling unused construction materials and demolition debris can also avert GHG emissions that would otherwise be generated from the harvesting and processing of new materials.
CONSTRUCTION (NOTE: MEASURES CONTAINED IN THE ""MINIMUM RECOMMENDED PRACTICES FOR OCCUPATIONAL SAFETY AND HEALTH RISK MANAGEMENT IN CONSTRUCTION" (ANNEX 1) ARE UNDERLINED.)		
General Occupational Health and Safety	Cause worker injuries or illness from falls and falling objects, collapses and heavy equipment, flying debris,	Follow host country occupational safety and health standards for construction. Under no circumstances, however, should construction health and safety

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Issues	exposure to toxics such as lead, asbestos, solvents, and cement dust; poor sanitation ; heat stress	practices be less protective than the minimum practices specified in annex 1, even where local requirements do not exist or are unclear. See Annex 1.
Construction crews and camps	Damage local habitat, compact soil and create erosion via building and occupation of construction camps Contaminate surface water and spread disease via solid waste and feces generated by camps Spread communicable diseases including malaria, tuberculosis, and HIV/AIDS via construction crews who come from outside the region Introduce alcohol or other socially destructive substances via construction crews Deplete local fauna and flora (especially game and fuelwood) via poaching and collection by construction crews	Explore off-site accommodation for crew, including in existing hotels or lodgings (P&D) (C) Keep camp size to a minimum. Require that crew preserve as much vegetation as possible, e.g., by creating defined footpaths (P&D) (C) Provide temporary sanitation on site, e.g., pit latrine (assuming the water table is low enough, with soil and geology of appropriate composition) (P&D) (C) Use local or regional labor, if possible. Screen potential crew members for HIV/AIDS and tuberculosis. Provide education and strict guidelines regarding contact with local residents, and enforce guidelines (P&D) (C) Set guidelines prohibiting poaching and collection of plants/wood with meaningful consequences for violation such as termination of employment. Provide adequate quantities of food and cooking fuel; both should be of good quality (C) Consider climate impacts and the needs of the local population
Use of heavy equipment	Cause erosion due to machinery tracks, damage to roads, stream banks, etc Compact soil, changing surface and groundwater flows and damaging future use for agriculture Contaminate ground or surface water when machinery repairs result in spills or dumping of hydraulic oil, motor oil or other harmful mechanical fluids Produce GHG emissions	Minimize use of heavy machinery (P&D) (C) Set protocols for vehicle maintenance such as requiring that repairs and fueling occur elsewhere or over impervious surface such as plastic sheeting. Prevent dumping of hazardous materials. (P&D) (C)
Use of hazardous	Contaminate ground or surface water when hazardous	Prevent dumping of hazardous materials. Burn waste materials that are not reusable/readily recyclable IF they do not contain heavy metals and are

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materials	construction materials are spilled or dumped Put workers/users at risk from exposure to hazardous materials	flammable (P&D) (C). Investigate and use less toxic alternative products (P&D) (C)
Demolition of existing structures (excluding hazardous materials issues)	Bother or endanger neighbors via noise, dust, and debris from demolition. Contaminates soil, groundwater or surface water from demolition waste containing residual amounts of toxic materials (e.g., leaded paint) Increase in GHG emissions due to need to harvest and process new materials.	Recover all reusable material (this may be standard practice in many developing countries) (P&D) (C) Determine whether toxic materials are present. If possible, dispose of waste in lined landfill. Otherwise, explore options for reuse in areas where potential for contamination of surface and groundwater are small (e.g., consider the feasibility of use as roadbed material, if non-hazardous.). (See the *Solid Waste Guideline* and references listed there for a more information) (P&D) (C)
Site clearing and/or leveling	Damage or destroy sensitive terrestrial ecosystems in the course of site clearing/preparation Increase greenhouse gas emissions from deforestation or land clearing. Produce areas of bare soil, which cause erosion, siltation, changes in natural water flow, and/or damage to aquatic ecosystems. These impacts can be exacerbated by more variable precipitation due to climate change.	Design infrastructure so that it will create least impact (P&D) Minimize disturbance of native flora during construction (P&D) (C) Remove, without destroying, large plants and ground cover where possible (P&D) (C) Use erosion control measures such as hay bales (C) Replant recovered plants and local flora as soon as possible (C)
Excavation	Cause erosion, siltation, changes in natural water flow, and/or damage to aquatic ecosystems when excavated soil is piled inappropriately Expose inhabitants and crew to risk of falls and injuries in excavation pits Deprive down-gradient populations and ecosystems of water if higher regions of aquifer are blocked	Cover pile with plastic sheeting, prevent runoff with hay bales, or similar measures (P&D) (C) Place fence around excavation (P&D) (C) Investigate alternatives allowing shallower or no excavation (P&D)

