

Guiding Principles for Environmental Planning

- During reconstruction, there are two principal environmental concerns: restoring damage to the environment from a disaster and minimizing the environmental impact of the reconstruction process itself.
- Site planning in new settlements should be governed by ecological concerns.
- Construction methods, building designs, and choice of materials all have an environmental impact; they should be based on local practices while being eco-friendly.
- Disaster debris is a valuable resource that should be reused during reconstruction whenever possible. However, materials that can be harmful to workers or the environment, such as asbestos or toxic substances, must be managed carefully.

Introduction

Disasters almost always have negative environmental impacts, ranging from damage to ecosystems to the production of vast quantities of waste. Post-disaster reconstruction can either be an opportunity to address these impacts and long-standing environmental problems in the disaster location or it can cause a second wave of damage. The choice is up to decision makers responsible for assessment, planning, and implementation of reconstruction programs. Assessment allows the disaster's environmental impacts to be identified and priority areas for corrective action to be determined. Physical and environmental planning present opportunities to analyze and rebalance the relationship between the built environment and the natural environment. And in implementation, actions can be taken that aid environmental recovery, mitigate the impacts of the reconstruction itself, and promote long-term sustainable development goals.

The scope of "environmental issues" is broad and encompasses built, social, and economic and ecological aspects, and each of these affects those who live where the disaster took place. This chapter focuses principally on critical ecological and built environment issues related to housing demolition and reconstruction. It attempts to persuade those involved in reconstruction that restoration of the environment should be one of their highest priorities. To that end, it covers environmental impact assessments, relocation, waste management, ecological planning of new settlements, environmental needs of habitat, and environmental assessment of housing reconstruction.

Key Decisions

1. **National and local governments** must decide on the legal framework for environmental management to be applied during reconstruction and on a division of labor that will ensure its successful implementation.
2. **Government** should decide immediately which agency will be in charge of post-disaster debris management and that agency should plan and coordinate the debris management program in a way that reduces risk, facilitates recovery and reconstruction, and disposes of debris in a cost-effective and environmentally sound manner, while keeping disposal of reusable or salable materials to a minimum.
3. The **lead environmental agency** must decide how to provide environmental guidance to all institutions active in reconstruction, keep this information updated, and monitor reconstruction implementation. It must also decide what incentives and sanctions will be employed.
4. **Land use planning and environmental institutions** need to agree on the mechanisms to ensure that post-disaster environmental planning and management activities are integrated with land use and site planning, as well as on how these local activities will be coordinated with the lead disaster agency.
5. In a consultative manner, **government** should define how **local community and civil society organizations** can contribute to environmental protection during reconstruction and on coordination mechanisms among the organizations and with government. These organizations can participate in local debris management, assessments, reconstruction monitoring, technical assistance and project implementation.

This Chapter Is Especially Useful For:

- Lead disaster agency
- Environmental specialists
- Local officials
- Project managers

This Chapter is from "Safer Homes, Stronger Communities: A Handbook for Reconstructing after Natural Disasters," published by the World Bank in January 2010. Additional chapters, other resources, and ordering information for the handbook can be found at the handbook Web site: www.housingreconstruction.org.

Some Environment-Related Consequences of Common and Recurrent Natural Disasters

Type of Disaster	Associated Environmental Impact
Hurricane/cyclone/typhoon	<ul style="list-style-type: none"> ■ Loss of vegetation cover and wildlife habitat ■ Inland flooding ■ Mudslides and soil erosion ■ Saltwater intrusion to underground freshwater reservoirs ■ Soil contamination from saline water ■ Damage to offshore coral reefs and natural coastal defense mechanisms ■ Waste (some of which may be hazardous) and debris accumulation ■ Secondary impacts by temporarily displaced people ■ Impacts associated with demolition, reconstruction, and repair to damaged infrastructure (e.g., deforestation, quarrying, waste pollution)
Tsunami	<ul style="list-style-type: none"> ■ Groundwater pollution through sewage overflow ■ Saline incursion and sewage contamination of groundwater reservoirs ■ Loss of productive fisheries and coastal forest or plantations ■ Destruction of coral reefs and natural coastal defense mechanisms ■ Coastal erosion or deposition of sediment on beaches or small islands ■ Marine pollution from back flow of wave surge ■ Soil contamination ■ Loss of crops and seed banks ■ Waste accumulation—additional waste disposal sites required ■ Secondary impacts by temporarily displaced people ■ Impacts associated with demolition, reconstruction, and repair to damaged infrastructure (e.g., deforestation, quarrying, waste pollution)
Earthquake	<ul style="list-style-type: none"> ■ Loss of productive systems (e.g., agriculture) ■ Damage to natural landscapes and vegetation ■ Possible mass flooding if dam infrastructure is weakened or destroyed ■ Waste accumulation—additional waste disposal sites required ■ Secondary impacts by temporarily displaced people ■ Impacts associated with demolition, reconstruction, and repair to damaged infrastructure (e.g., deforestation, quarrying, waste pollution) ■ Damaged infrastructure as a possible secondary environmental threat (e.g., leakage from fuel storage facilities) ■ Release of hazardous materials from industries, medical facilities, and nuclear plants
Flood	<ul style="list-style-type: none"> ■ Groundwater pollution through sewage overflow ■ Loss of crops, trees, livestock, and livelihood security ■ Excessive siltation that may affect certain fish stocks ■ River bank damage from erosion ■ Water and soil contamination from fertilizers and/or industrial chemicals ■ Secondary impacts by temporarily displaced people ■ Sedimentation in floodplains or close to river banks
Volcanic Eruption	<ul style="list-style-type: none"> ■ Loss of productive landscape and crops buried by ash and pumice ■ Forest fires as a result of molten lava ■ Secondary impacts by temporarily displaced people ■ Loss of wildlife following gas release ■ Secondary flooding should rivers or valleys be blocked by lava flow ■ Damaged infrastructure as a possible secondary environmental threat (e.g., leakage from fuel storage facilities) ■ Impacts associated with demolition, reconstruction, and repair to damaged infrastructure (e.g., deforestation, quarrying, waste pollution)
Landslide	<ul style="list-style-type: none"> ■ Damaged infrastructure as a possible secondary environmental threat (e.g., leakage from fuel storage facilities) ■ Secondary impacts by temporarily displaced people ■ Impacts associated with demolition, reconstruction, and repair to damaged infrastructure (e.g., deforestation, quarrying, waste pollution)

Source: United Nations Environment Programme (UNEP), 2008, *Environmental Needs Assessment in Post-Disaster Situations: A Practical Guide for Implementation* (Nairobi: UNEP), http://www.humanitarianreform.org/humanitarianreform/Portals/1/cluster%20approach%20page/clusters%20pages/Early%20R/UNEP%20PDNA_pre-field%20test%20draft.pdf.






For access to additional resources and information on this topic, please visit the handbook Web site at www.housingreconstruction.org.



6. The **lead environmental agency** must decide on and implement mechanisms that ensure that trees, groundwater, and other natural resources and other local environmental assets will be protected on a site-specific and regional basis during demolition and reconstruction. Community and advocacy organizations can play an important role in this.
7. **Local authorities** need to establish measures to ensure that decision points, such as the approval of site plans and the issuance of demolition and building permits, are used to ensure compliance with the environmental guidelines. These are opportunities to address such issues as the integration of infrastructure development with housing reconstruction and the use of local and eco-friendly materials and designs.
8. **National and local governments** should define any technical assistance requirements related to implementing post-disaster environmental management systems, norms, and procedures, and identify a point person to raise the necessary funding and to manage procurement. International agencies, including the World Bank, can frequently be of assistance.

Public Policies Related to Environmental Planning

National and local environmental law and regulations should be applied in reconstruction, although additional guidance may be needed to address the unique post-disaster situation. The national environmental ministry and local governmental environmental agency should be involved early and should participate in assessments. The World Bank will apply its environmental safeguards, as explained in  Chapter 20, World Bank Response to Crises and Emergencies, and  Chapter 21, Safeguard Policies for World Bank Reconstruction Projects. Policy guidance should be widely accessible to different actors, including all government agencies, the private sector, international agencies, NGOs, and local communities. If existing legal and regulatory instruments require updating, or strengthening, donors and other sources should finance technical assistance to develop reconstruction environmental policy guidelines that address the issues discussed in this chapter. Government should consider updating its environmental policies as part of its disaster risk reduction program so that the country is prepared to apply the policies in the event of a disaster. The objective is to provide environmental guidelines that balance environmental protection with the need to support reconstruction. The lead agency should also designate a group of experts to provide advice on specific cases and exceptions and to propose modifications to the policy as reconstruction experience is gained. The  case study on the 1999 Armenia post-earthquake reconstruction, below, describes how Colombia designed a comprehensive environmental management plan.

