SFG1030

ADDENDUM
TO
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) OF PROMOTING GIRLS EDUCATION IN BALOCHISTAN (PGEB) PROJECT FOR USE IN GLOBAL PARTNERSHIP FOR EDUCATION-BALOCHISTAN EDUCATION PROJECT (GPE-BEP)

March 2015

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EXECUTIVE SUMMARY

1. The Government of Balochistan is planning to initiate theGlobal Partnership for Education-Balochistan Education Project (GPE-BEP). The Addendum in hand is prepared to present environmental and social impact assessment (ESIA) of the project after making minor amendments in the existing ESIA of Promoting Girls Education in Balochistan (PGEB) project. The ESIA of PGEB was carried out in compliance with the national environmental laws of Pakistan and the World Bank Operational Policies. The adaption of ESIA of PGEB for GPE-BEP was considered owing to:a) similarities in the project activities; and b) the existing institutional setupto beused for GPE-BEP implementation. Further, a review of the existing ESIA of PGEB was also carried out to ascertain its adaptation in GPE-BEP and identifying sections which require amendments.
2. The present Addendumdelineates the environmental and social issues emerging from the GPE-BEP project, identifies the potentially adverse environmental and social impacts of the project activities, and suggests appropriate mitigation measures to offset or reduce these impacts. The report also suggests guidelines for environmental enhancement opportunities available during various phases of project implementation to maximize the benefit of the project. The mitigation measures and guidelines have been organized in the form of an environmental and social management plan (ESMP) to be implemented by the Project Management Unit (PMU) of the GPE-BEP project for avoiding or mitigating the significant environment and social impacts.
3. The ESIAencompasses the assessment of the environmental and social impacts of the GPE-BEP activities, which will be implemented in all 32 districts of the province, including the areas / administrative districts already catered for under PGEB Project.
4. The preparation of addendum was carried out after thorough review of the existing ESIA of PGEB. The review process included thorough study of primary and secondary sources of information collected during the ESIA of PGEB, correlating the available information with the baseline information of the newly added districts and reviewing project activities of the GPE-BEP.

5. Most of the environmental impacts of GPE-BEP project activities are similar to those of PGEB project, are isolated small-scale and site specific in nature and are of low to moderate in significance. Majority of the impacts pertaining to construction and operation are on surface water quality, air quality, noise and vibrations, soil erosion and land contamination, health and hygiene issues and inconvenience to public from improper stockpiling of the materials at the schools. Most of these impacts are of low to medium level and manageable by adopting appropriate mitigation measures during project implementation.
6. The present ESIA Addendum proposes mitigation measures for each stage of project activity. The siting and design stage measures include implementation of site selection guidelines, adopting eco-friendly designing and applying appropriate building codes in the designing of school buildings located in the earthquake prone areas and flood plains. Appropriate water efficient design of toilets with septic tank and soaking pit, sewerage connection and provision of proper ventilation for lighting in classrooms are some of the cardinal mitigation measures. The construction stage measures include preemptive actions by the construction contractor to avoid the adverse impacts, for example, covering the stockpiled materials, limiting excavation activities after schooling hours, and ensuring worksite safety. The mitigation measures relating to school operation include proper disposal of the solid waste, proper maintenance of water supply and sanitation system and ensuring the supply of safe drinking water. The application of rainwater harvesting techniques and installation of solar powered appliances are some of the environmental enhancement opportunities available in the area for which guidelines has been incorporated in the report.
7. During the preparation of the present Addendum, a review of the existing ESA of the PGEB project was carried out. The key shortcomings of the ESA implementation included absence of the environmental focal point for extended durations, weak monitoring, insufficient trainings, and inadequate reporting. The present Addendum includes an action plan to address these weaknesses.
8. The ESMP tailored for GPE-BEP provides a comprehensive mechanism for implementing the proposed mitigation measures and guidelines to attenuate the adverse impacts of the project to an acceptable level. The key components of the ESMPinclude environmental mitigation measures

and guidelines for implementation by the architect / design engineer, construction contractor, supervision firm and monitoring by the environmental focal persons at the provincial and district level. The parameters for monitoring, roles and responsibilities of designated officers for monitoring have also been described in the ESMP.

9. An institutional mechanism has been proposed for implementing the ESMP. A fulltime safeguard officer in the PMU will be responsible for ESMP implementation. The District Focal Persons (DFPs) will ensure ESMP implementation at the field level and will be responsible for upward and downward coordination, removal of bottlenecks, and maintaining a consolidated database. The District Focal Persons will also ensure compliance of the ESMP mitigation measures and guidelines and carry out internal monitoring through their teams with community participation in the form of Parent Teacher School Management Committee (PTSMCs) at each school site.
10. The ESMPalso describes internal and external monitoring mechanism to ensure compliance of the mitigation guidelines at various tiers and reporting of non-compliance issues for evaluation and mid-course correction by relevant actors amid project execution. External monitoring or third party validation in the form of an annual environmental audit has also been proposed to be conducted by an experienced environmental expert or consultancy firm. The external monitoring is aimed at reviewing the ESMP implementation process, identify any environmental issues on ground, and propose recommendations for keeping the project compatible with local context and changing conditions.
11. In order to ensure successful implementation, the ESMP proposes capacity building of the relevant staff and designated focal persons through specific and tailor made trainings on environmental and social impacts and mitigation measures. One- to two-days training workshops will be held at PMU Quetta and 32 one-day workshops (one in each district) during the project implementation phase. These workshops will be geared towards enhancing understanding of the environmental and social issues and apprising and sensitizing the participants about environmental and social importance of managing the on-ground problems associated with project activities. A total of 34 trainings will be held in the first year to train the project directors, managers, engineering team, monitoring and evaluation (M&E) Officers and District Focal Persons at provincial and

district levels. Refresher trainings will be arranged during subsequent years of project duration.

12. The estimated cost of ESMP implementation is Pak Rupees (PKR) 19.93 million for three years project duration which includes the costs of capacity building trainings and external monitoring or third party validation. The cost to be incurred on implementation of proposed mitigation measures and guidelines will be included in the bidding documents for school construction.

LIST OF ACRONYMS

ADB	Asian Development Bank
AZRI	Arid Zone Research Institute
BEF	Balochistan Education Foundation
BEMIS	Balochistan Education Management Information
BESP	Balochistan Education Sector Plan
BHU	Basic Health Unit
BOQ	Bill of Quantity
BUITEMS	Balochistan University of Information Technology, Engineering and Management Sciences
C&W	Communication and Works
CA	Coordinating Agencies
CMR	Central Mountains Range
CO	Carbon Monoxide
CSFP	Construction, Supervision and Facilitation Partner
DEO	District Education Officer
DFAT	Department of Foreign Affairs and Trade Australia
DFP	District Focal Person
DPD	Deputy Project Director
EA	Environmental Assessment
EFA	Education For All
EFP	Environmental Focal Person
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
ESIA	Environmental and Social Impacts Assessment
ESMP	Environmental and Social Management Plan
FATA	Federally Administered Tribal Areas
FGD	Focus Group Discussion
GBHS	Government Boys High School
GBPS	Government Boys Middle School
GDP	Gross Domestic Product
GER	Gross Enrolment Rate
GGPS	Government Girls Primary School
GMS	Government Middle School
GOB	Government of Balochistan
GP	Gender Policy
GPE-BEP	Global Partnership for Education-Balochistan Education Project
GPS	Government Primary School
HDI	Human Development Index
I&P	Irrigation and Power Department Balochistan
ICT	Information Communication Technology
IEE	Initial Environmental Examination
ILO	International Labour Organization
IPs	Implementing Partners
IT	Information Technology
IUCN	Internal Union for Conservation of Nature
IWMI	International Water Management Institute
Km	Kilometer
KP	Khyber Pakhtunkhwa
MAF	Million Acre Feet
MCH	Maternal Care Health
MICS	Multiple Indicator Cluster Survey
NEQS	National Environmental Quality Standards
NGO	Non-Governmental Organization

NOC	No Objection Certificate
NRB	Nari River Basin
NWQMP	National Water Quality Monitoring Program
O&M	Operation and Maintenance
OP	Operational Policy
PAD	Project Appraisal Document
PC-1	Planning Commission Performa-1
PCC	Project Coordination Committee
PCRWR	Pakistan Council of Research in Water Resources
PD	Project Director
PEPA	Pakistan Environmental Protection Act
PGEB	Promoting Girls Education in Balochistan
PITE	Provincial Institute of Teacher Education
PLB	Pishin Lora Basin
PM	Particulate Matter
PMU	Project Management Unit
PPE	Personal protective equipment
PTSMC	Parent Teacher School Management Committee
SDO	Sub-Divisional Officer
SE	Supervising Entity
SED	Secondary Education Department
SMC	Site Monitoring Committee
Sq- km	Square Kilometer
TA	Technical Assistance
TDS	Total Dissolved Solids
TLM	Teaching and Learning Material
TPV	Third Party Validation
TSP	Total Suspended Particulate
UBC	Uniform Building Code
UNESCO	United Nation Educational, Scientific and Cultural Organization
UNICEF	United Nations Children Fund
USAID	United States Agency for International Development
WAPDA	Water and Power Development Authority
WB	World Bank
WHO	World Health Organization
ZRB	Zhob River Basin

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EXHIBITS

1. INTRODUCTION

1.1 Background

The Government of Balochistan plans to initiate the Global Partnership for Education-Balochistan Education Project (GPE-BEP)conceived in pursuit of higher level objective of **Education For All** under Article 25A of the constitution of Pakistan. The GPE-BEP, is designed to support the Government of Balochistan's commitment and targets set under Balochistan Education Sector Plan (BESP) 2013-18.