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Filling	Block water courses when fill is inappropriately placed Destroy valuable ecosystems when fill is inappropriately placed Result in land subsidence or landslides later if fill is inappropriately placed, causing injuries or damage	Do not fill the flow-line of a watershed Be aware that in arid areas, occasional rains may create strong water flows in channels. A culvert may not supply adequate capacity for rare high volume events such as flash floods. (SS) (P&D) Design so that filling will not be necessary. Transplant as much vegetation and groundcover as possible (SS) (P&D) (C) Use good engineering practices (e.g., do not use soil alone. First lay a bed of rock and gravel) (P&D) (C)
Road improvement/new road construction (Consult the *Rural Roads Guideline* and resources listed there)	Erosion and changes to water quality and natural water flows via poor road construction practices and maintenance. These impacts may be exacerbated due to change in precipitation patterns due to climate change. Provide access for clearing agricultural land, logging, poaching, mining, settlement or other development that destroys natural resources, harms local populations, and/or leads to greenhouse gas emissions due to land use change Lead to the spread of human or livestock disease	Integrate climate projections into project development and operations planning, as climate change may affect impacts on the road and the resulting impacts on the surrounding landscape. Minimize land use change and deforestation. Find alternative site. Evaluate whether an alternative mode of transport would suffice (e.g., rail, water, or footpath) (SS) (P&D) Adhere to specifications for road design and maintenance that keep water off road surfaces (P&D) (C) (O&M) Follow best practices for design, construction, and operation and maintenance described in the *Rural Roads Guideline* and resources listed there. These include practices such as developing quarry and borrow pit plans, following the contour line, using camber and turnout drains, training operations and maintenance personnel, etc. (SS)(P&D) (C) (O&M)
Source of building materials	Damage aquatic ecosystems through erosion and siltation Harm terrestrial ecosystems via harvesting of timber or other natural products	Identify the most environmentally sound source of materials within budget (P&D) Develop logging, quarrying and borrowing plans that take into account cumulative effects (P&D)

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	Increase in greenhouse gas emissions due to land use change. Spread vector-borne diseases when stagnant water accumulates in active or abandoned quarries or borrow pits and breeds insect vectors	Monitor adherence to plans and impacts of extraction practices. Modify as necessary (C) (O&M) Fill in, quarries and pits before abandoning (C) Control runoff into pit (C) Avoid sourcing timber from unsustainable sources
DECOMMISSIONING		
Hazardous abandoned structures	Buildings with collapsing roofs and walls, open latrines or septic systems, accumulation of rubble	Remove or bury all abandoned construction materials and rubble Fill in and close all latrines and septic systems
Eroded soils in the vicinity of abandoned infrastructure	Gulleying and siltation. Damage to aesthetics. These impacts may be exacerbated due to more variable precipitation patterns due to climate change.	Restore the site through replanting, reseeding and use of soil erosion control measures (hay bales, etc.)

RESOURCES AND REFERENCES

IDENTIFYING AND MANAGING ENVIRONMENTAL IMPACTS IN CONSTRUCTION

- Additional Resources: Building Construction: Tools for the Identification of Environmental Effects Appropriate Mitigation Measures, and Guidelines for Specific Sectors of Activity (2007), *Environmental Handbook for Community Development Initiatives*. Canadian International Development Agency. http://www.acdi-cida.gc.ca/acdi-cida/acdi-cida.nsf/eng/EMA-218123618-NNH

- Center for International Forestry Research. Degraded Forest Land (definition). 2003. http://www.cifor.org/rehab/_ref/glossary/Degraded_Forest_Land.htm

- Tsunokawa, Koji and Christopher Hoban (Eds.) (1997) *Roads and the Environment: A Handbook. Wold Bank Technical Paper No. 376*. World Bank, Washington, D.C. http://www.worldbank.org/transport/publicat/reh/toc.htm

- USAID. *ENCAP Visual Field Guide: Construction:* For quick identification of serious environmental & occupational health and safety concerns in small-scale construction. December 2011.

MANAGING LEAD AND ASBESTOS IN REHABILITATION

See references provided in Annexes 2 & 3

OCCUPATIONAL SAFETY AND HEALTH IN CONSTRUCTION: STANDARDS

- International Finance Corporation., 2007. *IFC Environmental, Health and Safety Guidelines: 2.0 Occupational Health and Safety and 4.0 Constructions and Decommissioning.* www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines.