Technical Issues

The following paragraphs discuss in detail some of the technical issues related to environmental planning and provide examples of how these issues applied to real-world situations. Case studies involving some of these issues are found later in this chapter.


Rapid Environmental Impact Assessment

Governments, international aid agencies, NGOs, and communities use rapid environmental impact assessments (REAs) as the key starting point after any disaster. An REA needs to be conducted within 120 days of the event.¹ There are standards manuals and guidelines for REA on organization-level assessments, community-level assessments, consolidations, and analyses. Personnel required for an REA include specialists on disaster relief and environmental impact assessments (EIAs). Community REAs can be conducted by NGOs and field practitioners.² During the early recovery phase, UNEP recommends the use of the Environmental Needs Assessment (ENA) methodology.³ More detailed environmental studies may also be needed to analyze the particular issues of environmental impact at the relevant scale. For instance, groundwater contamination may need to be evaluated for the entire watershed, or the availability of local natural resources used in housing construction, such as lumber or stone, may need to be evaluated at the national or regional level. At the end of the housing reconstruction process, an integrated environmental assessment should be part of the project evaluation.

In Aceh, Indonesia, after the 2004 tsunami, the following 10 priority areas for environmental management in the recovery process were identified: (1) contaminated groundwater; (2) sanitation; (3) lost livelihood; (4) lack of coordination in relief or recovery response during the emergency response phase; (5) shelter and related domestic needs; (6) enhanced roles identified for local governance and the role of communities in environmental management; (7) volume of (mixed) waste; (8) uncertain land tenure for tsunami survivors; (9) strengthening

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1. Charles Kelly, 2005, *Guidelines for Rapid Environmental Impact Assessment in Disasters* (Geneva: CARE International), <http://www.reliefweb.int/rw/lib.nsf/db900SID/EVOD-6FCH52?OpenDocument>.
2. Ministry of the Environment Republic of Indonesia, 2005, *Rapid Environmental Impact Assessment, Banda Aceh, Sumatra* (Jakarta: Republic of Indonesia), <http://www.humanitarianinfo.org/sumatra/reference/assessments/doc/gov/Gol-EnvironmentalImpactAssessment-050405.pdf>.
3. UNEP, 2008, *Environmental Needs Assessment in Post-Disaster Situations: A Practical Guide for Implementation* (Nairobi: UNEP), http://www.humanitarianreform.org/humanitarianreform/Portals/1/cluster%20approach%20page/clusters%20pages/Early%20R/UNEP%20PDNA_pre-field%20test%20draft.pdf.

of local government to overcome the loss of infrastructure, staff, and resources; and (10) increase of capacity to direct and absorb relief assistance for sustainable development. After the 2008 earthquake in Wenchuan, China, the government reconstruction policy promoted the reuse of waste and encouraged improving the environmental sustainability of industrial plants rehabilitated after the earthquake, including those producing construction materials using recycled inputs, as described in the  case study, below.

"Without the trees the village is not alive. It is another village, not our village anymore."


Post-Disaster Waste Management

Post-disaster waste management is one of the most crucial and urgent issues following a disaster. Different types of waste are produced in urban and rural areas. Much of the waste from rural housing (stone, adobe or mud brick, and wood) can be recycled, while that from urban areas needs proper separation, collection, and treatment. In urban areas, asbestos and electrical appliances are a potential source of hazardous waste; therefore, proper separation and treatment of these wastes is required. Rubble and debris represent resources that have value in reconstruction; however, they can also represent a risk for communities and should be analyzed and handled with care. In case of water-related disasters, a large amount of biological waste is produced and needs to be treated properly. See Annex 1, How to Do It: Developing a Disaster Debris Management Plan, in this chapter. Also see text box "Managing Asbestos in Housing and Community Reconstruction" later in this chapter.


Typhoon Tokage, in the city of Toyooka, Japan (2004), produced disaster waste that was 1.5 times the annual waste production in the city. It took significant time and financial resources to process the waste in order to start the reconstruction process. Information and communications technology (ICT) tools and systems can be deployed. Catalogue and communicate availability of recycled materials to facilitate local economic activity. The  case study on the 1994 Northridge earthquake, below, discusses how the city of Northridge, California, recycled more than 50 percent of all disaster debris.

In-Situ Construction versus Relocation

The decision to relocate or build *in-situ* has environmental consequences. Likewise, the amount and nature of waste produced in a disaster often influences decisions about the reconstruction process. The environmental consequences of the *in-situ* versus relocate decision should be discussed with community members, government, and multilateral and bilateral donors. Local environmental guidelines should be consulted as well.

After the 2004 Indian Ocean tsunami, many settlements in Aceh, Indonesia had to be relocated 2-3 kilometers inland because of water logging and disaster debris, thereby causing challenges to the livelihoods of fishing communities. Some tsunami-affected countries like Sri Lanka imposed strict limits based on the Coastal Regulatory Zone Act. See  Chapter 5, To Relocate or Not to Relocate, for more information and a case study on this issue.

Ecological Planning of New Settlements

New housing settlements are often sited in areas with rich ecological resources and biodiversity, without evaluating the ecological footprint of the project, creating both new risks and an environmental conservation challenge. If the environmental assessment used for site selection is not properly conducted, relocation may create new risks. After a coastal hazard (like a typhoon or tsunami), the new settlement may be developed on mountain slopes. Yet the higher ground may have a high landslide risk. Therefore, proper ecological analysis and hazard mapping is required before selecting new settlements after a disaster. This is particularly important for fragile ecosystems, such as small islands and mountainous areas with higher biodiversity. Protection of natural habitat should be a priority after a disaster, including mangroves and nesting grounds of birds, along with architectural heritage, such as structures, since both contribute to the cultural, psychological, and economic recovery of the community. The  case study on the Indian Ocean tsunami reconstruction in Tamil Nadu, India, below, shows how the protection of trees was not fully considered in planning housing reconstruction.

Green and Clean Recovery and Reconstruction

Rural housing styles have evolved in harmony with local cultural and climatic conditions. Vernacular designs and techniques are often optimal because of their cost-effectiveness, local availability, and minimal environmental impact. There is increasing support for using local, environment-friendly housing materials in reconstruction (e.g., stone, mud brick, wood, and slate), especially in rural areas. False perceptions about environmental impacts can discourage the use of local materials (e.g., the

4. UNEP, 2005, *Environmental Management and Disaster Preparedness: Lessons learnt from the Tokage Typhoon* (Geneva: UNEP), <http://www.unep.or.jp/ietc/wcdr/unep-tokage-report.pdf>.
5. Sphere Humanitarian Charter and Minimum Standards in Disaster Response, <http://www.sphereproject.org/>.

ban on timber products in Aceh in the initial stage of the post-tsunami reconstruction). This makes reconstruction more difficult for homeowners who may be unfamiliar with new building materials and construction methods. Materials and design should be selected using environmental and climate change-oriented criteria, such as energy use, greenhouse gas emissions, the sustainability of production chains, the use of water, and the potential for recycling and reuse. See 🏠 Chapter 10, Housing Design and Construction Technology, for background on these issues.

Need for Basic Environmental Services

Lack of basic infrastructure such as water, sanitation, and waste management can cause serious environmental and environmental health problems and can lead to low occupancy rates of new and reconstructed housing. Sphere standards, which establish minimum health, sanitation, water supply, and housing standards for humanitarian operations, can be useful as a frame of reference in reconstruction.⁵ See 🏠 Chapter 8, Infrastructure and Services Delivery, for detailed guidance on post-disaster infrastructure restoration.

Tools for Environmental Planning

Community participation is absolutely critical at each stage of environmental planning and assessment. Public hearings, held to inform the community of environmental assessments and planned actions, can bring together all stakeholders, including project proponents, environmental agencies, NGOs, citizens, and project-affected persons.

The tools outlined below aim to apply core principles of building local capacity of communities to prevent and mitigate disasters, create partnerships among stakeholders, share and exchange information, and develop learning and decision-making tools to address disaster impacts. All tools incorporate common elements, such as assessment, stakeholder involvement mechanisms, and monitoring.⁶

Assessment Tools

Rapid Environmental Impact Assessment. Helps identify and prioritize likely environmental impacts in natural disaster conditions. A qualitative assessment approach is used to rank issues and identify follow-up actions.⁷

Environmental (or Ecological) Risk Assessment. Evaluates the adverse effects that human activities and pollutants have on the plants and animals in an ecosystem, and identifies impacts on human, ecological, and ecosystem health.⁸

Environmental Impact Assessment. Involves analysis of baseline environment, identification and evaluation of impacts, and mitigation measures to remedy adverse effects of natural and man-made disasters. See 🏠 Annex 2, How to Do It: Carrying Out Environmental Impact Assessment and Environmental Monitoring of Reconstruction Projects, for guidance on carrying out an EIA.

