Chapter 3
Small-Scale Construction

Contents

When planning a construction project, in order to properly evaluate their options, project developers must examine all the classes of impacts — direct, indirect, ancillary, cumulative and socio-cultural.

The magnitude of impacts is likely to be proportional to the size of the project.

Brief Description of the Sector

Virtually all small-scale development activities—housing, sanitation, water supply, roads, healthcare, energy, etc.—involve some amount of 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 which are its result.

The details of the construction carried out in support of any particular development activity or site will have a number of unique aspects. Construction activities in general, however, share a set of common features and potential adverse environmental impacts.

This sector briefing addresses a number of these common elements. It is intended to apply to the types of projects mentioned above, as well as the construction of schools, health posts, storage silos, market or community centers, fire observation towers, and any similar small-scale construction projects. It 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 the Guidelines).

USAID uses a working definition of small-scale construction as "Construction or repair of facilities where total surface area to be disturbed is under 10,000 sq. ft." While this "rule of thumb" is not strictly compliant with Regulation 216, it functions as a reasonable and practicable threshold value. Projects which involve construction of larger surface areas are generally subject to a higher degree of oversight with required application of environmental soundness checklists.

Potential Environmental Impacts of Construction and Their Causes

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 schools, health posts or other infrastructure;
- 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").

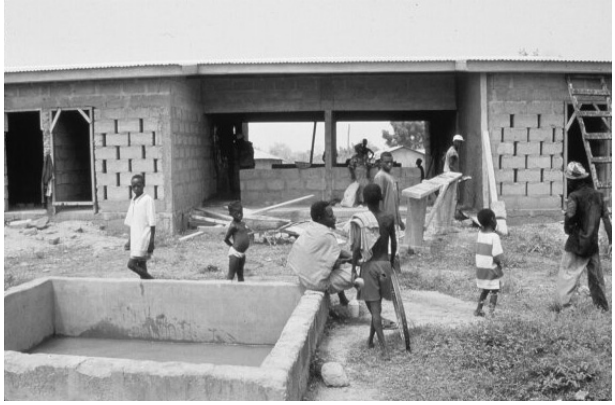
Another example could be a construction project's use of unsustainably extracted timber, which may contribute to the degradation of a forest some distance away. Direct impacts often receive more attention, but indirect effects can be just as significant.

Adverse Impacts of Construction Projects

- Damage to ecosystems
- Sedimentation of streams and surface water
- Contamination of water supplies
- Social impacts
- Spread of disease
- Damage to aesthetics of area

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.

Construction can also have significant effects on public health—for



This market near Tamale, Ghana, will provide permanent stalls for butcheries and restaurants. But the market lacks a solid waste disposal system.

example, the spread of HIV/AIDS and other communicable diseases is often associated with workers and construction camps. Standing water in quarries and borrow pits may become sources of contaminated water and disease-bearing insects.

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 or breeding habitat for food fish), 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 (see below). 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).

- **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 capacity of ponds and reservoirs, increasing flood potential, or substantially alter aquatic ecosystems by changing streambed, lakebed and estuary conditions.
- **Contamination of ground and surface 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.
- **Adverse social impacts.** Construction may displace local inhabitants, or reduce their access to environmental resources. (For example, farmers' income or subsistence may be reduced.) 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 Section 3-13).
- **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.

Sector Program Design—Key Questions for Construction Projects[1]

Apply best practices. All best practices discussed in Chapter 1 of this volume ("An Introduction to Environmentally Sound Design") apply to the construction dimension of projects.

Consider the full range of impacts. When planning a construction project, in order to properly evaluate their options, project developers must examine

A dusty road passes in front of the Tamale market's new buildings, but no provision was made for cleaning the facilities. This is one of the considerations to take into account in project design and site selection.

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.

Project Design Consideration

- Apply best practices
- Consider full range of impacts, both direct and indirect, for three main project areas:
    - site selection
    - planning and design
    - construction

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

Site Selection

- What are the current uses and activities at the proposed project site? Who will be displaced?
- How close are neighboring residences?
- What types of environment, landscape, flora and fauna are present in the area? Are any species of particular biological, medicinal,

[1] Incorporates material from "Checklist #2 / Building Construction" (1997), *Handbook on Environmental Assessment of Non-Governmental Organizations and Institutions Programs and Practices,* Canadian International Development Agency.

cultural, historical, social or commercial value—and, if so, could the project damage them?