- International Labour Organization, 1995. *Safety, Health and Welfare on Construction Sites - A Training Manual. http://www.ilo.org/safework/info/instr/lang--en/docName--WCMS_110237/index.htm*

- International Labour Office, 1992. *Safety and Health in Construction: an ILO Code of Practice.* ISBN 92-2-107104-9. Geneva.

- Also see other resources produced by the ILO's SafeWork program: *http://www.ilo.org/safework/lang--en/index.htm*

- United States Occupational Safety and Health Administration (OSHA). *OSHA Pocket Guide: Worker Safety Series – Construction.* http://www.osha.gov/Publications/osha3252.pdf

  Pocket guide to the most common health and safety hazards at US construction sites and the basic requirements of US standards in each case.

- Also see OSHA's Construction Industry Home Page. http://www.osha.gov/doc/index.html. Single point of access to all US federal occupational safety and health standards for construction and a number of related training materials.

OCCUPATIONAL SAFETY AND HEALTH IN CONSTRUCTION: CHALLENGES AND BARRIERS

- Kheni et al., 2008. "Institutional and Economic Challenges to Health and Safety Management Within SMEs in Developing Countries: A Case Study of Ghana" in Conference Proceedings: *Evolution of and Directions in Construction Safety and Health* (Hinze et al, eds.) International Council for Research and Innovation in Building and Construction (CIB). March. Available at: http://www.irbdirekt.de/daten/iconda/CIB10336.pdf

- Kheni et al, 2008. Health and Safety Management in Developing Countries: A Study of Construction SMEs in Ghana" in *Construction Management and Economics*. 26 (11) pp 1159–1169. https://dspace.lboro.ac.uk/dspace-jspui/handle/2134/5942

  Documents the barriers to occupational safety and health good practice and compliance, including fragmented government responsibility, poor construction firm capacity, and lack of responsible contracting practice. Also contains a useful biography for construction health and safety issues in developing countries.

RESPONSIBLE CONSTRUCTION CONTRACTING

- Wells, J and J Hawkins. *Promoting Construction Health and Safety through Procurement: a briefing note for developing countries*. Engineers Against Poverty; Institution of Civil Engineers, 2009. London. www.engineersagainstpoverty.org/_db/_documents/EAP-ICE_HS_Briefing_Note.pdf

  See the above website for description and outputs of the Engineers against Poverty "Health and Safety in Construction" initiative.

CLIMATE CHANGE

Note: USAID's Global Climate Change (GCC) Office can provide support on the climate change aspects of this Guideline. To contact the GCC office, please email: climatechange@usaid.gov

- USAID. 2007. Adapting to Climate Variability and Change: A Guidance Manual for Development Planning. http://pdf.usaid.gov/pdf_docs/PNADJ990.pdf

- USAID. 2009. Adapting to Coastal Climate Change: A Guidebook for Development Planners. http://pdf.usaid.gov/pdf_docs/PNADO614.pdf

  The guidances provide information to assist planners and stakeholders as they cope with a changing climate throughout the project cycle.

- AGC of America. 2009. Climate Change and the Construction Industry. *http://www.agc.org/galleries/advy/ClimateChangeandConstruction.pdf*

- U.S. Green Building Council. http://www.usgbc.org/

- Leadership in Energy and Environmental Design (LEED). https://www.leedonline.com/irj/servlet/prt/portal/prtroot/com.sap.portal.navigation.portallauncher.anonymous

- International Association for Impact Assessment (IAIA). FasTips #3. February 2013. Climate Smart Decisions. http://www.iaia.org/publicdocuments/special-publications/fast-tips/Fastips_3%20Climate%20Smart%20Decisions.pdf

- National Institute of Building Sciences. Whole Building Design Guide. 2013. Passive Solar Heating. http://www.wbdg.org/resources/psheating.php
- Fact sheet on "Addressing Climate Change Impacts on Infrastructure: Buildings" http://inside.usaid.gov/E3/offices/enviro_sci/climate/publications/upload/infrastructure_and_climate_change_buildings_12apr13.pdf

ANNEX 1: MINIMUM RECOMMENDED OCCUPATIONAL SAFETY AND HEALTH PRACTICES IN SMALL-SCALE CONSTRUCTION

Many developing countries have occupational health and safety requirements that apply to construction sites and workers. On USAID-funded projects, compliance with such host country requirements is mandatory.

More than this, USAID expects its construction projects to attain a level of protection of workers and public health as close to US standards as the local situation will allow.

Under no circumstances, however, should this principle be interpreted to result in construction health and safety practices less protective than the minimum practices specified in this annex, even where local requirements do not exist or are unclear.