Strategic Environmental Assessment. Evaluates the consequences of plans, policies, and programs on the natural environment using a systematic approach, taking into account social and economic considerations.⁹

Planning Tools

Eco and Hazard Mapping (EHM). Serves as a simple systematic and visual tool that aids in post-disaster reconstruction planning by using maps and plans of cities, neighborhoods, and buildings. The mapping process involves multi-stakeholder participation. Participants mark all environmental aspects, hazards, and risks on plans and maps that contribute to the formulation of post-disaster recovery plans.

Environmental Profiling. Provides planning and management options based on a study of development setting, environmental setting, and disaster setting of a city or village. The development setting studies the socioeconomic structure, institutional structure, and environmental resources. Environmental setting studies the natural and built environment in detail. Disaster setting provides an analysis of hazards and vulnerability faced by communities.¹⁰

Implementation Tools

Environmental Management System. Used as a problem-solving and problem-identification tool based on the concept of continual improvement. EMS forms the core of the international environmental standard ISO 14001. The EMS adopts the Plan-Do-Check-Act cycle to develop environmental policies; frame the EMS; and implement, review, and revise performance.¹¹

Environmental Management Plan. An Environmental Plan (EMP) is used to monitor the impacts and mitigation measures agreed to in the EIA of a specific project. See 🏠 Annex 2, How to Do It: Carrying Out Environmental Impact Assessment and Environmental Monitoring of Reconstruction Projects, for guidance on carrying out an EIA and implementing an EMP.



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6. United Nations Centre for Human Settlements (UN-HABITAT) and UNEP, 1999, *The SCP Source Book Series, V. 5, Institutionalising the Environmental Planning and Management (EPM) Process* (Nairobi: UNCHS and UNEP), <http://www.unhabitat.org/pmss/getPage.asp?page=bookView&book=1652>.
7. Charles Kelly, 2005, "Guidelines for Rapid Environmental Impact Assessment in Disasters," CARE International, <http://www.reliefweb.int/rw/lib.nsf/db900SID/EVOD-6FCH5270OpenDocument>.
8. See U.S. Environmental Protection Agency, National Center for Environmental Assessment, "Ecological Risk Assessment," <http://cfpub.epa.gov/ncea/cfm/ecologic.cfm>.
9. World Bank, Environment, "Strategic Environmental Assessment Toolkit," <http://go.worldbank.org/XIVZ1WF880>; and Organisation for Economic Co-operation and Development Directorate, Strategic Environmental Assessment Network, "Applying SEA: Good Practice Guidance for Development Co-operation," <http://www.seataskteam.net/guidance.php>.
10. UN-HABITAT and UNEP, 1998, *The SCP Source Book Series, Volume 1: Preparing the SCP Environmental Profile* (Nairobi: UN-HABITAT and UNEP), <http://www.unhabitat.org/pmss/getPage.asp?page=bookView&book=1427>.
11. International Organization for Standardization, "ISO 14000 Essentials," http://www.iso.org/iso/iso_catalogue/management_standards/iso_9000_iso_14000/iso_14000_essentials.htm.

Managing Asbestos in Housing and Community Reconstruction

What Is Asbestos and Where Is It Found?

Asbestos is the name given to a number of naturally occurring fibrous minerals with high tensile strength, the ability to be woven, and resistance to heat and most chemicals. Because of these properties, asbestos fibers have been used in a wide range of manufactured goods and construction materials, including roofing shingles, ceiling and floor tiles, paper and cement products, textiles, and coatings. In-place management dictates having a building management program to minimize release of asbestos fibers into the air and to ensure that when asbestos fibers are released, either accidentally or intentionally, proper control and cleanup procedures are implemented. However, in a disaster, there is a likelihood that construction debris—especially debris from engineered buildings—may include asbestos-containing materials (ACMs), making it necessary to develop abatement procedures as part of the debris management program. Under normal circumstances, abatement entails removal of asbestos before building demolition; however, after a disaster this may not be possible.

Managing Asbestos Health Effects

Exposure to airborne friable asbestos may result in a potential health risk, because people breathing the air may breathe in asbestos fibers. Fibers embedded in lung tissue over time may cause serious lung diseases, including asbestosis, lung cancer, and mesothelioma. Disease symptoms may take several years to develop following exposure. Continued exposure can increase the amount of fibers that remain in the lungs. Exposure to asbestos increases your risk of developing lung disease. That risk is made worse by smoking.

Good practice is to minimize the health risks associated with ACMs by avoiding their use in new construction and renovation, including disaster relief and reconstruction, and, if installed ACMs are encountered, by using internationally recognized standards and best practices to mitigate their impact. In reconstruction, demolition, and removal of damaged housing and infrastructure construction materials, asbestos hazards should be identified and a risk management plan adopted as part of the EMP that includes disposal techniques and end-of-life sites.

How Asbestos Is Detected

ACMs are mixtures of individual asbestos fibers and binding material. The asbestos content of manufactured items ranges from 1 percent to 100 percent. Asbestos fibers cannot be seen without a special microscope. Analysis by an accredited testing laboratory is the only way to know for certain whether a material contains asbestos. Workers should be protected from asbestos exposure even in the sampling process.

Disposal of Asbestos

Asbestos waste or debris should not be burned since the fibers can be released; it should be disposed of at an approved disposal site. Laws should require (1) safe methods to contain asbestos waste (wet, double-bagged), (2) procedures for hauling waste, (3) disposal of ACM in an authorized landfill, and (4) formal record keeping of asbestos waste disposal. Landfilling is the environmentally preferred method of asbestos disposal because asbestos fibers are immobilized by soil. Asbestos cannot be safely incinerated or chemically treated for disposal.

Information on Asbestos Regulation

Because the health risks associated with exposure to asbestos are now widely recognized, global health and worker organizations, research institutes, and some governments have enacted bans on the commercial use of asbestos, and they urge the enforcement of national standards to protect the health of workers, their families, and communities exposed to asbestos through an International Convention. Information on these standards and emerging legal frameworks are available from the sources below.

The International Ban Asbestos Secretariat (IBAS), <http://ibasecretariat.org/>. IBAS keeps track of national asbestos bans.

International Finance Corporation, 2007, “Environmental, Health, and Safety Guidelines,” <http://www.ifc.org/ifcext/sustainability.nsf/Content/EnvironmentalGuidelines>.

World Health Organization, 2006, “Elimination of Asbestos-Related Diseases,” http://www.who.int/occupational_health/publications/asbestosrelatedisease/en/index.html.

World Bank Group, 2009, “Good Practice Note on Asbestos: Occupational and Community Health Issues,” <http://siteresources.worldbank.org/EXTPOPS/Resources/AsbestosGuidanceNoteFinal.pdf>.

Sources: World Bank Group, 2009, “Good Practice Note on Asbestos: Occupational and Community Health Issues,” <http://siteresources.worldbank.org/EXTPOPS/Resources/AsbestosGuidanceNoteFinal.pdf>; and US Environmental Protection Agency, “Asbestos,” <http://www.epa.gov/asbestos/>.



Risks and Challenges

- Ignoring environmental issues in any phase of reconstruction and not involving environmental experts in decision making at the policy and programmatic level.
- Delays in conducting the environmental assessment increase environmental risks created by the disaster.
- Dangerous or hazardous rubble and debris (such as toxic or ignitable substances, asbestos, explosives, collapsing buildings) are not handled with caution, with negative effects on communities and the environment
- Damage to infrastructure leads to secondary impacts like fire and floods before problems are identified and addressed.
- Political and institutional factors, rather than community and environmental priorities, drive site-selection decisions.
- Poor planning permanently destroys environmental assets, such as endangered habitats, coastal sand dunes, and mangroves.
- Infrastructure and site development negatively affect groundwater quality and quantity.
- Social and cultural assets are destroyed because of ad hoc development planning.
- Community participation in environmental decision making is downplayed because of political and commercial interests.
- Local building practices are combined in an unsafe way with practices promoted by external actors.
- Commercial interests influence material and technology selection, with negative ramifications on the environment and community.