The GPE-BEP will be financed through an indicative grant allocation of US$ 34 million from GPE Fund and shall be executed by the Government of Balochistan, Secondary Education Department (SED) through the existing Project Management Unit (PMU) of the on-going Promoting Girls Education in Balochistan (PGEB) Project. An Environmental and Social Impact Assessment (ESIA) was carried out for the PGEB project; the ESIA is currently under implementation (see **Annex A** for the table of contents of the existing ESIA).

The interventions and their environmental and social impacts of the PGEB and GPE-BEP projects are quite similar to each other therefore some necessary revisions have been made in the existing document and the present Addendum has been prepared. The Addendum identifies the potentially negative impacts of the planned activities under GPE-BEP and proposes appropriate mitigation and control measures to address these negative impacts.

The principal World Bank publications that were reviewed in the preparation of this Addendum are listed as under.

- The World Banks' Operations Manual.
- World Bank Group Environment Health and Safety Guidelines (appended as **Annex B**).

This Addendum contains the following sections, to be read in conjunction with the ESIA of PGEP Project for its implementation in GEP-BEP:

i. Introduction
ii. Regulatory and Institutional Framework.
iii. Project Description
iv. Baseline Conditions for the Province of Balochistan
v. Stakeholder Consultations
vi. Environmental and Social Management Plan
vii. ESMP Implementation Budget

1.2 Scope of ESIAAddendum

The ESIAAddendumencompasses the assessment of the environmental and social impacts of the GPE-BEP activities, which will be implemented in all 32 districts of the province, including the areas / administrative districts already catered for under PGEB Project; see**Exhibits-1-A** and**2-A**.

1.3 Review of ESIA of PGEB for its Adaptation in GPE-BEP

In order to preparethe presentAddendum, the ESIA of PGEB was thoroughly reviewed and its each section was looked into with the prospect of its adaptation and/or amendment for inclusion in the Addendum.

The review process also included thorough study of primary and secondary sources of information collected during the ESIA of PGEB, correlating the available information with the baseline information of the newly added districts and comparing project activities of the GPE-BEP with those of the PGEB. The review of the existing ESIA and respective conclusions arrived at are described as under:

- The data pertaining to ESIA of PGEB, including reports of site visits, information collected from key persons like government functionaries, departmental briefs of line departments, reports regarding focus group discussion with communities and visual photographs taken from field was reviewed and was found equally applicable to GPE-BEP.

- The review of section containing information regarding stakeholder consultations and analysis concluded that though the consultations carried out during preparation of ESIA of PGEB would provide sound basis for successful implementation of ESMP of GPE-BEP, however, additional consultations would be required in order to obtain views, concerns of the project and its design, especially regarding the design and construction of transitional schools.

- It was also concluded, after the review of respective section **(Section 2, ESIA of PGEB)**, that the environmental and social legislation and guidelines of the Government of Pakistan, Provincial Laws of Balochistan, found applicable during ESIA of PGEB, would also be equally applicable to the amended ESIA of GPE-BEP. As regards World Banks' environmental and safeguard policies, it is felt that re-assessment of GPE-BEP would be required, especially to assess the project against Gender Policy (GP).

- The activities of the PGEB and GPE-BEP were also compared for similarity using the project document of both the projects and it was concluded that in

addition to increase in scope and design of one constructional activity viz. construction of transitional low cost schools under GPE-BEP is a bit different than the constructional activities being taken up in the PGEB Project. However, the constructional activities associated with the transitional low cost school are likely to cause environmental and social impacts mostly similar in nature and extent to the ones being caused by the activities being undertaken under PGEB and assessed in its ESIA.

- The Section 6 of ESIA of PEGB pertaining to project alternatives was found fully applicable to the GEP-BEP, after thorough review of the section in light of the project background discussed in World Banks' Project Appraisal Document (PAD) and Government of Pakistan's Planning Commission Performa-1 of the GPE-BEP Project.

- The impact assessment matrix **(Section7: Table-16 ESIA of PGEB),** which was employed to assess the environmental and social impact of PGEB, was also reviewed. It was accordingly concluded thatowing to similarities in constructional activities of PGEB and GPE-BEP, same environmental impacts on physical, biological, and socio-economic environment will occur during execution of project activities of GPE-BEP, therefore, the impact assessment matrix of PGEB can pragmatically be used as environmental impact assessment tool for GPE-BEP as well. Similarly, the same mitigation measures suggested in ESIA of PGEB **(Section 7 of PGEB)** will be applicable in GPE-BEP.

- The review of baseline information of the project area of PGEB concluded that some of the sub-sections will require inclusion of information regarding the newly included districts under GPE-BEP.

- The review of ESMP of PGEB also resulted in conclusion that minor amendment in sub-sections pertaining to institutional setup, roles and responsibilities, internal monitoring, capacity building and training programme and ESMP cost will be essential.

The review thus concludes, that the following sections of ESIA of PGEB would require minor amendments and/or inclusion of information pertaining GPE-BEP for making the existing ESIA of PGEB equally applicable GEP-BEP.

i. Regulatory and Institutional Framework
ii. Brief Description of Project

iii. Baseline Environmental Conditions
iv. Stakeholders consultation
v. Environmental and Social Management Plan
vi. Capacity building and Training
vii. ESMP Costs.

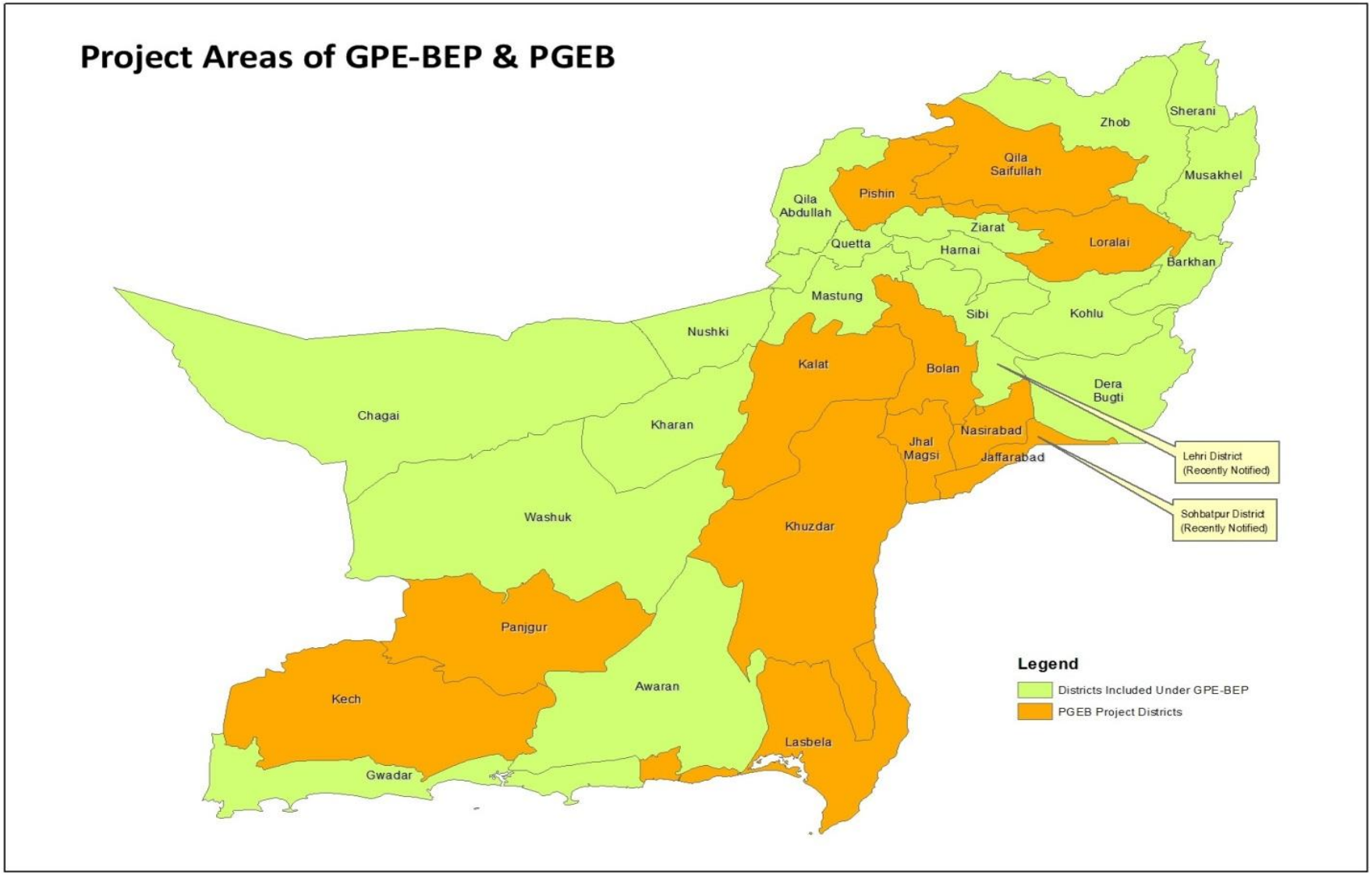


Exhibit 1-A: Map Showing GPE-BEP and PGEB Project Districts

Exhibit 2-A: District Map of Balochistan (Source I&P Presentation)