These minimum practices also can be used as the basis for field inspection of construction activities by individuals with oversight authority who are not construction health and safety specialists. (The *Visual Field Guide: Construction* is a simple field monitoring tool based on these minimum practices. Available online at: http://www.usaidgems.org/fieldGuides.htm)

It should be assumed that failure to implement these minimum practices indicates serious and significant non-compliance with any host country requirements.

Compliance with a health or safety standard should be a requirement of any construction contract. (see "Environmentally and Socially Responsible Construction Contracting" on page 5.)

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1. Policies and Training.

- All workers receive a safety and health induction that explains safe work practices, the proper use of personal protective equipment, and their safety and health protections under law.
- The construction contractor has a written policy in place regarding worker health and safety and commitment to compliance with host country requirements.
- The construction contractor has an internal system for (1) regular self-inspection of site against these standards and (2) tracking violations and accidents.

2. Site Management

- Site boundary is well-marked and access actively controlled.
- Good housekeeping practices are in place — site maintained in a generally orderly condition
- Safety signs and posters—at minimum, to mark site boundary, hardhat areas, explosion and toxic hazards.
- Smoking is banned altogether or restricted to designated smoking area well away from flammable materials.

3. Hygiene and First Aid

- First Aid kit is on-site, as is someone familiar with its use and trained in basic first aid.
- Drinking water and sanitary facilities are provided (or very close at hand), including hand-wash station.
- All workers have an up-to-date tetanus vaccination.

4. Personal protective equipment.

The following equipment is supplied as specified and its use enforced:

Hardhats	Required whenever flying debris may be generated (as in demolition) or there is a risk of tools or materials objects falling from head height or higher.
Footwear providing reasonable protection against sole puncture*	All workers at all times. (*e.g., Foam flip-flops are NOT acceptable. Sandals made from scrap tire are)
Hard-toed boots	All workers engaged in excavation, demolition, or working around heavy equipment.
Respiratory Protection	2-strap N95* dust mask or better when mixing portland cement or polishing or cutting concrete or stone. 2-strap N95 dust masks or better to ANY WORKER desiring to use them Activated-carbon half-mask respirator when using highly volatile solvents (e.g., contact cements) See respiratory protection recommendations for work involving leaded paint or asbestos in asbestos and lead-paint annexes to this guideline.
Hearing protection	Mandatory for all workers using powered tools or working in close proximity to these operations
Safety Glasses	All workers engaged in demolition, grinding, cutting, or using power tools, or working in close proximity to these operations.
Reflective vests	Mandatory for all individuals working in proximity to heavy equipment and during demolition.

*US National Institute for Occupational Safety and Health Standard. "N95" designates a respiratory protection device rated to capture at least 95% of airborne particles.

Note: toxic materials not referenced on this chart will require additional protection.

5. Scaffolding & Fall Protection

- Scaffolding must be able to carry at LEAST 4 times its maximum intended load without settling or displacement.
- Scaffolding must be on solid footing—footing may NOT be boxes, loose bricks and stones, etc.
- Scaffolding has guardrails, midrails and toeboards
- Scaffolding is at least 3m from any electric power line

- Scaffolding inspected EACH DAY by a competent manager
- Guardrails or at least ropes near the edge of floors and roofs where a drop is greater than 2m. If not possible, workers in these areas to wear a body harness and rope.

6. Trenches

- spoils are maintained at least 1m back from edge of trench
- shore or slope back the trench wall for ANY trench 1.75m or deeper
- provide a means of exit (ladder, stair, ramp) at least every 10m.

7. Toxics.

- Neither leaded paint nor asbestos in any form is used in new construction
- For rehabilitation or demolition, check <u>prior to commencing work</u> whether lead-based paint, asbestos (including roofing sheets) and other toxics are present
- If present, a management plan exists that specifies safe practices to be followed and determines disposal of any waste. Appropriate worker training and PPE must be provided.*

*See "Rehabilitation works involving asbestos" and "Rehabilitation works involving leaded paint," also annexed to this guideline.

ANNEX 2: REHABILITATION WORKS INVOLVING LEADED PAINT

Lead and Health. Lead is a soft, dense metal used since ancient times. It is highly hazardous to children: lead poisoning reduces intelligence and causes learning disabilities and behavior problems; these problems can begin in the womb. Lead is also hazardous to adults, and can result in high blood pressure, loss of mental acuity and memory, miscarriage and male infertility, among other impacts. Lead poisoning can occur by ingestion, breathing fine particles of lead in the air, or by drinking water containing lead.