Recommendations

1. Include government staff and consultants in the environmental assessment teams so that they acquire firsthand knowledge of environmental issues in the affected area and can identify how incentives for environmentally sustainable reconstruction can be incorporated in the reconstruction policy.
2. Identify the legal framework for environmental management to be applied in reconstruction early on, how it will be implemented and by whom, and how it will be monitored and evaluated.
3. Mobilize the post-disaster debris management effort immediately after the disaster, carrying out a rapid planning exercise if a debris management plan was not in place before the disaster.
4. Ensure that the environmental requirements for reconstruction are effectively and continually communicated to all agencies participating in the reconstruction program.
5. In developing the reconstruction policy, government, UN shelter cluster partners, and environmental organizations should work together to minimize the environmental impact and maximize the local sustainability of the building materials and practices to be used.
6. Use the environmental review process to evaluate the ecological footprint of a relocation site or in-situ reconstruction project and to select the site, develop mitigation measures for the project and its construction, and adjust project parameters.
7. Plan new settlements or the rehabilitation of existing systems so that sanitation and other basic infrastructure are provided as early as possible to ensure healthy environmental conditions for new residents.

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Limitations

- Environmental issues are not restricted to the disciplinary boundary of environmental management. In a post-disaster context, environmental issues also deserve consideration when making decisions regarding, among other things, financial management, technical and engineering aspects of housing reconstruction (safer design), material availability, accessibility, cost, and time.
- Environmental issues tend to become a lower priority when measured against the desire to speed up the reconstruction. Respecting the existing environmental policy framework of the country and documenting and mapping environmental hazards and assets may help rebalance these considerations. In the long run, wise environmental decisions will pay off.

Case Studies

1999 *Eje Cafetero* Earthquake, Armenia, Colombia

An Integrated Response to Post-Disaster Environmental Management

The devastating earthquake in Armenia, Colombia, in January 1999, left 1,230 people dead and 200,000 affected, and damaged or destroyed 80,000 homes. Given the economic importance of this agricultural and coffee-growing region, recovery of the environment was immediately identified as one of the most critical concerns. The President not only declared an economic and social state of emergency, but—for the first time in Colombian history—declared an ecological state of emergency in the affected region. This action, together with the creation by the President of the Fund for the Reconstruction of the Coffee Zone (*Fondo para la Reconstrucción del Eje Cafetero*, or *FOREC*), which was charged with integrated reconstruction of the zone, ensured that the environmental dimensions of the disaster would be prominent in the reconstruction plan. The reconstruction strategy was also designed to respect and further national environmental strategies and laws, while promoting the sustainable economic development of the region. The importance of the environment was also reflected in the degree of central government involvement in this aspect of the recovery process, not fully delegating responsibility to NGOs and local governments, as was done with most other aspects of the reconstruction program. A broad range of activities were developed to promote environmental goals: (1) careful management of almost 4 million cubic meters of debris, (2) development of environmental guiding principles, and of environmental guidelines for land use planning and reconstruction, (3) formulation of integrated land use plans that incorporated environmental management and disaster prevention, (4) investment in new infrastructure for ecotourism in the Nevados Park, (5) new environmental regulations for the mining industry, and (6) stabilization of critical mountain slopes. In addition, a sustainable management was implemented during reconstruction for *guadua* (a type of bamboo used in the region as a construction material). As a result, 1,045 hectares of culms were planted to compensate for over-exploitation in an effort to reduce avoid soil erosion, improve air and water quality, and contribute to improving the quality of life in the region.

Sources: Ana de Campos, 2009, personal communication and FOREC, El Ministerio del Medio Ambiente, las corporaciones autónomas regionales del Valle del Cauca (CVC), Quindío (CRQ), Risaralda (CARDER), Caldas (CORPOCALDAS), Tolima (CORTOLIMA), el Instituto de Hidrología, Meteorología y Estudios Ambientales - IDEAM, el Instituto de Investigación e Información Geocientífica Minero - Ambiental y Nuclear - INGEOMINAS, el CORPES de Occidente, 2002, *Plan de Manejo Ambiental para la Reconstrucción del Eje Cafetero. Informe Final de Gestión y Resultados*, Armenia.

2004 Indian Ocean Tsunami, Tamil Nadu, India

Neglecting the Importance of Trees for Livelihoods and Thermal Comfort

"Without the trees the village is not alive. It is another village, not our village anymore."

Some of the housing reconstruction projects in the aftermath of the 2004 Indian Ocean tsunami in Tamil Nadu, India, should have more carefully considered the space around the house and the surrounding vegetation as equally important aspects of the inhabited space. People now live in houses of a new design, built with foreign materials, in a strange settlement layout, and sometimes in a new location, without any trees. In fact, the loss of trees is described in this region as one of the worst consequences of contractor-built reconstruction. In several villages, contractors refused to start any

reconstruction work before the ground was completely cleared of houses, trees, and other vegetation. In one village, people estimated that 800–1,200 trees were cut down, demonstrating a lack of understanding of the importance and the central role of trees in these communities. Tree products are abundantly used in every home as food, fodder, and firewood, and to fabricate utensils—and are also a valued source of income. Trees also have cultural importance: trees are connected to notions of health, protection, beauty, and sacredness. In a tropical climate where temperatures exceed 40°C most of the year, the importance of shade cannot be overemphasized. Areas with trees demarcate locations where people sit together, talk, and play, in short, where social life takes place. Even though the sites were specifically chosen by the communities themselves and the cutting of trees was probably inevitable, the fact remains that the tree cover is gone with serious adverse effects. The demolition of trees resulting from reconstruction projects risks causing a long-term detrimental impact on the social networks, livelihoods, and general well-being of the village community.

Source: Jasmin Naimi-Gasser, 2009, "The socio-cultural impact of post-tsunami housing reconstruction programs on fishing communities in Tamil Nadu, India: An ethnographic case study" (thesis, University of Zurich); and C. V. Sankar, 2009, written communication.



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2008 Wenchuan Earthquake, China

Using Waste as a Resource to Create an Environment-Friendly Society

Following the 2008 Wenchuan earthquake in China, some people proposed that the concept of a circular economy be applied in reconstruction. The idea was to use the resources available for reconstruction, including debris from the earthquake, in the most efficient and productive way possible. It also translated into a focus on industrial rebuilding for industries that could contribute to the circular economy in the long term and on the way in which industrial activities would be carried out once rehabilitated, seeking to reduce energy consumption; improve the conservation of water, land, and materials; and reduce their impact on the surrounding communities. The policy mentions emission reduction of high energy-consuming enterprises and promotion of cleaning production technology. Lastly, it encourages the recycling of construction waste, industrial solid waste, and coal gangue to develop environmental friendly construction materials. These activities both conserve resources and protect the environment, which, in turn, promote the community's economic, social, and environmental development in a way that is healthier, integrated, and sustainable.

Source: People's Republic of China, National Development and Reform Committee (NDRC), 2008, "The Overall Planning for Post-Wenchuan Earthquake Restoration and Reconstruction," <http://en.ndrc.gov.cn/policyrelease/P020081010622006749250.pdf>.

1994 Northridge Earthquake, California

Acting Quickly to Recycle Debris after a Major Urban Earthquake

On January 17, 1994, residents of the Los Angeles region of southern California were awakened by a 6.7 magnitude earthquake that proved to be the most costly earthquake in United States history. Fifty-seven people died, more than 9,000 were injured, and more than 20,000 were displaced. Surprisingly, the city of Los Angeles did not have a disaster debris management plan in place, but quickly developed procedures afterward. City officials updated an existing list of licensed, insured debris removal contractors and asked them to attend an orientation and to sign hastily drafted contracts for debris removal. At first, contracts were only two pages long and covered one week of work, but the contracts ultimately grew to 22 pages, each contractor was assigned a grid of streets to clear, and the work periods were extended. These early contracts allowed the city to begin removing debris quickly. Yet recycling was not included until two months after the date of the disaster, due to a dispute about whether the costs would be eligible for Federal reimbursement. Once recycling was approved, the city developed contract terms that rewarded haulers for source-separated materials while working with businesses to develop processing for mixed debris. The city also provided training and financial incentives to haulers. Most of the materials collected were recyclable; wood, metal, dirt, concrete and asphalt, and red clay brick were separated. After four months, the city was recycling about 50 percent of the debris collected each week. A year later, the city was recycling more than 86 percent of the debris, totaling more than 1.5 million tons. City inspectors (pulled from other assignments) monitored the contractors. By the end of the program, the city had recycled almost 56 percent of all materials from the earthquake for less than the cost of disposal, a total that would have been much higher had the city implemented recycling from the beginning of recovery. To prepare for the possibility of future disasters, Los Angeles later issued a request for proposals for a contingency contract for various disaster waste management activities, including the use of sites in the event of a natural disaster.