2. REGULATORY AND INSTITUTIONAL FRAMEWORK

The Environmental and Social Impact assessment of PGEB was carried out after careful review of the relevant environmental and social safeguard legislation and guide lines of Government of Pakistan, Provincial Laws of Government of Balochistan and the World Bank environmental safeguard policies for their applicability to PGEB, as described in **Section 2 of ESIA of PGEB.**

During the preparation of the ESIA and Addendum in hand, the environmental and social safeguard legislations and guidelines of Government of Pakistan and laws of Government of Balochistan and World Bank environmental safeguard policies were again reviewed for their pertinence to GPE-BEP.It was found that the environmental and social safeguard legislation guide lines of Government of Pakistan and Government of Balochistan, described in section 2 of ESIA of PGEB, are equally applicable to in similar manner and force to GPE-BEP. However, it seemed more appropriate to re-assess the GPE-BEP against World Banks' operational polices viz. a viz OP 4.01 (environmental assessment), OP 4.04 (indigenous people), OP 4.09 (pest management), OP 4.11(physical cultural resources), OP 4.12 (involuntary resettlement), 4.20 (gender and development), OP 4.36 (forestry), OP 4.37 (safety of dams), OP 7.50(projects in international waters), OP 7.60 (projects in disputed areas) and policy on access to information. **Table 2-A** below presents the summary of applicability of the World Bank Operational Policies to the GPE-BEP

Table 2-A World Bank Operational and Safeguard Policies and their Relationship to GPE-BEP Activities

Operational Policy	Description	Details/Comments
OP 4.01	Environmental Assessment	This Operational Policy (OP) requires Environmental Assessment of the projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable with an objective improve decision-making process in these projects. The OP also categorizes projects on the basis of type, location, sensitivity, scale of the project and magnitude and nature of their potential environmental impacts and places them in one of the three categories Viz. A, B and C on merit and degree of severity.

Operational Policy	Description	Details/Comments
		The GPE-BEP project activities are likely to have low to medium level of adverse impacts on environment and human population therefore the project has been classified as Category B Project. This Addendum has been prepared in response to Operational Policy 4.01 considering the potential environmental and social impacts arising from GPE-BEP.
OP 4.04	Natural Habitat	The conservation of natural habitats, like other measures that protect and enhance the environment, is essential for long-term sustainable development. Through this OP, the WB supports the protection, maintenance, and rehabilitation of natural habitats and the sustenance of their functions. The GPE-BEP project activities include limited quantum of constructional activities, related to up-gradation of schools, rehabilitation of under-utilized government buildings/community provided space, provision of facilities in the community provided spaces/under-utilized government buildings and construction of low cost-eco-friendly transitional schools on community donated lands. None of these activities will affect any of the local or regional natural habitats. Therefore, this OP is not triggered. In furtherance, construction activities under GPE-BEP will not be carried out in the areas listed in **Annex-B and C of ESIA of PGEB**.
OP 4.09	Pest Management	Through this OP, the WB supports a strategy that promotes use of biological or environmental control methods and reduces reliance on synthetic chemical pesticides. The GPE-BEP does not involve any activity

Operational Policy	Description	Details/Comments
		relating to agriculture production such as use of pesticides, fertilizer or other chemical inputs except painting of doors and windows. Hence, this OP is not applicable to the GPE-BEP and the OP does not trigger.
OP 4.10	Indigenous Peoples	This OP defines the process to be followed if the Programme affects the indigenous people (i.e., people having the following characteristics: self-identification as members of a distinct indigenous cultural group, and recognition of this identity by others; collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories; customary cultural, economic, social, or political institutions that are separate from those of the dominant society and culture; and an indigenous language, often different from the official language of the country or region). This OP is not applicable to the GPE-BEP project since there are no reported indigenous people in the project area.
OP 4.11	Physical Cultural Resources	The World Bank's general policy regarding cultural property (i.e., sites/artefacts of archaeological, cultural, historical, or religious significance) is to assist in their preservation, and to avoid their elimination. The construction activities the GPE-BEP is not likely to pose any risks to the cultural properties, assuming that they are already there and will not include any large-scale excavations or demolition of buildings. Hence no cultural property is likely to be affected which may trigger this OP. However, should

Operational Policy	Description	Details/Comments
		any such sites or artefacts are discovered during project implementation, will be reported to the concerned department for preservation according to the relevant laws[1] and guidelines[2]. Detailed procedure for "chance find" management of archaeological site or artefacts is given in Section 2.10.5 of ESIA of PGEB. Moreover, construction activities under the project will not be carried out in areas listed in (**Annex-D. ESIA of PGEB**.)
4.12	Involuntary Resettlement	This OP includes safeguards to address and mitigate the impoverishment risks (dislocation, asset loss, income loss, and others) associated with the involuntary resettlement caused due to the project operation. The GPE-BEP operations such as construction of Transition shelter schools on community donated land, provision of missing facilities in existing schools, rehabilitationof, provision of mission facilities, underutilized government buildings and community provided spaces through community participation does not involve any land acquisition. Most of the new construction as part of the project will be carried out on existing school premises or the community will voluntarily donate a vacant land/space; thus, it will not cause any involuntary resettlement. Hence, this OP does not trigger.
OP 4.20	Gender and Development	The objective of the Bank's gender and development policy is to assist member countries to reduce poverty and enhance

[1] The Federal Antiquities Act, 1975

[2] Guidelines for Environmentally Sensitive and Critical Area (October, 1997)

Operational Policy	Description	Details/Comments
		economic growth, human well-being, and development effectiveness by addressing the gender disparities and inequalities that are barriers to development, and by assisting member countries in formulating and implementing their gender and development goals. In view of applicability of this policy the GPE-BEP is designed to achieve gender parity by up-gradation of 60 girls' schools in the province, establishment of 2000 gender mix primary schools, preference in deployment female teachers in newly established schools and provision of female specific infrastructure in schools. At community level women would be encouraged to become members of Parent Teacher School Management Committees (PTSMCs). Additionally, boys and men would be engaged for formation of local community groups as protection mechanism to ensure that enrolment and retention of the girls particularly at the middle level and teacher turnover and absenteeism can be kept at minimal level.
OP 4.36	Forests	The objective of this OP is to assist the WB's borrowers to harness the potential of forests to reduce poverty in a sustainable manner, integrate forests effectively into sustainable economic development, and protect the vital local and global environmental services and values of forests. The rehabilitation and construction work under GPE-BEPwill be carried out in the existing facilities and/or community provided spaces / donated land, which are in the rural and urban

Operational Policy	Description	Details/Comments
		areas and therefore, designated forest area is not likely to be affected. Minor cutting of trees, if any, will be compensated through tree plantation in the schools premises. Hence, this OP does not trigger
OP 4.37	Safety of Dams	This policy seeks to ensure that appropriate measures are taken and sufficient resources provided for the safety of dams the World Bank finances. This OP is not applicable since the project does not involve any work relating to the dam construction.
OP 7.50	Project on International Waterways	This OP defines the procedure to be followed for the WB financed projects that are located on any water body that forms a boundary between, or flows through two or more States. This OP is not applicable since the GPE-BEP does not involve any works on international waterways.
OP 7.60	Project in Disputed Areas	Projects in disputed areas may raise a number of delicate problems affecting relations not only between the Bank and its member countries, but also between the borrower and one or more neighboring countries. In order not to prejudice the position of either the Bank or the countries concerned, any dispute over an area in which a proposed project is located is dealt with at the earliest possible stage. The GPE=BEP interventions and schools are not located in any disputed areas. Hence, this OP does not trigger.
-	Policy on Access to	The World Bank recognizes that transparency

Operational Policy	Description	Details/Comments
	Information	and accountability are of fundamental importance to the development process and to achieving its mission to end extreme poverty and promote shared prosperity. This policy sets out Banks' Policy to access to any information in its possession, except for information whose disclosure could cause harm to specific parties or interest. This policy is applicable to the GPE-BEP and the Education Department; Government of Balochistan will provide access of public to this ESIA and other project related documents. In compliance of Policy, this ESIA will be publicized and disclosed on the website of Education Department, Government of Balochistan and the InfoShop of the World Bank. Hard copies of ESIA will also be shared with all the project staff and all the District Education Officers (DEO).