- Is the site itself of cultural, archeological, historical, or social value?
- Are there any bodies of water, wooded areas, slopes, wetlands or other vulnerable sites nearby?
- Is the area and/or site prone to landslides, flooding, heavy rainfall, earthquakes and other disasters?
- Is the site steeply sloped? Is the soil sufficiently stable? What is its thickness, texture, drainage and topographical features?
- How distant is the site from the intended users?
- Would use of the site require construction or improvement of a road?
- Are water and sanitary facilities readily available or would they need to be provided?
- Are historical data available on precipitation, surface water flows and climatic conditions?
- Can the extent and quality of groundwater supplies be determined? Are historical and seasonal data available?

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

Planning and Design

- What are the local zoning, building, and permit requirements?
- Is the proposed design constructed of materials appropriate to the climate and site?
- Are erosion and flood protection measures incorporated?
- Is this a small, isolated project, or one of many similar projects?

- Will ancillary or associated infrastructure development be necessary?
- 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?
- What are the types, quantities and source of construction materials? Where does the material come from, e.g., quarries, borrow pits, relatively undegraded forest?
- 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 these services are provided in an environmentally sound manner?
- 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?
- If healthcare facilities are to be constructed, will their waste streams be handled as described in the "Healthcare Waste: Generation, Handling, Treatment and Disposal" sector briefing in this volume?

  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 graywater 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?
- 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 "Management of Solid Waste from Residential, Commercial and Industrial Facilities" in this volume?
- If hazardous chemicals, radioactive waste or other types of hazardous materials will be produced, does the design include proper storage, handling and disposal facilities, as described for some sectors in "Activities with Micro and Small Enterprises (MSEs)" in this volume? (These materials could include heavy metals, oil, lubricants, batteries, dyes, glue, solvents, acids, etc.)
- 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 elements for treatment, storage and discharge, as described for some sectors in "Activities with Micro and Small Enterprises (MSEs)" in this volume?
- What kind of public health education will construction workers receive? Will it include information about HIV/AIDS?

Construction Phase

- Where will the construction crew come from? Will the construction schedule compete with local crop harvesting?

- What site preparation and construction activities will be carried out? Will there be demolition, excavation, leveling, clearing, filling, backfilling or wetland reclamation?
- How will any construction and demolition debris be disposed of?
- How will the materials be conveyed to the site and stored?
- What toxic materials will be used during construction? Are non-toxic substitutes available? Are measures in place to ensure that toxic materials are properly disposed of?
- What measures are in place for monitoring environmental impacts and ensuring adherence to environmental guidelines?

Environmental Mitigation and Monitoring Issues

Table 1: Environmental Mitigation and Monitoring Issues for Construction-Related Aspects of Development Projects

Issue or aspect of activity	**Impact** *The activity may. . .*	**Mitigation** *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)		
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	• Build as far as practical from 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) • Screen facility with trees or fencing to control noise (P&D) • 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" section of the Guidelines)	Cause one or more of a set of adverse environmental impacts typical of roads, including erosion, changing water tables, or providing access for illegal landclearing, logging or poaching	• 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

Issue or aspect of activity	**Impact** *The activity may. . .*	**Mitigation** *Note: Mitigations apply to specified project phase: Site Selection (SS); Planning and Design (P&D), Construction (C), or Operation and Maintenance (O&M)*
Site contains habitat for important ecosystems, animals or plants	Destroy or harm plants or animals of ecological, cultural, and/or economic importance	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, large plants and ground cover where possible (C) • Replant recovered plants and other flora from local ecosystem after construction (C)
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)
Site is wetland or abuts body of water	Destroy or harm valuable and sensitive ecosystems and organisms	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) *If facility will include sanitation facility, find alternative site* (SS)

Issue or aspect of activity	**Impact** *The activity may. . .*	**Mitigation** *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 steeply sloped	Cause erosion and damage to terrestrial and aquatic ecosystems during construction or use	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) • Revegetate as soon as possible (C) • Maintain design features (O&M)
Area is heavily wooded	Degrade forest, contributing to flooding potential	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 preservation (SS) (P&D) (C)
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	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) 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)

Issue or aspect of activity	**Impact** *The activity may. . .*	**Mitigation** *Note: Mitigations apply to specified project phase: Site Selection (SS); Planning and Design (P&D), Construction (C), or Operation and Maintenance (O&M)*
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	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 biohazardous 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)