Sources: U.S. Environmental Protection Agency, "Wastes - Resource Conservation - Reduce, Reuse, Recycle - Construction & Demolition Materials," <http://www.epa.gov/osw/conserve/rrr/imr/cdm/pubs/disaster.htm#la> and U.S. Geological Survey, "USGS Response to an Urban Earthquake: Northridge '94," <http://pubs.usgs.gov/of/1996/ofr-96-0263/>.



FEMA NEWS PHOTO

Stronger Communities: A Handbook for Reconstructing after Natural Disasters," published by the World Bank in January 2010. Additional chapters, other resources, and ordering information for the handbook can be found at the handbook Web site: www.housingreconstruction.org.

2004 Indian Ocean Tsunami, Sri Lanka

Ecological Planning of Settlements to Address Waste Management

After the 2004 Indian Ocean tsunami in Sri Lanka, waste management became an additional challenge to the problem of dealing with the regular waste generated by the growing population. There was a need to address the waste generated by the changing consumption patterns of the tsunami-affected people, many of whom were housed in transitional shelters. Many new housing schemes, settlements, and townships were developing in numerous, dispersed locations, and in these locations there was inadequate space and capacity to tackle this problem. Therefore, it was important to ensure that local authorities were provided the resources and capacity to manage the impacts of these settlements on the waste stream, to avoid waste management becoming a major issue when these settlements were occupied. New ecological plans were developed in many cases, with the assistance of outside experts.

Sources: Satoh Tomoko, 2007, *Study on Evolution of Planning and Responses to Water-Related Disaster in Japan, and Its Application to Indian Ocean Tsunami Case in Sri Lanka* (master thesis, Kyoto University); and Aat van der Wel, Valentin Post, 2007, "Solid Waste Management in Sri Lanka: Policy & Strategy," <http://www.waste.nl/page/1554>.

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Annex 1

How to Do It: Developing a Disaster Debris Management Plan

Natural disasters can generate tremendous quantities of debris. After a disaster, some institution must immediately take the lead to develop and direct a plan for collecting and managing disaster debris. Failure to do so will increase the secondary risks for the affected community and will delay reconstruction. If disasters are anticipated, a disaster debris management plan should be in place that lays out the roles and responsibilities of different agencies, a plan of action, and the mechanisms for coordination. While this sort of planning is becoming more common, especially in countries with strong local governments, it is more likely that both the preparation and the execution of the debris management plan will be done immediately after the disaster strikes, sometimes by an inexperienced lead agency. This section provides basic guidance on how institutions can collaborate to manage post-disaster debris. It does not assume pre-planning has been done and therefore covers planning as well as some important topics to consider in each component. It is based on a range of publicly available documents.¹

Phases of Disaster Debris Management

Post-disaster debris management typically occurs in two overlapping phases: initial clearance and long-term removal, management, and processing. The overall plan should address both.

Phase 1. Initial clearance of debris. Debris clearance will be the primary debris management activity during the first few days. During this phase, debris is cleared from power lines and key roadways to restore transportation, emergency access, and utility services as quickly as possible. Households and businesses will set debris at the side of the road, for later collection. Various agencies may be available to provide assistance, including the national guard or military, utility companies, local and state police, and public works and highway agencies. Coordination among them will be required. This phase will last approximately 10 days.

Phase 2. Long-term removal, management, and processing of debris. Following initial clearance, debris management generally shifts to local public agencies, and becomes more complex. It will include removing, collecting, processing, and disposing of debris, including all debris in public areas, as well as debris set out by residents for collection. The rules for handling institutional, commercial, and industrial waste must be part of the plan. This phase may last up to one year.

Components of a Disaster Debris Management Plan

Disaster debris may be viewed as pure waste or as a resource. Disaster debris may be viewed as pure waste or as a resource. The reality is somewhere in between; some portion is a usable resource and some portion must be disposed of. The goals of post-disaster debris management are to reduce risk, facilitate the recovery and reconstruction efforts, and dispose of debris efficiently and in a cost-effective and environmentally sound manner, while keeping final disposal of reusable or salable materials to a minimum.

The management plan must cover collection of waste and a hierarchy of waste disposal options that usually includes: reuse, reduction, recycling, composting, combustion, and land-filling. The plan should also include strong monitoring and regulatory mechanisms, such as controls to prevent and sanction illegal dumping by both households and businesses, a very common occurrence in many countries. The demands of post-disaster debris management may mean that normal operating procedures have to be rapidly expanded or strengthened, even in communities with well-run solid waste management systems. This could include locating additional debris staging and storage areas, contracting out services normally performed “in-house,” and/or finding ways to reuse or market debris materials. A comprehensive disaster debris management plan should include the following activities.

Disaster Debris Management Plan Activities

Activity	Considerations
A. Define requirements and management approach	
1. Define roles and responsibilities (national/ local government, public/ private entities, households, and institutions).	Pre-planning of roles and responsibilities significantly speeds the start-up of debris management. The default lead should be the local government, even if other actors are principally responsible for Phase 1 activities. Actors who are likely to be involved include utility companies (water and power), local police, national guard or military, public works and highway agencies, local government, local emergency management agency, the private sector (e.g., contractors and property owners), institutions, households, community and civil society organizations, and volunteers.
2. Identify debris types and forecast amounts.	Take the time to categorize the waste stream in order to properly design the management strategy. Data from prior disasters, sampling, and estimation tools can be used. Identify any toxic or hazardous substances in the debris, such as fiberglass or asbestos. See Note 1: Identify debris types and forecast amounts , below.
3. Identify applicable national and local environmental regulations to be followed.	The disaster will already have caused significant environmental damage. Don't compound the problem by ignoring environmental law in the handling the disaster debris. See section on Public Policies Related to Environmental Planning, in this chapter.

Activity	Considerations
4. Inventory current operational, regulatory, and financial capacity and requirements for debris management, including equipment and administrative needs, establish debris-tracking mechanisms.	Identify public and/or private local resources that are available to assist with debris collection and management. Identify local or national contractors that own heavy equipment needed for debris removal and collection, such as bulldozers, dump trucks, skid steer loaders, front end loaders, and logging trucks, and that can provide skilled operators to run the equipment. Analyze the financial resources available for debris management and develop a financial plan, which may include taxes, user fees, donations, and resources from a higher level of government. Debris management costs often exceed estimates and can undermine the financial stability of local agencies. External support is usually required. Tracking should be by weight, volume, and type of debris, and will be useful for control and later reimbursement of costs.
5. Identify activities to be contracted out and agree on contracting approach.	Common areas for contracting include (1) collection, (2) recycling, (3) DMS operation, (4) hazardous waste management, and (5) monitoring of all of the above. Ideally, contracts will have been pre-arranged, companies pre-qualified, and/or contract scope, terms and prices pre-defined. If not, identify contracting mechanisms and procurement rules to be used and agree on areas for contracting and contract types. Types include (1) time and materials (good early on; likely to be more expensive used long-term), (2) unit price (useful when quantities are hard to define), and (3) lump sum (if scope of work is clearly defined). Due to the opportunities for revenue generation and livelihood, consider a preference for community groups or other civil society organizations to carry out contracted debris management services, assuming they demonstrate competency and ability to manage any risks associated with materials handling.
6. Select debris management sites (DMS).	Identify an environmentally safe site between 10 and 50 acres, with good egress and ingress. See Note 2: Selecting debris management sites , below.
7. Identify DMS management approach.	DMS management may be done by the public agency or contracted out. Good management will permit the site to be closed and returned to its original use within a reasonable time. A pre-negotiated contract allows a quicker set-up of the DMS and better prices than what might be offered after the disaster. Key contract requirements include (1) provision of a pre-approved site (optional), (2) documentation of all costs and monitoring and auditing of all activities to guard against fraudulent cost claims or diversion of materials, and (3) compliance with all applicable legal requirements including environmental laws.
8. Establish a monitoring and regulatory system.	Good practice dictates the contracting of monitoring, particularly for any contracted services. Private contract terms, waste management behavior of households and businesses, DMS management, and the environmental impact of the plan are some critical areas to monitor. ² Ensure that regulations and contracts allow violations to be adequately sanctioned.
9. Develop a communications plan.	Communications regarding the Disaster Debris Management Plan must be effective for the audiences for which they are intended. What's important is what people hear, not just what is said, so consultation with target groups regarding the messages should take place before and as communications take place. For guidance on communications in reconstruction settings, see 📖 Chapter 3, Communication in Post-Disaster Reconstruction.
10. Plan for DMS closure.	Closure of the DMS should be the goal once the post-disaster debris stream returns to manageable volumes and normal composition. If site management is contracted out, the contract should include benchmarks and financial incentives to evaluate and facilitate closure.
B. Develop the debris removal and disposal strategy	
1. Design a debris collection system.	Collection options may include one or more the following: (1) curbside collection using existing solid waste and recycling system; (2) additional clearance and collection routes run by agency staff or additional contractors, potentially including specialized contractors to handle volume or for certain types of debris (e.g., hazardous waste, white goods, electronics, or vehicles); and (3) drop-off and exchange locations for debris and recyclables.
2. Establish hazardous materials categories and procedures for hazardous materials and medical waste identification and handling.	Separation is a critical aspect of hazardous waste management. Procedures are directly influenced by the findings of activity A3, above. These wastes are often regulated at the national level. If no regulation applies, refer to international guidelines. See Note 1: Identify debris types and forecast amounts , below.
3. Create incentives to encourage household reduction and reuse of waste.	Use the communications plan to promote reuse of building materials and on-site reduction, such as guidelines for salvaging of household items. Do not encourage practices that expose residents to toxins or mold. Take measures to prevent illegal scavenging and resale of private property. Consider a financial incentive so households or community organizations clear local debris.