3. PROJECT DESCRIPTION

Global Partnership for Education-Balochistan Education Project (GPE-BEP) is a three year developmental praxis conceived in pursuit of higher level objective of education for all under Article 25A of the constitution of Pakistan. The project is in line with the World Bank's approved Pakistan Country Partnership Strategy for 2015-19 and the stated objectives Global Partnership for Education (GPE). The project is designed to support the government of Balochistan's commitment and targets set under Balochistan Education Sector Plan 2013-2018.

GPE-BEP will be financed through an indicative grant allocation of US$ 34 million from GPE Fund. The GPE-BEPwill be executed by the Government of Balochistan, Secondary Education Department, through the existing Project Management Unit of on-going Promoting Girls Education in Balochistan (PGEB) Project headed by a Project Director, which has been tasked to manage the GPE-BEP as well. Whereby,

the World Bank would be the Supervising Entity (SE) for the grant and United Nations Children Fund (UNICEF), Department of Foreign Affairs and Trade Australia will be the Coordinating Agencies (CA) of the Project.

The GPE-BEP will be implemented in all 32 districts of the province and will benefit four groups. The children who will enroll in the newly established and those already enrolled in government schools, the girls who did not have the opportunity to enroll in higher grades, the teachers and education managers will benefit through professional development and the communities who will receive the project interventions.

3.1 Objectives of the Project

The board-based development objective of the project is to increase school enrollment and retention in project supported schools, with special focus on girls' participation; and to develop mechanism for information collection and use for the improve management of education.

In pursuit of achieving its development objective the project is designed to achieve the following specific objectives:

- to improve access and equity of girls and boys to schooling.
- to improve quality of teaching in early grades through provision of simple teaching and learning management tools for teachers as well as introduction of mechanisms to increase the accountability of teaching and learning in schools.
- to support the establishment of systems and procedures for effective planning and implementation of project activities and developing robust monitoring system.

3.2 Project Components

The GPE-BEP has three main components and 4 sub components as listed below.

- Access and Equity
    - Expanding Access through Community School Mechanism
    - Support Transition to Higher Levels of Education
- Quality and Increased Accountability
    - Promoting Early Childhood Education through teacher training and teacher learning materials (TLM).
    - School information collection, dissemination and use of improved planning and decision making.

- Quality and Increased Accountability.

3.2.1 Component1: Access and Equity

3.2.1.1 Sub-Component 1a: Expanding Access through Community School Mechanisms.

Under this sub-component, support would be provided to the Secondary Education Department (SED) in expanding access to school, by establishing 2000 mixed gender primary schools in 32 districts of theprovince,through an improved and transparent process of school site selection with community support.

1275 such school shall be establishedwhile using underutilized existing government building after necessary rehabilitation and repair of these building and/or in the community provide space that too after carrying out necessary rehabilitation and provision of necessary facilities. Whereas, 725 schools will be established in low cost transitional shelters at those sites where community cannot afford to provide two roomed shelter for establishment of new school, however, no land acquisition would be involved in this sub-component as per virtue of its design, already mentioned earlier. A construction supervision and facilitation firm shall be deployed for carrying construction works as per approved designs

The implementation arrangement of community based school establishment approach similar to PGEB Project shall be followed in the project. However, the lessons learned from the implementation of the PGEB will be used to take informed decision in designing and implementation of this project.

The other key design elements of this sub-component include establishment of parentteacher school management committees(PTSMC) and contractual appointment of teachers for the schools.

3.2.1.2 Sub-component 1b: Support Transition to Higher Levels of Education.

Under this sub-component the project resources shall be used to upgrade 50 primary Girls school to Middle and 10 Girls Middle schools to Higher Secondary Level. Prior up- gradation of the schools demands shall be submitted by the DEOs, which shall be verified by the PMU of GPE-BEP through conducting physical verification. Thereafter, after proper verification of schools, up-gradation request shall be process.

In each primary up-graded school additional rooms shall be constructed as per approved design. Furniture and fixture alongwith reading and writing material shall also be provided to each such up-graded school. In case of secondary up-graded schools, in addition to construction of additional rooms, Science and Information Technology (IT) Laboratories shall also be constructed.

3.2.2 Component 2: Quality and Increased Accountability

3.2.2.1 Subcomponent 2a: Promoting Early Childhood Education through teacher training and teacher learning materials.

This sub-component will support implementation of ECE approach through technical assistance for the development of an ECE policy, curriculum and Teachers learning Material (TLM) and identify mechanisms to improve teacher selection for early grades.

The Provincial Institute of Teacher Education (PITE) would be responsible, along with the SED, for developing simple management tools like time tables, daily plans, sample teaching activities, assessment tools, teacher responsibilities in the classroom and multi-grade teaching mechanisms. The implementation of these simple tools in the Project targeted schools would be monitored regularly by the Project Management Unit (PMU) and PITE with the objective of holding teachers accountable for learning management in the classroom. The Project would also involve the Parent Teacher School Management committees (PTSMCs) to track simple tasks like a) does the school have a time table, b) is it followed c) has the syllabus for the quarter been completed and d) if teachers have access to TLM and are using it in the classroom. The Project will also explore options to provide remote support to teaching and learning processes through Information Communication Technology (ICT), some activities have been piloted across Pakistan in remote areas and there are opportunities to expand these in Balochistan.

3.2.2.2 Subcomponent 2b: School Information collection, dissemination and use for improved planning and decision making.

Balochistan Management Information System (BEMIS) performs an important function of conducting an annual school census; however the exercise is marked with data inconsistencies and weak analysis reducing its usefulness for planning and decision making. Using the existing system as a foundation, additional diagnostic activities are planned to improve the

validity of the data, collect timely and reliable information through ICT and improve data presentation to support decision making. Some key activities envisaged under this activity are: i) strengthening the quality of existing data collection tools and methods, ii) training for SED staff to use data for planning and decision making, iii) improving presentation of data, and iv)introducing, innovative ICT techniques for data collection on selected indicators and generating regular reports. Third party validation surveys are also planned for various project activities to further improve information for planning and decision making.

This sub-component will also undertake a learning assessment of students in project supported schools to establish a baseline of student learning outcomes in basic numeracy and literacy in early grades. The project will also closely work with a USAID financed project supporting student assessments and teacher professional development.

3.2.3 Component 3: Technical assistance for improved capacity for management and monitoring.

Under this component the establishment of systems and procedures for effective planning and implementation of Project activities and developing robust monitoring systems shall be supported. The Technical Assistance (TA) facility would support the set-up of a PMU, building on the staff capacity of the existing PMU under PGEB, support district education offices to implement and monitor project activities. The SED will notify district focal points who will play an important role in capacity building of communities, monitoring of key project activities as well as coordination with District Education staff and ensuring their involvement and endorsement of all activities undertaken in the government schools. The TA facility will also build the capacity of the Education officials to develop the link between access and quality and initiate a dialogue on student learning outcomes. Communication strategy and action plans would be developed by SED/PMU to ensure information sharing upstream (Provincial departments and district education departments) as well as downstream (schools, communities). Some key communication aspects include wide sharing of grievance redressal systems, sharing of criteria for school site selection through district offices, print media. In addition to the above, the TA facility may also support the relevant education departments such as the Directorate of Education, BoC and PITE in capacity building activities.

3.3 Description of Physical Activities

3.3.1 Site Selection and Designing

This stage would include activities relating to the selection of an appropriate site for new schools construction, identification of existing schools to be supported under the project, preparation of project documents, layout plans, and structural drawings for new construction, need assessment for missing facilities, preparation of bidding document, obtaining approvals from relevant agencies and departments, and award of contracts/work orders to the contractor.

3.3.2 School Construction/Rehabilitation Stage

The activities at this stage would comprise of mobilization of machinery and materials to the sites for new construction and repair works, procurement and onsite stockpiling of construction materials, excavations for foundations, construction of superstructures, removal of unspent materials and debris, and external development comprising of landscaping, beautification and tree plantation.

3.3.3 School Operation Stage

The activities during this stage would relate to usage of the school buildings for education and learning, use of drinking water, collection and disposal of wastewater and solid waste, and annual repair and maintenance of the civil structures and equipment.

3.4 Project Implementation Arrangements

The Secondary Education Department, Government of Balochistan will implement the project. The existing PMU PGEB will execute the GPE-BEP under the overall supervision of Secretary Education Department, Government of Balochistan.

3.5 Project Coordination Committee (PCC)

A Project Coordination Committee (PCC) has been constituted under the overall supervision of Secretary Education Department, Government of Balochistan to monitor the implementation of the project. The PCC has representation from the Secondary Education Department, Planning and Development Department, Finance Department, Government of Balochistan as well as the World Bank and Implementing Partners. The PCC will quarterly review the progress of the project.

3.6 Project Management Unit (PMU)

The existing PMU PGEB with enhanced staffing, as detailed below,will execute the project activities through Implementing Partners, Parent Teachers School Management Committees (PTSMCs), Construction Supervision, and Facilitation Partner (CSFP).

PMU will be sufficiently staffed with management and Sectoral experts such as listed below.