Leaded Paint in Developing Countries. Historically, lead was a common ingredient in interior and exterior building paints worldwide. This posed particular risks to children, who frequently put their hands in their mouths and are thus easily poisoned by ingesting flakes and dust from deteriorating paint on window, doors and other surfaces.

Consequently, lead paint is now almost uniformly banned in wealthy economies—the US ban took effect in 1978. But it is well-documented that a great deal of leaded paint is still sold in sub-Saharan Africa, Asia, and Latin America—even where officially banned. And even where not still sold, leaded paint is present in older structures.

The problem is significant enough that elevated blood lead levels in children are suspected as a significant public health issue in urban areas. This is increasingly being documented as fact with recent research (See references section.)

Colored enamel paint (e.g., glossy paints typically used on windows, doors and floors and in health care facilities) has a particularly high probability of being leaded.

Other common sources of lead poisoning include: contaminated water sources and soils from mine tailings and spoil, particularly from artisanal mining; and informal recycling of car batteries and electronic waste. Sub-Saharan Africa phased out leaded gasoline, previously a leading source of lead exposure, in 2006.

The Risks of Renovation/Rehabilitation Activities. Renovation or rehabilitation usually involves scraping or sanding surfaces and demolishing or cutting into building elements like walls, pillars, and window frames. If these surfaces are covered with leaded paint, these activities generate hazardous lead-containing paint flakes and dust particles. Construction workers are thus particularly at risk of lead poisoning.

Protecting workers from lead poisoning during rehabilitation is important. But it is also very important to clean up well *after* rehabilitation, particularly facilities like schools and clinics that will be used by children and women. And if a facility is being partially renovated while still in use it is very important to protect non-workers while the renovation is going on.

Managing Lead Hazards in Rehabilitation: First Steps. Managing lead hazards in rehabilitation begins with three steps:

1. **Check for leaded paint.** When undertaking rehabilitation works, first check for presence of lead paint with a swab-type test kit (on USAID-funded projects, these kits should be US EPA-recognized.).
2. **Determine if you need to disturb the paint.** If the planned rehabilitation involves disturbing leaded paint, ask if there is some way to avoid doing so—or to minimize the disturbance? For example, can a painted floor be covered over rather than scraped and repainted?

At the same time, rehabilitation works should NOT leave flaking or deteriorated lead paint behind, even if addressing this issue was not part of the original renovation plan.

3. **Determine the standards to apply.** If you need to disturb lead paint, determine what host country requirements, if any, apply to management of lead paint hazards in remediation work. On USAID-funded projects, compliance with such host country requirements is mandatory.

More than this, if US standards are more stringent, USAID expects its construction projects to attain a level of protection of workers and public health as close to US standards as the local situation will allow.

Under no circumstances, however, should this principle be interpreted to result in construction health and safety practices less protective than the minimum practices specified below, even where local requirements do not exist or are unclear.

Minimum Recommended Practices for Rehabilitation Works Involving Lead Paint.

1. Educate workers on lead paint hazards and the procedures enumerated below.
2. Provide and require proper PPE for workers
    - Effective filter mask—should filter at least 99.97% of airborne particles. If a disposable type, should have a metal or moldable nosepiece to assure tight fit. (US "N100" or "HEPA" standard)
    - Eye shields
    - Do not allow workers without this PPE into the work area.
3. Other safe worker behavior
    - Absolutely no eating, smoking or drinking while working in a lead hazard area
    - Wash hands and face after stopping work each time---i.e. before meals, bathroom breaks, and end of day.
    - Change clothes before going home. Clothes should be washed at the work site and water disposed to a seepage pit well above the water table.
    - Ideally, workers shower before going home; at minimum, workers sponge-bath, thoroughly wipe down all exposed skin and rinsing out hair.
4. **Contain the work area**
   If the total leaded paint area to be disturbed is less than 0.5 m2, or limited solely to light sanding or scraping that will be performed wet, full containment of the work area as described below is usually not necessary. Full containment IS required if the work is in an active school, clinic, or other facility used by women and children.)
    - Post hazard signs
    - Screen off the work area with plastic sheeting. The sheeting must be tightly taped or otherwise attached to walls and surfaces to prevent dust from escaping.
5. Minimize dust and hazard
    - Again, wherever possible, avoid sanding or scraping surfaces with leaded paint. Consider instead covering over woodwork and fixtures that have lead paint.
    - Do NOT use a powered sander, sand-blaster, or powered wire brush to remove paint.
    - Do not use torches or high-temperature heat guns to remove leaded paint (temperature must be less than 1100F).
    - Wet the surface before scraping or sanding. Wipe the surface with a damp cloth immediately after scraping/sanding & rinse cloth often.