Activity	Considerations
4. Maximize recycling; identify recycling options and procedures.	Assist recycling systems to scale up if necessary. Allow scavenging of recyclable materials to reduce the waste stream. Offer small businesses access to raw materials, such as trees for saw mills, at reduced or no cost. Publicize safe reuse methods for different types of waste and promote their use. Provide testing if any safety issues exist. Ensure reconstruction guidelines are clear on use of recycled materials to avoid inappropriate and unsafe reuse.
5. Analyze waste-to-energy options.	Unless existing waste-to-energy plants are in operation, this option is unlikely to be employed. Best practice is to have pre-negotiated contracts and prices by type of waste.
6. Identify disposal options and procedures.	Make sure public and private entities understand the range of options and that procedures are widely publicized. Create a hierarchy of disposal options that reduces the waste stream at the source and minimizes the costs and environmental impacts of disposal.
7. Evaluate the open burning option and establish rules.	The risks of burning include fires, pollution from particulate matter, and release of hazardous materials. Establish procedures based on existing rules on burning waste. If post-disaster procedures diverge from existing rules, publicize them as temporary and limit their scope. Requiring permits is an option, but may be difficult to manage in post-disaster circumstances.
8. Investigate options for sale of materials.	Existing commercial markets for sale of glass, metals, wood, and other recyclables of value should respond to the increased materials stream created by the disaster, although temporary storage may be necessary to allow market to “catch up.” Promote to potential users options for reuse of materials, such as the use of crushed concrete and glass for roads. Ensure that users are experienced materials handlers and do not expose others to harm.
9. Establish guidelines and secure locations for preservation of historical materials.	Local museums or historical societies may need help with storage and may be able to provide guidelines for the handling or storage of these materials. Monitor informal markets to ensure historical assets are not being scavenged or sold.

Note 1: Identify debris types and forecast amounts.

The categories of waste that will have to be handled after a disaster include the following.

Vegetative Waste: Typically one of the largest volume debris streams.

Much can be diverted as lumber, chipping for mulch, composting, or fuel.

Construction and Demolition (C&D) Debris: Large amounts are produced in most disaster events. May be possible to divert by reprocessing for construction, such as crushing concrete for aggregate and reusing brick and stone. Some paving materials, such as asphalt blacktop, can be recycled for road repair. If C&D debris contains asbestos, it must be managed separately and safety practices and personal protective equipment must be used by workers to minimize exposure. Asbestos-containing materials should not be burned. Governments should have regulations or procedures for asbestos removal, handling, and disposal personnel and permits. In their absence, an effort might be made to use international standards, such as those of the USEPA. However, these may be difficult to implement under time pressure and without an adequate institutional framework.³ See “Managing Asbestos in Housing and Community Reconstruction” text box in this chapter.

Bulky Waste: Material such as carpet, furniture, and mattresses. Usually must be sent for disposal.

Appliances and Electronics: Should be collected separately and component materials recycled.

Vehicles and Boats: Should be inventoried by vehicle identification number (VIN) or license plate number, and held for a reasonable time for reclaiming or insurance purposes, then recycled/crushed, using normal environmental safeguards.

Trash: Household trash volume will decline if people are displaced and will increase if they return and dispose of damaged household items. Household collection service may need to be increased at that time.

Soils and Sediments: High rainfall and flooding can produce large quantities of soil and sediments. These may be contaminated, containing bacteria or toxins; testing is advised. Workers around flood waters and

sediments may require safety practices and personal protective equipment to minimize exposure.

Business and Household Hazardous Waste: Manage and dispose of these wastes separately. If the normal household hazardous waste collection system is good, simply ramp it up; otherwise, disposal procedures should be established and communicated and a qualified contractor hired to oversee them. Businesses should be responsible for managing their own hazardous wastes, if adequate systems are in place, although small business hazardous waste may be handled with household waste. If systems are inadequate, government will have to establish arrangements for handling these materials, including industrial chemicals and other industrial inputs and wastes, paints, solvents, underground storage tanks, etc. If tracking systems exist for hazardous wastes, do not let them lapse in the post-disaster environment. Consider a special charge for this service if it will not unduly discourage responsible handling by producers, since disposal costs may be high. **Putrescible wastes:** This includes fruits, vegetables, meats, dairy products, and other produce from grocery stores, restaurants, institutions, and residences. It can also include animal carcasses. These rot or decay quickly and should be segregated accordingly and quickly managed. Some putrescible wastes can be composted or rendered. More information about composting food and other putrescible wastes can be found at USEPA’s Food Waste Recovery Hierarchy Web site.⁴

Infectious/Medical Waste: In certain disasters, there will likely be large amounts of infectious and medical waste, as well as human bodies. These materials require special handling and management, and a major effort to keep them separate from other trash. National standards should exist; if they don’t, procedures should be quickly set up based on international guidelines.⁵ Workers exposed to this material should wear personal protective equipment to protect against infectious agents. Incineration of these wastes is often the best disposal solution.

Forecasting debris quantities. Models that can be used for forecasting debris quantities for a local area include the United States Army Corps of Engineers (USACE) Hurricane Debris Prediction Model.⁶ The calculation and its parameters are as follows:

$Q = H (C) (V) (B) (S)$ where:
 Q = estimated debris total generated in cubic yards
 (Note: The predicted accuracy of the model is $\pm 30\%$)
 H = number of households, or population/3 (average household size is 3)
 C = hurricane category factor (cat1 = 2, cat2 = 8, cat3 = 26, cat 4 = 50, cat5 = 80)
 V = density of vegetation (1.1 for light, 1.3 for medium, 1.5 for heavy)
 B = percentage of commercial structures (1.0 for light, 1.2 for medium, 1.3 for heavy)
 S = precipitation factor (1.0 for none to light, 1.3 for medium to heavy)

Note 2: Selecting debris management sites

If no site has been identified for debris disposal before the disaster, use GIS information or land records to identify a large open space, generally between 10 and 50 acres, depending on results of debris stream analysis. If properly managed, the site can be closed or returned to its prior use once all materials are disposed of. At a minimum, the following site characteristics, should be considered when selecting the DMS: (1) publicly owned land; (2) good ingress and egress with room for scale, (3) relatively flat topography; (4) location near final disposal sites to reduce hauling distances, if possible; (5) can accommodate separation and reduction of types of debris and capacity for debris operations, such as chipping, grinding, crushing, burning, and recycling; (6) minimal effect on residential neighborhoods, educational facilities, or health care facilities; (7) no impact on environmentally sensitive areas, such as wetlands, endangered species, rare ecosystems, or other areas with environmental restrictions or on historic or archaeological sites.

Before being put into use, the DMS should be equipped with (1) fencing surrounding the site; (2) a scale and/or other means of registering weights and quantities; (3) signage and security measures to limit unauthorized access; (4) fire control equipment; storm-water controls to prevent discharge of contaminated runoff into water bodies; (5) controls to prevent migration of dust, wood chips, or other debris from both haulers and handling of debris on the site; (6) clearly marked sorting, staging, and processing areas for all categories of waste; and (8) monitors to correctly identify and segregate waste types.