1. Project Director
2. Deputy Project Director
3. Five Specialist
4. Seven Managers
5. Four Engineers
6. Four Monitoring Officers
7. Admin and Logistics Officer
8. Two Education Officer
9. Teacher Payroll Officer
10. Media and Communication Officer
11. Social and Safeguard Officer
12. Accounts Officer
13. Procurement Officer
14. Data Administrator/IT Officer
15. Programme Officer

3.7 Parent Teacher School Management Committee (PTSMCs)

Parent Teacher School Management Committees will ensure community participation in the implementation of the project right from the site selection to the school management and operation. The PTSMCs will coordinate with community and Education Department during the construction of schools, hiring of local teacher, monitoring the affairs of school, and submit reports to Education Department accordingly.

3.9 Construction, Supervision and Facilitation Partners (CSFP)

The CSFP currently engaged in the PGEB project will be assessed for immediate onboarding, and will be rehired through variation in contract for implementing project constructional activities. However, provision has been made for engaging a firm as through competitive process once the project completes its offing stage.

4. BASELINE ENVIRONMENTAL CONDITIONS

This chapter provides an overview of the baseline environmental conditions including physical, biological and socio-economic profiles of the project areas.

4.1 Project Area

The project area spreads over all 32 districts of Balochistan covering the entire 347190, sq. km of provincial area. Exhibit 1-A presentdistrict boundaries of the province, with specific mention of the districts already covered under PGEB. Similarly, the Table, 2-A

shows the list of the districts which have been newly added in the GPE-BEP in addition to districts already covered under PGEB.

4.2 Geography

Balochistan province is the largest in size and the smallest in population with about 9.162million people[3]. However, according to preliminary censes report 2012, the population of the province has increased to 13.162 million[4] peoples not including the districts of Khuzdar, Kech and Punjgur.Theprovincecovers347,190 km^2,almost44%ofthecountry'slandmass. The provinceislocatedinsouth-western side of Pakistan at32.12°N67.01°Ecoordinates bordering by Iran to the west, Afghanistan to the north-west, Khyber Pakhtunkhwa and FATA to the north and Punjab to the northeast and Sindh to the southeast of the province. The district wise area and population of 30 districts including 12 administrative districts covered in PGEB Project are given in **Table2-A.**It is pertinent to mention here that data regarding 2 newly created districts namely, Lehri and Sohbatpur which have been carved out of Districts Sibi and Jafferabad respectively, have not been cleared by the government as yet.

Table 1-A District wise Area and Population of Balochistan

	Name of District	Area (Sq. Km)	Population 2011
1	Pishin	7,819	579000
2	Bolan	7,499	335000
3	Kalat	6,622	262000
4	Jaffarabad	2,445	629000
5	Sohbatpur	NC	
6	Nasirabad	3,387	402000
7	Khuzdar	35,380	572000
8	K. Saifullah	6,831	238000
9	Kech	22,539	441000
10	Lasbella	15,153	364000
11	Panjgur	16,891	312000
12	Loralai	9,830	356000
13	Jhal Magsi	3,615	158000
14	K. Abdullah	3,293	653000
15	Chaghi	44,748	151000
16	Zhob	20,297	244000
17	Musa Khail	5,728	179000

[3]Development Statistics of Balochistan (2011) – (projected population in 2011).
[4] Preliminary Censes Report, 2012 (http://en.wikipedia.org/wiki/Balochistan,_Pakistan#Demographics)

	Name of District	Area (Sq. Km)	Population 2011
18	Barkhan	3,514	154000
19	Sibi	5,304	161000
20	Lehri	NC	
21	Ziarat	1,489	35000
22	Kohlu	7,610	129000
23	Dera Bugti	10,160	270000
24	Mastung	5,896	194000
25	Kharan	14,958	173000
26	Awaran	29,510	124000
27	Gawader	12,637	271000
28	Noshki	5,797	148000
29	Sherani	N.C	84000
30	Washuk	33,093	133000
31	Harnai	2,492	126000
32	Quetta	2,653	1285000
Total Balochistan		347,190	9,162,000

NC- Information regarding District has still not been clarified.

4.3 Topography and climate

About80 percent ofthearea of the province isinter-mountainous.Theremaining20 percentconsistsoffloodplainsandcoastalplains. Due to dominated mountainous terrain, only 15 percent of the landscape is available for landformsonwhichmosthuman settlements,farms,androadsaredeveloped. Theimportantmountains rangesareSuleiman Range, Kirthar Range, CentralBrahui Range, Toba-Kakar-Kakarkhurasan Range, Marri-Bugti Hills, Chagai-Hills, Ras Koh Range and Makran Coastal Range. The climate of Balochistanis continentalsemi-arid Mediterranean,with annualprecipitationvarying from200to 350mmandavariableproportionofthistotalfall asmoistureofsnowand rainin themid-winterperiodorasintenseshowersinsummer.Theuniformaridity(average annual rainfall not exceeding400mm anywhere,butinmanypartsas lowas50mmannually)makesun-irrigatedagricultureimpossible[5].

Altitude determines the temperature regime in Balochistan to a large extent. The cool temperature regime is associated with high altitudinal belt (>2000m) and indicated by the juniper, conifers and pines in the N-S range of the Central Mountains Range. Coastal temperature regime is moderate having lower annual precipitation range and

[5] Environmental Profile, Balochistan (LARUS-IT, Enschede: Netherland, 1992)

therefore implies lower heat and cold for natural vegetation, crops and animals. The continental climate has more extreme temperatures with high annual and daily precipitation range. Humidity is low for most of the year except for the rainy seasons.

4.4 Geology

Geologically, the province is divided into four main geological regions (**Exhibit-3-A).** Central Mountains Range, Chagai Hills and Ras Koh Range, Makran Mountains Range and Chagai – Kharan Basin. The hills and mountains ranges consist predominantly of folded and faulted Mesozoic to middle Tertiary limestone. Mesozoic and tertiary sedimentary rocks, mostly inter bedded limestone, sandstone, shale and marls make up the bulk of the Central Mountains Range. Similar sedimentary rocks in addition to the Calc-alkaline and ultramafic intrusions are found together with young quaternary volcanic rocks in the Ras Koh Range. This range is favorable for copper, iron and Sulfur deposits (Saindak)[6]. The Makran Mountains Range includes central and coastal ranges and is mainly made up of uniform sequence of tertiary and quaternary sedimentary rocks. The Chagai-Kharan Basin is mostly desert basin partly filled with younger sedimentary rocks derived from surrounding mountains ranges.

4.5 Land Use and Soil Erosion

In Balochistan, mountains dominatetheterrain,andvalleyfloors and piedmontplainsmakeuponly15 percentofthelandscape[7]. The relief[8] or "physiographic unit" is of utmost importance in Balochistan since this collects and concentrates the scarce rainfall. Relief is categorized into mountains, hills, basin and piedmont plains. Under the prevailing arid conditions, relief determines largely the availability of land for crops and vegetation potential. Balochistan comprises of the following relief or physiographic units.

- High and low mountains (51.7 percent)
- Gravelly fans and terraces (21.5 percent)
- Piedmont plains (11.6 percent)
- Saline basin (2 percent)
- Loess plains (0.4 percent)
- sand plains (7.5 percent)
- river plains (2.8 percent) and
- tidal plains (0.8 percent)

[6]Environmental Profile, Balochistan (LARUS-IT, Enschede: Netherland, 1992)

[7] Balochistan Conservation Strategy (May 19, 2000)

[8]Environmental Profile, Balochistan (LARUS-IT, Enschede: Netherland, 1992)

These reliefs represent the Micro-Land Management System in Balochistan. In east central and northern part of the province are the high mountains reaching an elevation above 2300 meters and the valleys situated at around 1500 meters above the sea level. The lowest mountains ranges are generally below 2300 meters and their valleys go down to 76 meters above the sea level.

According to the Development Statistics of Balochistan, the reported area of the province is about 51.2% of the total area. The variation from district to district is also considerable. However, it is assumed that all agricultural and forestry uses are reported, and that there are no significant areas of cultivated land in the unreported area. The principal land uses[9] in the province are agriculture which is about 1.5 to 1.6 million hectare (7.6 percent), forests about 1.41 million hectare (4.06 percent), rangelands about 21 million hectares (60 percent) and area not available for cultivation is about 9.83 million hectares (28.3 percent). Out of the total cultivated area, 48.9 percent is irrigated land while 51.1 percent is rain-fed area or flood irrigated area. Land use in the urban centers is predominantly of fixed and permanent structures, it is of mixed disposition in the suburbs and along outer rim of the cities, where agricultural lands interpose with new constructions, inhabitations, and farmhouses[10]. **Table3-A** describes district wise land utilization in the project area.