6. Clean up thoroughly at the end of each work day.
   - Do NOT sweep dry dust. Instead, wet and then sweep.[6] Finish by wiping all surfaces—including plastic sheeting— with a damp cloth, rinsing frequently.
   - Damp-mop around the containment area.
7. Dispose of sweeping, debris and rinse water as safely as possible in the local context.
   - Store sweepings in a sealed container prior to disposal.
   - Unless a landfill certified for construction waste exists, dispose by burial ABOVE the water table.
   - Dispose of rinse water in a seepage pit well above the water table.
   - Do NOT burn construction waste containing objects covered with lead paint. This releases toxic lead fumes. Unless a landfill certified for construction waste exists, dispose by burial ABOVE the water table.
8. Make sure that new paint is not leaded!

ANNEX 2 REFERENCES:

- Lead paint test kits. US EPA maintains a webpage dedicated to EPA-recognized lead paint test kits: http://www.epa.gov/lead/pubs/testkit.htm.

  Lead-safe renovation hazards and practices:

- US Environmental Protection Agency (US EPA), 2010. The Lead-Safe Certified Guide to Renovate Right: Important lead hazard information for families, child care provider,s and schools. EPA-740-K-10-001. April. Available at www.epa.gov/lead/pubs/renovaterightbrochure.pdf.

  Explains the lead hazards posed by renovation & the basics of lead-safe work practices.

- US Department of Housing and Urban Development, 2001. Lead Paint Safety: a Field Guide for Painting, Home Maintenance, and Renovation Work. HUD-1779-LHC. March. Available at: www.hud.gov/offices/lead/training/LBPguide.pdf

  More detailed guidance on lead-safe practices in a number of common renovation situations.

- US EPA. Lead-Safe Renovation, Repair and Painting. http://www.epa.gov/lead/pubs/renovation.htm. Accessed 11 April 2011.

  General resource page on lead-safe practices and lead hazards in renovation work.

  Leaded paint in developing countries.

- International POPs Elimination Network, 2012. Global Lead Paint Elimination by 2020: A Test of the Effectiveness of the Strategic Approach to International Chemicals Management. Available at http://ipen.org/iccm3/wp-content/uploads/2012/09/IPEN-Global-Lead-Paint-Elimination-Report-2012.pdf

- Clark et al, 2009. "Lead levels in new enamel household paints from Asia, Africa and South America" in Environmental Research (109) 930–936. Available at http://www.eh.uc.edu/news/pdfs/7-7-09-clark.pdf.

[6] Instead of sweeping, the work area can first be vacuumed with a HEPA (high filtration) vacuum.

Documents high levels of lead in many new enamel paints manufactured in Asia, Africa and Latin America. Contains an extensive bibliography on the issue of lead-based paint in developing areas.

- Adebamowo,EO et al, 2007. "Lead content of dried films of domestic paint currently sold in Nigeria" in Science of the Total Environment (388) 116–120. Available at http://www.eh.uc.edu/news/pdfs/7-19-07-clark.pdf

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- University of Cincinnati, 2007. "Lead-based Paint Problem Isn't Isolated To China, Study Shows." ScienceDaily 2 Oct. Accessed 12 Apr. 2011. Available at www.sciencedaily.com/releases/2007/09/070927113155.htm

ANNEX 3: REHABILITATION WORKS INVOLVING ASBESTOS

ASBESTOS AND HEALTH

Asbestos refers to a group of related silicate minerals characterized by long, thin fibrous crystals. In its various forms, asbestos is flame- and chemical-resistant, and a good thermal and electrical insulator. Its fibers also add strength to other materials. For these reasons, asbestos was widely used worldwide in pipe and structural insulation, roofing sheets (bonded with cement), fiberboards and ceiling tiles, in backing for linoleum, vehicle brake pads, and other uses.

Inhalation of asbestos fibers can cause a number of serious adverse health effects, including malignant lung cancer, mesothelioma (a terminal cancer of the tissue that lines the chest cavity), and asbestosis, a debilitating and sometimes fatal build-up of fibrous scar tissue in the lungs. Higher concentrations and prolonged exposure make these effects more likely. These effects may occur up to 30 years after exposure stops.

For these reasons, starting in the 1980s most wealthy economies have banned or severely restricted the use of asbestos, particularly in construction.

ASBESTOS

The most common uses of asbestos in developing countries are in asbestos-cement roofing sheets, which remain extremely common, and in linoleum and similar flooring products. Facilities such as hospitals that have or had centralized hot water systems may also have asbestos insulation on pipes and boilers. In some areas, asbestos-cement pipe and canal liners were used in irrigation systems.