Annex 1 Endnotes

1. State of Connecticut, 2008, "Disaster Debris Management Plan," September 2008 (Annex to the State Natural Disaster Plan, 2006), State of Connecticut Department of Environmental Protection, [http://www.ct.gov/dep/lib/dep/waste_management_and_disposal/debris_management/final_ddmp_plan_september_2008_\(pdf\).pdf](http://www.ct.gov/dep/lib/dep/waste_management_and_disposal/debris_management/final_ddmp_plan_september_2008_(pdf).pdf); U.S. Environmental Protection Agency (USEPA), 2008, "Planning for Natural Disaster Debris Guidance," USEPA, Office of Solid Waste and Emergency Response, <http://www.epa.gov/osw/conserve/rrr/imr/cdm/pubs/pnnd.pdf>; California Waste Management Board, "Disaster Preparedness and Response," <http://www.ciwmb.ca.gov/Disaster/Links.htm> and Integrated Waste Management Disaster Plan, <http://www.ciwmb.ca.gov/Disaster/DisasterPlan/>; USEPA, "Disaster Debris," <http://www.epa.gov/epawaste/conserve/rrr/imr/cdm/debris.htm>; and Federal Emergency Management Agency, 2007, "Public Assistance Debris Management Guide," FEMA-325, FEMA, <http://www.fema.gov/pdf/government/grant/pa/demagde.pdf>.
2. Numerous sample contracts for post-disaster debris management and monitoring are available on the Internet, for example: <http://iaemeuropa.terapad.com/resources/8959/assets/documents/SAMPLE%20DEBRIS%20MANAGEMENT%20PLAN.pdf>; http://www.barkerleamar.com/organicmanagement/resources_loader.aspx?ID=57; http://www.nctcog.dst.tx.us/envir/SEELT/disposal/DDM/docs/TAB_1_Debris_Monitoring_Scope_of_Services.pdf; and <http://sema.dps.mo.gov/Debris%20Management%20&%20Public%20Assistance/Example%20Locals%20Tonnage%20Debris%20Contract.pdf>.
3. USEPA, "Asbestos in Demolition and Renovation," <http://yosemite.epa.gov/R10/OWCM.NSF/webpage/Asbestos+in+Demolition+and+Renovation>.
4. USEPA, <http://www.epa.gov/epawaste/conserve/materials/organics/index.htm>.
5. California Integrated Waste Management Board, 2007, "Receipt of Medical Waste at Solid Waste Facilities and Operations," <http://www.ciwmb.ca.gov/publications/facilities/23206006.pdf>.
6. U.S. Army Corps of Engineers Hurricane Debris Estimating Model, [http://www.gema.state.ga.us/ohsgemaweb.nsf/1b4bb75d6ce841c88525711100558b9d/f715ec607d3bd6c852571e30055c99a/\\$FILE/Appendix%20A.pdf](http://www.gema.state.ga.us/ohsgemaweb.nsf/1b4bb75d6ce841c88525711100558b9d/f715ec607d3bd6c852571e30055c99a/$FILE/Appendix%20A.pdf).




How to Do It: Carrying Out Environmental Impact Assessment and Environmental Monitoring of Reconstruction Projects

Conducting an Environmental Impact Assessment

Environmental impact assessment (EIA) is the process of identifying, predicting, evaluating, and identifying and selecting options for mitigating the biophysical, social, and other relevant effects of proposals for development projects prior to finalizing project designs and commitments. EIAs are required in some form and for some types of projects in nearly all countries, although the specifics of what is required vary.

Frameworks for Environmental Impact Assessment

Each country has its own environmental assessment requirements that are applied at the project level, although there may be pressure to suspend them in a post-disaster environment. Environmental ministries generally promulgate and oversee environmental regulations under environmental laws, the implementation of which is sometimes delegated to lower levels of government. Reconstruction policy should define the environmental framework to be applied in reconstruction. The World Bank also defines what it requires in the projects it finances, but this will generally not replace local environmental review requirements (although the Bank may in some cases accept country procedures as a substitute for its own). See  Chapter 21, Safeguard Policies for World Bank Reconstruction Projects, for a description of World Bank requirements.

The content and organization of the framework for environmental management varies from one country to another and from one region to another.

- In China, the Environmental Impact Assessment Law requires an EIA prior to project construction. However, if a developer ignores this requirement, the only penalty is that the Environmental Protection Bureau may require the developer to do a make-up environmental assessment. This lack of enforcement has resulted in a significant percentage of projects not completing EIAs prior to construction. However, China's State Environmental Protection Administration has used the legislation to halt projects, including three hydro-power plants under the Three Gorges Project Company in 2004.
- In India, the Ministry of Environment and Forests of India has been involved in promoting the EIA process. The main national laws are the Water Act (1974), the Indian Wildlife (Protection) Act (1972), the Air (Prevention and Control of Pollution) Act (1981), and the Environment (Protection) Act (1986). The responsible body is the Central Pollution Control Board.¹
- The European Union provides separate guidelines for environmental assessment that is undertaken for individual projects, such as a dam, motorway, airport, or factory ("Environmental Impact Assessment") or for plans, programs, and policies ("Strategic Environmental Assessment").²

- International standards may also be called for or required in certain situations, such as the International Organization for Standardization (ISO) 14000³ or the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention).⁴

Objectives of Environmental Impact Assessments

- To ensure that environmental considerations are explicitly addressed and incorporated into the development decision-making process
- To anticipate and avoid, minimize, or offset the adverse significant biophysical, social, and other relevant effects of development proposals
- To protect the productivity and capacity of natural systems and the ecological processes that maintain their functions
- To promote development that is sustainable and optimizes resource use and management opportunities

EIA Principles and Scope

The EIA process should be applied⁵:

- as early as possible in decision making and throughout the life cycle of the proposed activity;
- to all development projects that may cause potentially significant effects;
- to biophysical impacts and relevant socioeconomic factors, including health, culture, gender, lifestyle, age, and cumulative effects consistent with the concept and principles of sustainable development;
- to provide for the involvement and input of communities and industries affected by a project, as well as the interested public; and
- in accordance with internationally agreed measures and activities.

The environmental resources that may be affected by a project will vary by sector.⁶ Many environmental agencies develop checklists or guidelines that apply to projects in specific sectors. In housing and community reconstruction, environmental impacts may result from (1) demolition, (2) site preparation and development, (3) building and infrastructure construction, and (4) occupancy of the site once developed. A general list of the resources to be evaluated includes the following.⁷

- (i) Physical Resources
 - Atmosphere (e.g., air quality and climate)
 - Topography and soils
 - Surface water
 - Groundwater
 - Geology/seismology

(ii) Ecological Resources

- Fisheries
- Aquatic biology
- Wildlife
- Forests
- Rare or endangered species
- Protected areas
- Coastal resources

(iii) Economic Development

- Industries
- Infrastructure facilities (e.g., water supply, sewerage, flood control)
- Transportation (e.g., roads, harbors, airports, navigation)
- Land use (e.g., dedicated area uses)
- Power sources and transmission
- Agricultural development, mineral development, and tourism facilities

(iv) Social and Cultural Resources

- Population and communities (e.g., numbers, locations, composition, employment)
- Health facilities
- Education facilities
- Socioeconomic conditions (e.g., community structure, family structure, social well-being)
- Physical or cultural heritage
- Current use of lands and resources for traditional purposes by indigenous peoples
- Structures or sites of historical, archeological, paleontological, or architectural significance

EIA processes generally provide for the following steps or elements.

Elements of an Environmental Impact Assessment Process⁸

Screening	To determine whether or not a proposal should be subject to EIA and, if so, at what level of detail.
Scoping study or initial assessment	To identify the issues and impacts that are likely to be important and to establish terms of reference for EIA or other environmental assessment.
Examination of alternatives	To establish the preferred or most environmentally sound and benign option for achieving proposal objectives.
Impact analysis	To identify and predict the likely environmental, social, and other related effects of the proposal. In most environmental policy frameworks, projects are categorized at this stage by their potential environmental impact (Category A, B, or C), and this category determines the scope and content of the EIA or other environmental assessment that is required.
Mitigation and impact management	To establish the measures that are necessary to avoid, minimize, or offset predicted adverse impacts and, where appropriate, to incorporate these into an environmental management plan or system.
Evaluation of significance	To determine the relative importance and acceptability of residual impacts (i.e., impacts that cannot be mitigated).
Preparation of environmental impact statement (EIS) or report statement	To document clearly and impartially impacts of the proposal, the proposed measures for mitigation, the significance of effects, and the concerns of the interested public and the communities affected by the proposal.
Review of the EIS	To determine whether the report meets its terms of reference, provides a satisfactory assessment of the proposal(s), and contains the information required for decision making.
Decision making	To approve or reject the proposal and, if approved, to establish the terms and conditions for its implementation.
Follow-up	To ensure that the terms and condition of approval are met; to monitor the impacts of development and the effectiveness of mitigation measures; to strengthen future EIA applications and mitigation measures; and, where required, to undertake environmental audit and process evaluation to optimize environmental management.