• **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	• 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 Supply and Sanitation" section of the Guidelines)	Deplete ground and/or surface water resources and damage local ecosystems or downstream/down-gradient communities Poison users with natural or man-made chemical contaminants such as arsenic Spread disease with pathogenic contaminants Cause groundwater contamination	• Determine safe and sustainable yield. Establish system for regulating use (P&D) (O&M) • 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 "Water Supply and Sanitation" secction of these *Guidelines* (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" section of the *Guidelines*)	Discharge untreated or insufficiently treated sewage that: • Contaminates drinking water (ground and surface) • Spreads diseases • Degrades aquatic ecosystems	• 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: Generation, Handling, Treatment and Disposal" section of the *Guidelines*)
	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[2] materials
	Contaminate water supplies (ground and/or surface) via improper land disposal. (May also damage local ecosystems, animals or plants.)
		• 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: Generation, Handling, Treatment and Disposal" section of the *Guidelines*, 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-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 graywater 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 from Residential, Commercial and Industrial Facilities" section of the *Guidelines*)	Spread disease Contaminate drinking water (ground and surface) Degrade aquatic ecosystems Generate greenhouse gases	• 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)

[2] Teratogenic means causing birth defects.

Facility will house automotive, laboratory or other industrial activities (Also consult the "Activities with Micro and Small Enterprises (MSEs)" section of the *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. (Also consult the "Activities with Micro and Small Enterprises (MSEs)" section of the *Guidelines*)	Expose workers or local population to toxic, carcinogenic and teratogenic materials Contaminate drinking water (ground and surface) Damage local ecosystems, animals or plants	• Incorporate cleaner production technologies into design, operation and maintenance as described in the "Activities with Micro and Small Enterprises (MSEs)" section of these *Guidelines* and resources listed there (SS) (P&D) (C) (O&M) • Design with elements for storage, treatment and discharge of wastewater (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	• 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)

Issue or aspect of activity	Impact *The activity may. . .*	Mitigation *Note: Mitigations apply to specified project phase: Site Selection (SS); Planning and Design (P&D), Construction (C),* *or Operation and Maintenance (O&M)*
Construction		
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 (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)
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.	• 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. Burn waste materials that are not reusable/readily recyclable, do not contain heavy metals and are flammable (P&D) (C) •
Use of hazardous materials	Contaminate ground or surface water when hazardous construction materials are spilled or dumped Put workers at risk from exposure to hazardous materials	• Prevent dumping of hazardous materials. Burn waste materials that are not reusable/readily recyclable, do not contain heavy metals and are flammable (P&D) (C) • Investigate and use less toxic alternative products (P&D) (C)

Issue or aspect of activity	Impact *The activity may. . .*	Mitigation *Note: Mitigations apply to specified project phase: Site Selection (SS); Planning and Design (P&D), Construction (C),* *or Operation and Maintenance (O&M)*
Demolition of existing structures	Bother or endanger neighbors via noise, dust, and debris from demolition Contaminate soil, groundwater or surface water from demolition waste containing residual amounts of toxic materials (e.g., leaded paint)	• 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 "Management of Solid Waste from Residential, Commercial and Industrial Facilities" section of the Guidelines 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 Produce areas of bare soil which cause erosion, siltation, changes in natural water flow, and/or damage to aquatic ecosystems	• 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)
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)

Issue or aspect of activity	Impact *The activity may. . .*	Mitigation *Note: Mitigations apply to specified project phase: Site Selection (SS); Planning and Design (P&D), Construction (C),* *or Operation and Maintenance (O&M)*
Road improvement/new road construction (Consult the "Rural Roads" section of the *Guidelines* and resources listed there)	Erosion and changes to water quality and natural water flows via poor road construction practices and maintenance Provide access for clearing agricultural land, logging, poaching, mining, settlement or other development that destroys natural resources and/or harms local populations Lead to the spread of human or livestock disease	• 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" section of the Guidelines 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 Spread vector-borne diseases when stagnant water accumulates in active or abandoned quarries or borrow pits and breeds insect vectors	• 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) • 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)
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	• Restore the site through replanting, reseeding and use of soil erosion control measures (hay bales, etc.)

Resources and References

CIDA "Checklist #2 / Building Construction" (1997). *Handbook on Environmental Assessment of Non-Governmental Organizations and Institutions: Programs and Practices.* Canadian International Development Agency. http://www.acdi-cida.gc.ca/search-e.htm