Table 2-A Land Utilization Statistics of Balochistan

PROVINCE/DISTRICT	AREA	REPORTED AREA	CULTIVATED AREA	UN-CULTIVATED AREA		
			TOTAL	CULTURA-BLE WASTE	FOREST	NOT AVAILABLE FOR CULTIVATION
BALOCHISTAN	**34719000**	**17799681**	**2633798**	**3921126**	**1410158**	**9834599**
Quetta	168800	161558	10002	31753	97950	21853
Pishin	787400	293868	153443	32410	25865	82150
K.Abdullah	323800	14468	13855	0	613	0
Chaghi	5054500	3261148	372336	380900	75392	2432520
Loralai	801800	318523	127796	64263	58391	68073
Musakhail	572800	48316	11720	12573	4173	19850
Barkhan	351400	122650	42067	41368	0	39215
Zhob	2029700	227341	51784	75037	12908	87612

[9] Agriculture Statistics of Balochistan 2011-12.
[10] Arid steppes of Balochistan (Pakistan), Scientific article published in Secheresse (2006), 17(1-2)203-9

PROVINCE/DISTRICT	AREA	REPORTED AREA	CULTIVATED AREA	UN-CULTIVATED AREA		
			TOTAL	CULTURA-BLE WASTE	FOREST	NOT AVAILABLE
K.Saifullah	683100	416780	148194	106989	20287	141310
Sibi	961300	393847	282954	47580	26329	36984
Ziarat	330100	87357	5044	1323	72530	8460
Kohlu	761000	53858	31421	0	0	22437
Dera Bughti	1016000	65567	25215	352	0	40000
Nasirabad	338700	234304	217359	2275	5	14665
Jaffarabad	244500	241981	214499	5522	0	21960
Bolan	568200	324707	75712	96994	4	151997
Jhalmagsi	361500	333251	127976	101281	0	103994
Kalat	662200	631452	122497	29422	51935	427598
Mastung	686100	324075	199545	50202	26817	47511
Khuzdar	3538000	3304749	132545	1062949	17353	2091902
Awaran	2951000	209218	21518	0	187700	0
Kharan	4805100	3593379	99794	758541	97139	2637905
Lasbella	1515300	1512226	48480	888041	453136	122569
Turbat	2253900	554336	61372	55808	104	437052
Punjgoor	1689100	673228	34321	44030	0	594877
Gawadar	1263700	397494	2349	31513	181527	182105
Washuk	**Area Not Cleared As yet**					
SohbatPur						
Lehri						
Sherani						

Source : Agriculture Statistics of Balochistan 2011-12

Soil degradation is one of the major environmental problems in the province. Salinity and soil erosion are the major environmental issues. Given the climate, both natural and man-made soil salinity is component of desertification. Natural salinity occurs throughout the province in the playas where run on water evaporate and consequently dissolved solids accumulate. About three quarter of the piedmont basin soils is naturally saline[11]. Man-made salinity occurs on the piedmont plain in the command area of Kirthar Canal which is caused due to unsustainable design of irrigation practices, lack of proper drainage structures leading to water logging and salt accumulation. About 30 to 40 percent of Kirthar Canal command area is affected by man-made salinization. However, fortunately both the natural and man-made salinity in Balochistan is self-reclaimable but

[11]Environmental Profile, Balochistan (LARUS-IT, Enschede: Netherland, 1992)

requires some years of ample irrigation to leach the salts[12]. Soil erosion continues throughout the province particularly on the rangeland and leads to increased sediment loads in the rivers, loss of top soil containing most of the nutrients and organic matter on arable land and barren mountain slopes reducing moisture storage capacity resulting into large-scale flash floods during monsoon[13].

Rangeland degradation is another issue usually associated with grazing. However, a major factor causing range degradation in Balochistan is the cutting and uprooting of native trees and shrubs by peoples for fuel wood. Cutting of trees and shrubs is more severe in about 5 km radius of villages and towns, particularly refugee's camps in Balochistan. This has also contributed toward desertification and degradation of environment[14].

4.6 Soil Morphology

Most soil in Balochistan has a homogenous porous structure invariably calcareous in nature. The lime content of soil varies from five to 30 percent. Lime is uniformly distributed in most soil texture. Where having a high lime content (> 15 percent), the soil is hard when dry and friable when moist. The organic matter content is generally low as 0.3 to 0.5 percent. Most of the surface of mountains and hills slopes is bare rock without soil cover (about 70 percent). Small patches contain shallow, strongly calcareous, gravelly and stony loams. Soil in the piedmont plains is very deep, well drained, homogeneous, silty and strongly calcareous with an 18-20 percent lime content uniformly distributed[15].

Soil of the saline basin (playas) is characterized by being strongly hygroscopic, gypsiferous and saline with local sodicity and pH value of 8.6 – 10.0. The loess plains have brown silt loams or very fine sandy loams and are strongly calcareous containing about 22 percent calcium carbonate. While sandy plains are extremely homogeneous in soil. The lime content ranges between 5 and 10 percent[16].

4.7 Seismology

Pakistan have been divided into four main Seismic zones in term of major, moderate, minor and negligible zones with respect to ground acceleration values. A seismic map showing different seismic zones is given in **Exhibit4-A.** According to this map, most parts of the Balochistan province lie in the Earthquake Zones Classification of the Uniform Building Code (UBC – 1997) of the United States. Southern Balochistan lies in

[12] Ibid
[13] Ibid
[14] Land and Range Resource Management Issues and Food Security in Balochistan – AZRI, Quetta, (1994)
[15] Environmental Profile, Balochistan (LARUS-IT, Enschede: Netherland, 1992
[16] Ibid

Zone-4. The Central Brahui range, Siahan range, Kirthar range and the Central Makran mountain ranges run through this zone. Northern part of Balochistan lies in Zone-2 while Quetta – Sibi belt lies in Zone-3. The geological and seismological features of this zone are almost similar to those of Zone 2 [17] . Earthquakes andtsunamishave shapedthehistory oftheprovinceandhavehada profoundeffectonpeopleandproperty. An earthquake of magnitude 4.8 rector scale was recorded at 13:28 hours midnight in Kalat and Quetta on 26th May 2012 while the field assessment was underway for this study.

4.8 Surface and Groundwater Resources

Balochistan is water scarce and land rich area of Pakistan. Surfacewater mainly comesfromprecipitationintheformofsurfacerunoffanditsshare ofwaterfromtheIndus River. Surface water resources are very limited, except Naseerabad and Jafferabad and Sohbatpur, which are fed by the pat Feeder, the Desert and Kirthar Canals emanating from Guddu and Sukkur Barrages on the Indus River. Remaining part of the province depends on rainfalls, tube-wells, Karez, flows, flood flows, hill torrent and diversions from non-perennials streams, which bring substantial runoff during the rainy seasons[18]. The main non-perennials rivers and streams in the province and project area are given in **Table-4-A.**

Table 3: A Major River Basins of Balochistan

	Hydrological Basins	Ground water Potential Available Approx.: (Cusecs)	Groundwater Extraction Approx.: (Cusecs)	Groundwater Potential available for future exploitation Approx.: (Cusecs)
1	Zhob River Basin	125	40	85
2	Nari River Basin	120	20	100
3	Kachhi Plain	95	25	70
4	Pishin Lora Basin	145	145	0
5	Mula River Basin	26	10	16
6	Gaj River Basin	38	20	18
7	Porali River Basin	155	45	110
8	Hingol River Basin	168	20	148
9	Hamun-e-Lora Basin	28	5	23

[17] http://allaboutgeology.blogspot.com/2011/04/seismicity-with-reference-to-pakistan.html

[18] Water Resources Management Research Issues in the Highlands of Balochistan, Report No. R92, Pakistan National Program, IWMI (July 1999)

	Hydrological Basins	Ground water Potential Available Approx.: (Cusecs)	Groundwater Extraction Approx.: (Cusecs)	Groundwater Potential available for future exploitation Approx.: (Cusecs)
10	Dasht River Basin	51	10	41
11	Rakhshan River Basin	27	5	22
12	Hamun-e-Mashkhel Basin	68	5	63
13	Other Areas	140	50	90
	Total	**1186**	**400**	**786**

Source: WAPDA 1992

Ground water resources divide into three hydrological regions: the Indus Basin, the Kharan closed Basin and the Makran Coastal basin, which constitute approximately 73 small or large rivers and streams. According to an estimate the total water potential of the province are 22.116 million acre feet (MAF) originating from the following sources[19]:

A. Indus Water as per Indus Accord

a. Perennial Flows= 3.87 MAF
c. Flood Share = 4.620 MAF

B. Non-Indus Basin Waters

b. Ground Water = 0.87 MAF
d. Flood Runoff = 12.75 MAF

The groundwater occurs in the unconsolidated deposits in Balochistan. Layers of gravel with sand, slit and clay constitute the aquifers. Gravel aquifers occur in the hydrologic basin of mountainous areas of the province. Fissured aquifers exist in hard rocks, which permit storage and movement of water. These aquifers are widely spread in Balochistan. The groundwater in fissured aquifers in carbonate rocks of Quetta and Kalat has locally been developed through tube wells. The sedimentary rocks in northern areas of the province bear water due to fissures or faults exposed to the surface.