Increasingly, asbestos material production is taking place in developing countries including Brazil, India, Indonesia, Pakistan, and Korea, and being purchased by Angola, Argentina, India, Mexico, Nigeria, Thailand, and Uruguay. Mining production is highest in Russia, China, Brazil, and Kazakhstan.

THE RISKS OF RENOVATION/REHABILITATION ACTIVITIES.

Asbestos is only dangerous when it can release free-floating fibers into the air. Asbestos that is "locked in" to a material like roofing sheets or linoleum is not dangerous, except when these materials are cut, scraped, or broken up. When this happens—as in renovation activities—asbestos fibers can be released to the air, presenting a hazard to construction workers, users of the facilities, and potentially the nearby community. (Roofing sheets do release very small quantities of asbestos in use, as the surface of the sheet erodes over time.)

Asbestos pipe or boiler insulation can be dangerous even when in place, if it can be easily damaged or disturbed. <u>Air currents are sufficient to dislodge asbestos fibers from loose or damaged insulation.</u>

MANAGING ASBESTOS HAZARDS IN REHABILITATION

FIRST STEPS

Managing asbestos hazards in rehabilitation begins with two steps:

1. **Determine whether asbestos materials are present.** Asbestos roofing sheets are well-recognized as such by local contractors.

Beyond this, scientifically confirming the presence of asbestos usually requires a laboratory test, and these will rarely be available in most developing countries. In the absence of a test, use the following rules of thumb:

- If old linoleum sheet or tiles will be scraped off a floor, assume that the backing contains asbestos.
- If cement- or plaster-like pipe or boiler insulation is present, or if pipes are insulated with what appears to be corrugated cardboard or paper or fiber tape, assume it contains asbestos.
- If fiberboard ceiling tiles are present, assume they contain asbestos.

2. **Determine if you need to disturb the asbestos.** If the planned rehabilitation involves disturbing asbestos materials, ask if there is some way to avoid doing so—or to minimize the disturbance? For example, can a linoleum floor be covered over with new flooring material rather than scraped off? Can asbestos pipe insulation be wrapped with fiberglass tape?

At the same time, rehabilitation works should NOT leave asbestos materials behind in a condition that can easily release asbestos fibers (e.g., damaged pipe insulation). The work needs to address this issue even if not part of the original renovation plan.

3. Determine **the standards to apply.** If asbestos is present and will be disturbed, determine what host country requirements, if any, apply to management of asbestos hazards in renovation work and follow these. On USAID-funded projects, compliance with such host country requirements is mandatory.

More than this, USAID expects its construction projects to attain a level of protection of workers and public health as close to US standards as the local situation will allow.

Under no circumstances, however, should this principle be interpreted to result in health and safety practices less protective than the minimum practices specified below, even where local requirements do not exist or are unclear.

MINIMUM RECOMMENDED PRACTICES FOR REHABILITATION WORKS INVOLVING ASBESTOS.

I. ALWAYS

1. Educate workers on asbestos hazards and the relevant procedures enumerated below.
2. Require safe worker practices:
   - Workers involved in the task must wear an effective half-mask respirator (NOT a dust mask), rated to filter at least 99.97% of airborne particles (US "N100" or "P100" or "HEPA" standard).
   - Long pants, sleeves, and boots are strongly recommended, as asbestos fibers are irritating to the skin and can lead to calluses and corns.
   - Absolutely no eating, smoking or drinking while working in an asbestos hazard area.
   - Wash hands and face after stopping work each time—i.e. before meals, bathroom breaks, and end of day.

- Change clothes before going home. Clothes should be washed at the work site and water disposed to a seepage pit.
- Ideally, workers shower before going home; at minimum, workers sponge-bath with SOAP, thoroughly wipe down all exposed skin and rinse out hair.

3. If asbestos-containing materials are present, but not a planned part of the renovation:
   - If they are undamaged: prevent them from being damaged or disturbed.
   - As above, if the materials are of a nature or in a condition that can easily release asbestos fibers (e.g., damaged pipe insulation), address this issue during the renovation. For example, damaged pipe insulation could be patched with a non-asbestos material. Follow part III below.
4. Do not use new asbestos-containing materials in the renovation.