Monitoring, evaluation, and management plan indicators should be designed so that they contribute to local, national, and global monitoring of the state of the environment and sustainable development.

Initial Environmental Assessment

The initial assessment (IA) is an important tool for incorporating environmental concerns at the time of initial project planning. It should be carried out as early as the project planning stage as part of feasibility so that it can ensure that the project will be environmentally feasible. The IA is conducted if the project is likely to have minor or limited impacts, which can easily be predicted and evaluated and for which mitigation measures are prescribed easily. The IA is also used to confirm whether a more extensive EIA is required.

The IA study should provide the following information:

- General environmental settings of the project area, including baseline data
- Potential impacts of the project and the characteristics of the impacts, magnitude, distribution; who will be the affected group; and the duration of the impacts
- Potential mitigation measures to minimize the impact, including mitigation costs
- The best alternative project with the potential for greatest benefit at least cost in terms of financial, social, and environment; it is not always necessary to change location of the project, but it can be changed in project design or project management
- Information for formulating a management and monitoring plan

If the IA determines that an full EIA is required, the assessment is conducted in more detail, focusing on the issues identified in the initial assessment. Mitigation measures are then defined, depending on the findings of the EIA.

The environmental assessment should analyze not only the impact of the project and their corresponding mitigation measures, but also the potential impact and mitigation measures for the construction activities, including traffic impacts, air pollution, noise pollution, and management of runoff or other potential contamination from the construction activities.

Mitigation Plan

The EIA should identify feasible and cost-effective measures that may reduce potentially significant adverse environmental impacts to acceptable levels. The plan includes compensatory measures if mitigation measures are not feasible, cost-effective, or sufficient. Specifically, the EIA should:

- identify and summarize all anticipated significant adverse environmental impacts (including those involving indigenous people or involuntary resettlement);
- describe—with technical details—each mitigation measure, including the type of impact to which it relates and the conditions under which it is required (e.g., continuously or in the event of contingencies), together with designs, equipment descriptions, and operating procedures, as appropriate;
- estimate any potential environmental impacts of these measures; and
- provide linkage with any other mitigation plans (e.g., for involuntary resettlement, indigenous peoples, or cultural property) required for the project.

Outline of Environmental Impact Assessment Report

- A. Introduction
- B. Description of the Project
- C. Description of the Environment
- D. Potential Environmental Impacts and Mitigation Measures
- E. Institutional Requirements and Environmental Monitoring Plan
- F. Public Consultation and Information Disclosure
- G. Findings and Recommendation
- H. Conclusions

Developing an Environmental Monitoring Plan⁹

A project's EMP consists of the set of mitigation, monitoring, and institutional measures to be taken during implementation and operation to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels. The plan also includes the actions needed to implement these measures. The content of the management plan is based on the results of the EIA, on the project design documents, and on any other regulations that apply. Another important objective of the EMP is to ensure that the mitigation measures and monitoring requirements approved during the environmental review are actually carried out in subsequent stages of the project.

An EMP for a housing or infrastructure reconstruction project should address the impact of the project on:

- the environment;
- the existing surrounding communities; and
- those who will take up residence at the site.

If a project is being built in phases, there may need to be EMPs for different phases, or the EMP may need to be updated as the project progresses.

To support timely and effective implementation of environmental project components and mitigation measures, the EMP draws on the EIA to:

- identify the principal and alternative responses to potentially adverse impacts;
- determine requirements for ensuring that those responses are made effectively and in a timely manner; and
- describe the means for meeting those requirements.

An EMP for a construction project should include the components and subcomponents described below.¹⁰

Environmental Management Structure and Procedures

The EMP should describe the following.

- The organization chart of the project management and the management responsibilities and lines of authority, including those for environmental management; if necessary, the EMP should recommend the hiring of outside consultants or other measures to strengthen the environmental management capacity of project management, such as the training of staff, in order to ensure implementation of EIA recommendations
- The permits and licenses that will be acquired for the project and assign responsibility for compliance with any conditions
- The measures that will be taken on the site to manage potential environmental impacts on any of the resources identified in the EIA
- The measures that will be taken on the site to manage environmental impacts from demolition and construction, such as noise, water, and air pollution
- Procedures for dealing with accidents or other unexpected environmental events that affect any of the resources analyzed in the EIA or with unexpected resources or contaminants found on the site during demolition and construction

Monitoring and Auditing

Environmental monitoring and auditing during project implementation provide information about key environmental aspects of the project, particularly the environmental impacts of the project and the effectiveness of mitigation measures. Such information enables the project sponsor to evaluate the success of mitigation as part of project supervision and allows corrective action to be taken when needed.

The EMP identifies monitoring objectives and specifies the type of monitoring, with linkages to the impacts and the mitigation measures identified in the EIA, including:

- a specific description, and technical details, of monitoring measures, including the parameters to be measured, methods to be used, sampling locations, frequency of measurements, detection limits (where appropriate), and definition of thresholds that will signal the need for corrective actions; and
- monitoring and reporting procedures to provide early detection of conditions that necessitate particular mitigation measures and information on the progress and results of mitigation.

Implementation Schedule and Cost Estimates

With respect to implementation, the EMP should provide:

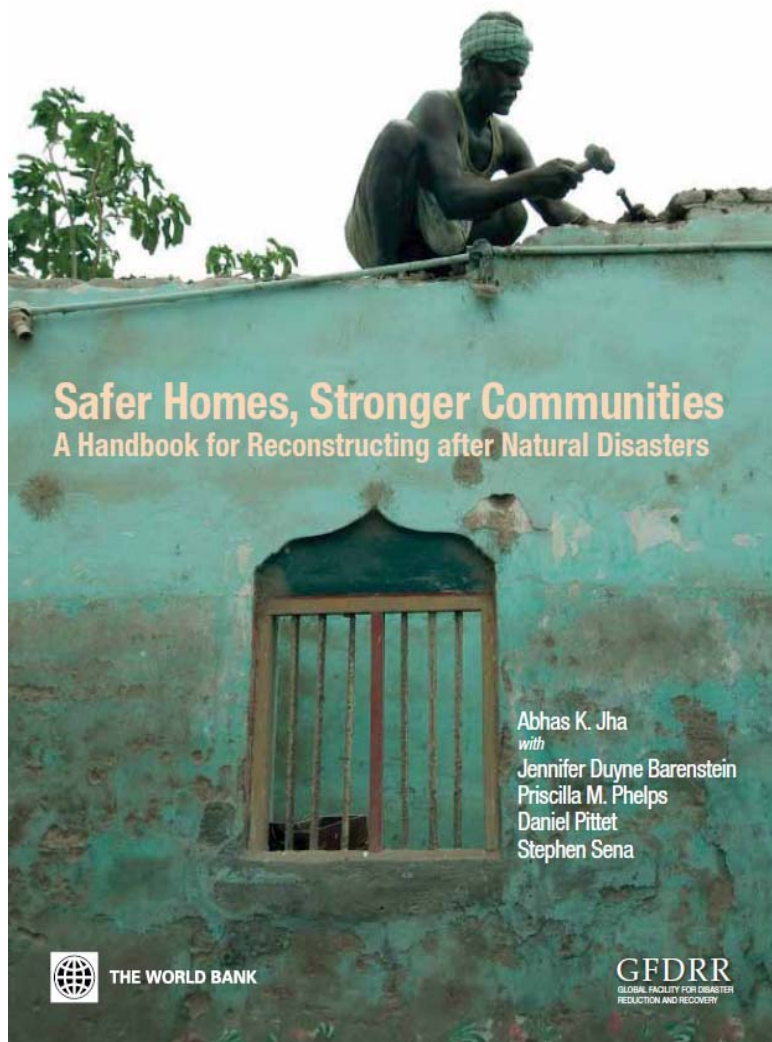
- a description of the works to be undertaken as part of the project;
- an implementation schedule for the works;
- a schedule of environmental management measures that will be carried out as part of the project, showing phasing and coordination with overall project implementation plans; and
- capital and recurrent cost estimates and sources of funds for implementing the EMP.

The costs of implementing the EMP should be incorporated into the total project cost estimate to ensure that they are provided for as part of project financing.

Annex 2 Endnotes

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The World Bank
1818 H Street NW
Washington DC 20433
Telephone: 202-473-1000
Internet: <http://www.worldbank.org>
E-mail: feedback@worldbank.org

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