The ground water potential of the province has estimated[20] in terms of flow at 1,116 cusecs (cubic feet per second), while 687 cusecs were already utilized, which leaves 429 cusecs for future development. Ground water is the essential renewable natural resource in most part of Balochistan. The most important income generating activities, irrigated horticulture and pastoralism, depend mainly on ground water. **Exhibit-5-A** shows the ground water potential of hydrological basin of the province.

[19] http://siteresources.worldbank.org/PAKISTANEXTN/Resources/293051-1114424648263/Session-VII-Nadir.pdf
[20] http://waterinfo.net.pk/cms/?q=node/77

Water quality analysis of four major cities i.e. Quetta, Khuzdar, Loralai and Ziarat were carried out by National Water Quality Monitoring Program (NWQMP)[21] in which total 66 water sources weremonitored. In Khuzdar and Loralai 91 percent of water, samples were found unsafe due to bacteriologicalcontamination. In Quetta,76 percentsampleswereunsafe, mainlydueto bacteriological contaminants, excessiveiron, fluorideand nitrate content. Onlyeight sourcesoutof34were supplyingsafedrinkingwaterin Quetta. Theworstwaterqualitysituationwas recorded in Ziarat, where all the 10 selected sources were contaminated. Analysis report of these cities is given in **Table5-A, 6-A,7-A and 8-A.**

Table 4:-A Water Quality Parameters of Quetta (2002-06)

Parameter(s)	YearofMonitoring				
	2002	2003	2004	2005	2006
	No.ofSamplesCollected				
	38	35	34	32	34
	%SamplesBeyondPermissibleLimits				
Turbidity	16	9	15	19	9
Magnesium	3	3	3	3	3
Hardness	13	9	9	6	6
Sodium	5	3	3	3	6
Sulphate	8	6	6	6	3
Nitrate(N)	0	0	24	25	24
Chloride	3	3	0	0	3
Fluoride	42	31	24	22	24
TotalDissolvedSolids(TDS)	13	8	9	6	9
Iron	8	0	24	34	26
BacteriologicalContamination	50	48	50	56	68

Source: PCRWR - Fifth Monitoring Report (2007)

Table 5-A:Water Quality Parameters of Loralai (2002-06)

Parameter(s)	YearofMonitoring				
	2002	2003	2004	2005	2006
	No.ofSampleCollected				
	11	10	11	11	11
	%SamplesBeyondPermissibleLimits				

[21]Pakistan Council ofResearch inWaterResources, NWQMP, Fifth Monitoring Report (2007)

Turbidity	18	30	18	18	9
Hardness	9	10	9	9	9
Nitrate(N)	0	0	9	9	9
Fluoride	55	10	9	9	9
TotalDissolvedSolids(TDS)	10	10	9	9	9
BacteriologicalContamination	100	80	73	82	91

Source: PCRWR - Fifth Monitoring Report (2007)

Table 6-A Water Quality Parameters of Khuzdar (2002-06)

Parameter(s)	YearofMonitoring				
	2002	2003	2004	2005	2006
	No.ofSampleCollected				
	8	8	11	9	11
	%SamplesBeyondPermissibleLimits				
Nitrate(N)	0	0	18	11	18
BacteriologicalContamination	100	62	91	67	91

Source: PCRWR - Fifth Monitoring Report (2007)

Table 7-A Water Quality Parameters of Ziarat (2002-06)

Parameter(s)	YearofMonitoring				
	2002	2003	2004	2005	2006
	No.ofSamplesCollected				
	8	7	10	10	10
	%SamplesBeyondPermissibleLimits				
Turbidity	25	43	20	20	10
Nitrate(N)	0	0	20	50	50
BacteriologicalContamination	100	100	100	100	100

Source: PCRWR - Fifth Monitoring Report (2007)

Water availability is the ultimate issue all over the province. It is also a major cause of social disputes among the tribes. Customary tribal law determines water use rights in Balochistan. These rights are mostly linked with the land rights. Among the tribes, water can be used freely for drinking, animal watering, and domestic purposes such as bathing, washing and cleaning by everybody. Universal domestic use rights apply only to water on the spot or fetched in buckets and pitchers, but do not allow the construction of channels or pipes to homes for this purpose[22].

[22] Environmental Profile Balochistan, LARUS-IT, Enschede: Netherland, 1992

Withthechangingclimaticconditionsandthe droughtprevailingoverthepast several years has created acutewatershortageandendangeredthesustainabilityofthispreciousresource. The over exploitation of ground water resources poses amajorthreattoenvironment,health,food securityanda threattothe welfare of poor. The focusofthe groundwater exploitation in the province hadbeenthe three hydrologicalbasinsbeingdensely populatedandhavinggreaterpotentialfordevelopment. These arePishinLora Basin(PLB), NariRiver Basin(NRB), andZhobRiver Basin(ZRB). Duetounplannedtube-wellsinstallationandsubsequentindiscriminatepumping ofwaterfor thelasttwoandahalfdecades,theareais nowfacing problem ofdepletinggroundwater tableattherateofmorethanfourtofivemetersannually inmany ofitsaquifersandhence tube-wells dryingis acommon phenomenon[23].

4.9 Meteorology, Climate, and Air Quality

Balochistan is generally an arid region with scanty rainfall varying from 12 inches in the North to 4 inches per annum in the South. According to the rainfall[24], data collected over a period of 1961 – 2004 the province divides into different climatic zones with varying level of annual precipitation. ZoneIincludesGwadar, Kech,andPanjgurdistricts with annualrainfall variesfrom36-110mmandincreaseswithincreaseinaltitude.Maximumrainfall occursinthe monthsfromJanuarytoMarch(45to73 percent)andminimumduringmonsoon.ZoneIIconsistsofChagi andKharandistrictswithannualrainfall varyingfrom30-160mm. Maximumrainfall occursinthemonthsfromJanuarytoMarch(30to50 percent).ZoneIIIincludesthedistrictsofLasbelaandAwaranandsouthernpartofKhuzdardistri ct with annualrainfall variesfrom110-250mm.ZoneIVconsistsofKalatandnortherntipofKhuzdardistrict.Averageannualrainfall was between90 - 200mm. Quetta,Pishin, Mastung,QilaAbdullah,KillaSaifullah(60 percent west)andZiaratdistrictsareincluded inZoneV.Therainfall in this zone variesfrom200-280mm/year.Themaximumrainfall occursinthemonths fromJanuarytoApril(70 percent)andisoutofthemonsoonalbelt.ZoneVIconsistsofthenorthernpartoftheprovince including Musakhel,Loralai,Kohlu,Barkhan,ZhobandKilaSaifullah(40 percent east).Theaveragerainfallvariesfrom200-400mm/year in this area.

Air quality study of the capital city (Quetta) of the province indicates that thepollutants ofvarious kindsare affecting the city badly[25]. Theleadandsulphur dioxide pollutants are

[23]The causesofgroundwater decline inupland Balochistan: Paper presented atthe39th Australian ConferenceofEconomists in Sydney,Australia27-29 September2010.

[24]The IUNC-Balochistan Program, water requirement of major crops in different agro-climatic zones of Balochistan.

[25]Air Pollution Problems and Diseases Caused by Hazardous Gases in Quetta, Pakistan, J. Appl. Sci. Environ.

higher than otherpollutants. Motor vehicles/ automobilesconstitute themainsourceofair pollutionin Quettacity. Domestic industries,power plants and biological contents in Quetta city are the dominant sources of air pollution. Authentic air quality data for other cities and districts could not found. However, generally observed during field visit, air pollution situation in other cities such as Pishin, Loralai and Khuzdar was comparatively less than the capital city of Quetta.

Ambient concentration of carbon monoxide (CO) and dust particles (TSP) in Quetta was recorded (1981) as 10 ppm, and 200 -300 ug/cm^3 respectively[26]. Pak EPA also carried out monitoring of ambient air quality in Quetta in May 2011 and reported dailymeanvalue for SO_2,NO,NO_2,COandO_3satisfiedthestandards value of WHO limits,while$PM_{2.5}$valuesmostlyexceededstandard[27]. Air pollution in other urban centres has not been measured and reported. However, it is presumed that the same level of air quality prevail in rest of the cities as well. Although, neither industrial pollution nor agro-chemical pollution have been reported in Balochistan but several sources of chemical pollution of air, water and soil are suspected. Around 100 or so industries with about 20, 000 total employees operating in Hub Industrial and Trading Estate discharge their untreated effluents in the estate sewerage, which outflows to a dry riverbed, a tributary of the Hub River downstream of the Hub Reservoir[28]. The use of agro chemicals, both fertilizers and pesticides also requires attention especially in the ground water irrigated vegetables and fruit cultivation. Persistent pesticides with human and environmental health hazards are probably used in the orchards, which could find back into the aquifers, used for drinking purposes. Therefore, monitoring of water quality is important in such locations[29].

4.10 Habitat, and Ecologically Sensitive Areas

Balochistan has a total area of 34 million hectare, of whichonly4 percent (1.41million hectare)isundercultivation,while51.1 percent of the cultivated area is rain-fed. Approximately, 93 percent of this area is rangelands. Aridandsemi-aridareasare fallingwithintherainfallzonesof50-200mmand250-400 mm, respectively. Rainfall patternsareunpredictable duetogreatfluctuationsin itspattern. The rangelands provideadiversity ofuses,includingforageforlivestock,wildlifehabitat, medicinal plants, water storage and distribution, energy, minerals, fuel-wood, recreational activity, wildernessandnaturalbeauty[30].