II. IF DRILLING, CUTTING OR REMOVING ASBESTOS ROOFING SHEETS OR SIDING:

1. Minimize breakage, drilling and cutting to the degree possible.
2. Close windows and door leading into the structure, and nearby structures. If doors or windows do not close, seal with plastic sheeting. (If work will leave the interior open to the sky, disregard, but then follow clean-up instructions for interior, below.)
3. To the degree possible, clear the worksite of all workers EXCEPT those involved in the roofing sheet/siding work and stop other activities.
4. Wet the affected area thoroughly with a detergent solution. If the operation may result in heavy vibration or cracking of the whole sheet, wet the whole sheet.
5. Lower pieces gently to the ground. Do NOT drop.
6. Dispose by burial. Use a regulated landfill, if available.

III. REMOVING OR OTHERWISE DISTURBING OLD LINOLEUM, PIPE/BOILER INSULATION, OR CEILING TILES (AND SIMILAR MATERIALS)

1. If it is feasible to cover over old linoleum or similar materials rather than to remove it, do so. Similarly, damaged asbestos pipe insulation can be wrapped or patched with a non-asbestos material. <u>Permanently label any covered asbestos.</u>
2. Contain the work area.
   - Post hazard signs
   - Screen off the work area with plastic sheeting. The sheeting must be tightly taped or otherwise attached to walls and surfaces to prevent dust from escaping.
3. Work wet, and by hand.
   - Wet the material thoroughly with a detergent solution
   - Do NOT use a powered sander, sand-blaster, or powered wire brush to remove materials.
   - As material is removed, place WET in strong plastic bags or sealable container (e.g., plastic barrel).
4. Clean up thoroughly at the end of each work day.

- Do NOT dry-sweep the area. Instead, wet thoroughly and then sweep.[7] Finish by wiping all surfaces—including plastic sheeting— with a damp cloth, rinsing frequently. Store sweepings in a sealed container prior to disposal.
- Unless a landfill certified for construction waste exists, dispose sweepings, broom, cleaning cloth, and waste by burial. Dispose of rinse water in a seepage pit and then add a layer of fresh soil to the bottom.
- Damp-mop around the containment area. Rinse mop frequently. Dispose of rinse water in seepage pit.

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ASBESTOS RENOVATION HAZARDS AND GOOD PRACTICES

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- Health and Safety Executive, Government of the United Kingdom, 2007. "A14: Removing asbestos cement (AC) sheets, gutters, etc and dismantling a small AC structure" (Factsheet, "asbestos essentials" series. December. www.hse.gov.uk/pubns/guidance/a14.pdf

Explains the basic principles of small-scale roofing and structural renovation involving asbestos cement sheets. Other factsheets in the series (referenced on this sheet) may also be of interest.

- US Occupational Safety and Health Administration (OSHA). "Work practices and engineering controls for Class I Asbestos Operations." www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10868

In the US, Class I asbestos work refers to removal of asbestos-containing thermal insulation. Class II refers to roofing, wall, ceiling and flooring materials. This regulatory guidance shows the work practices that achieve compliance with US occupational health and safety regulations.

- US Agency for Toxic Substances and Disease Registry, 2007. *Case Studies in Environmental Medicine (CSEM): Asbestos Toxicity*. http://www.atsdr.cdc.gov/csem/asbestos/index2.html. April.

An on-line learning course oriented towards medical treatment, but has a set of useful, more general sections on asbestos hazards and risk management.

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- Abraham Rumanzi, 21 Oct 2009 "Rwanda: Asbestos Roofs Banned Because They Are a Health Hazard." *AllAfrica.* http://allafrica.com/stories/200910221043.html
- *SouthAfrica.info*. 28 March 2008. "South Africa bans all use of asbestos." http://www.southafrica.info/services/health/asbestos-280308.htm

[7] Instead of sweeping, the work area can first be vacuumed with a HEPA (high filtration) vacuum.

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- Manuel en environnement - Ressources complémentaires — Construction de bâtiments. Outils pour l'identification des effets environnementaux de secteurs d'activités spécifiques, des mesures d'atténuation appropriées et lignes directrices ACDI 2007. http://www.acdi-cida.gc.ca/acdi-cida/acdi-cida.nsf/fra/EMA-218123618-NNH
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- Guías sobre medio ambiente salud y seguridad para la extracción de materiales de construcción. Corporacion financiera internacional Abril 2007. http://www1.ifc.org/wps/wcm/connect/67c9d5004886597fb966fb6a6515bb18/0000199659ESes_Construction_Materials_Extraction%2Brev%2Bcc.pdf?MOD=AJPERES&CACHEID=67c9d5004886597fb966fb6a6515bb18
- Guía de manejo de escombros y otros residuos de la construcción. Oficina Regional para Mesoamérica *y el* Caribe 2011. http://cmsdata.iucn.org/downloads/guia_escombros_baja.pdf
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