Manage.March,2008, Vol 12(1), 123-126

[26] Environmental Profile Balochistan, LARUS-IT, Enschede: Netherland, 1992

[27] ComprehensiveEnvironmentalMonitoringReportForSelected PilotAreas in Pakistan (www.environment.gov.pk)

[28] Environmental Profile Balochistan, LARUS-IT, Enschede: Netherland, 1992

[29] Environmental Profile Balochistan, LARUS-IT, Enschede: Netherland, 1992

[30] Rangeland improvement by community participation in highland, Balochistan, Quarterly SCIENCE VISION, vol.14(JanuarytoDecember2008)

4.11 Forests

Major types of natural forests found in Balochistan are coniferous forests, scrub forests, sub- tropical desert andriverainforests[31]. Coniferousforestsoccuratelevations of1,500–3,500 metres and include chilghoza (Pinusgerardiana) andDryJuniperForest(Juniperus excelsa). ChilghozaareconfinedtotheSuleiman Mountains, intheShiranitribalarea(ZhobDistrict),rangingfrom2,700to3,400metresinelevation. Themainchilghoza areas arefound atShinghar, Kaisaghar,Takht-e-SuleimanandTorghar.In Shinghar,2,562hectares areincludedinstateforests, whiletheShiranitribeownstheremainder. Chilghozais thedominantspecies,with thesporadicoccurrence of kail(Pinuswallichiana)intheupperreaches ofTakht-e-SuleimanandTorghar.

Balochistanhasoneofthelargest areasofjuniper forestsintheworld.Theycoverapproximately141,000 hectares. The most extensive (86,000 hectares) and best-knownexamplesareZiaratand Zarghoonhills. Scrub forests are found at elevations of 500–1,500 metres in the province including the following three categories:

- DryTemperateScrub - Quetta,Mastung,Kalat,QilaAbdullah, Pishin, KilaSaifullah
- Dry Sub-tropical broad-leavedForests– SuleimanMountains
- Tropical ThornForests – Sibi Plains and Nok Kundi

Sub-tropical desert forests arefound in Kharan and Chagai districts at elevation of 480 -1220 meters and in dry salt lakes such as Hamun-e-Lora and Hamun-e-Mashkel at elevation 610 – 860 meters. Riverain and Mangrove forestsspread over an area of about 20,000 hectares[32] as per Forestry Sector Master Plan of Balochistan, includingprivateforestsindistrictSibiandLasbela. These forests have been severely damaged. Remnants of mangrovesoccur alongthe coast in districtsLasbelaand Gwadar. District wise distribution of forests in the project area is given in **Table-9-A**[33]. Cultivated forests by Forest and Wildlife Department of Balochistan on road and canal side plantations in Naseer Abad, Jaffer Abad, Sibi, Quetta, Bolan, Kalat, Khuzdar, Zhob and Pishin districts cover a length of 700 Average Kilometer. Sand dunes in Mastung, Mashkhel, Pasni, Gwadar, Pishukan and Nushki areas have been planted. Cultivated plantation spread over an area of 5000 acres, and are well protected[34]. Plantation is

[31] Balochistan Conservation Strategy (May 19, 2000)

[32] Balochistan Conservation Strategy (May 19, 2000)

[33] Development Statistics of Balochistan (2010)

[34] Development Statistics of Balochistan (2010)

also raised by community inirrigatedplantationsandonfarm- land. Irrigatedplantations arelimitedtoabout 298 hectares inLasbela,Sibi,Zhob,PishinandQuettadistricts. InNaseer Abad andSibidistricts,plantationsirrigates with water fromthePatFeederand KirtharcanalsandfromNariRiver.Inother areas,they dependonwaterfromtube-wells[35].

Table 8-A District Wise Distribution of Forest Area (In Hectare)

Districts	Coniferous	Irrigated Plantation	Reverian Bela Forest	Scrub Forest	Coastal Forest	Range Lands	Total
Quetta	43029	-	-	42518	-	-	85547
Pishin	41500	-	-	138971	-	-	180471
Chagai	-	-	-	186300	-	757760	944060
Killa Abdullah	-	-	-	-	-	-	0
Loralai	45763	-	-	47910	-	55551	149224
Zhob	2560	-	-	37590	-	14080	54230
Killa Saifullah	-	-	-	28051	-	-	28051
Barkhan	-	-	-	-	-	-	0
Musa Khail	-	-	-	10311	-	-	10311
Sibi	43658	-	4158	63876	-	-	111692
Ziarat	126797	-	-	-	-	-	126797
Kohlu	-	-	-	-	-	-	0
Dera Bugti	-	-	-	-	-	-	0
Nasirabad	-	-	-	-	-	-	0
Jaffarabad	-	150	-	-	-	-	150
Bolan	-	135	-	-	-	-	135
Jhal Magsi	-	-	-	80353	-	-	80353
Kalat	55230	-	-	112947	-	-	168177
Khuzdar	-	-	1280	-	-	1280	
Kharan	-	-	25020	289720	-	-	314740
Lasbela	-	-	2000	301252	1494	87040	391786
Mastung	-	-	-	42720	-	12000	54720
Awaran	-	-	-	-	-	-	0
Turbat	-	-	2560	-	-	-	2560
Panjgur	-	-	-	-	-	-	0
Gawader	-	-	-	35840	40840	-	76680
TOTAL IN HECT:-	**145207**	**115**	**14182**	**574435**	**17145**	**375205**	**1126290**

Source: Balochistan Development Statistics 2010

[35] Balochistan Conservation Strategy (May 19, 2000)

4.12 Deforestation

About three percent of Balochistan has been gazetted state forests[36]. Major parts (70-80 percent) of the state forests are grass and shrubs. The remaining state forests are sparse to open coniferous wood, riverain forests in the Sibi – Kachhi Plain and widely scattered shrubs. In state forests, green trees and wildlife are protected under the forests and wildlife regulations[37]. Exploitation rights (fuel-wood, grazing, fruit collection) as well as employment rights are specifically included in the notification of each state forest area. Several state forests have been destroyed due to settlement of Afghan Refugees, e.g. Popalzai Jungle. In Kalat district partly juniper, partly Pistacia and Olive wood forests are under degradation. Juniper forests in Ziarat are in very poor conditions. Many trees show signs of lopping for fodder and debarking for roofing. The juniper woods are often the only source of fuel-wood in the cold winter and timber supply for house construction over vast areas in the province with poor and rapidly growing population[38]. Mangroves in the coastal area are exploited for fuel wood and forage due to scarcity of other trees in coastal belt.

4.13 Wetlands

Balochistan has few worlds'finest wetlandhabitats. Theyattract avarietyofwaterfowl, includingswans, geese,ducks, grebes,heronsandseveralspeciesofwaders.ZangiNawarLakeinChagaiDistrictisawetland ofinternationalimportance.Morethan60,000birdscountedthere inthemid-1980s [39] . However,itdriesduring droughtyears such as 1987,1999and2000.SpinKarez, wetland nearQuetta,isa site for migratory, breedingandwatering waterfowlspecies. Hanna Lake was developedasrecreational sites in Quetta district, also attractsomewaterfowl inwinter.SirandaLakeinLasbeladistrictisfamousfor attractingalargenumberofcommonshelduck. TheBiroonKirtharCanal inJaffer Abad district is habitat to largenumberofmallards, pintails, widgeons andcoots.Greyheronsandegrets areabundantonthissite.Otherimportant wetlands includemangroveforestsin sheltered baysonthecoast,PasniBayandHabReservoir.

Diversionsofsurface runoff for agriculture haveanimpactonthefunctioningofwetlands.Without an adequate input of fresh water, the qualityofwetlandsandassociatedhabitatsdeteriorate,as well as themangroveforeststhat

[36] Balochistan Forest Regulations, 1890
[37] Balochistan ForestRegulation(Amendment) Act,1974 and Balochistan Wildlife Protection (Amendment) Act, 1980
[38] Environmental Profile Balochistan, LARUS-IT, Enschede: Netherland, 1992
[39] Balochistan Conservation Strategy (May 19, 2000)

fringethreeestuariesalongthecoast.Reservoirsandcanalshavegreatlyenrichedthehabitat and wildlifepopulations oftheprovince.Someof theselost mostoftheirstorage capacityovertime,due tosiltation.Presently,thereis no sufficientwatertoirrigate hardly 200 hectares [40] . Onceanimportant breedingandstayingarea forbirds,thereservoirisdryformostoftheyearandis being encroachedby orchardsandsettlements.

4.14 Biodiversity Degradation

Game animals in the province have been on decline because of unsustainable hunting, food and furs. Universal netting and capitulating of birds has lead to sharp decline of some species or even some of these became extinct. Habitat destruction due to land use changes is another cause of decline in wildlife. Amongst migratory birds the Hobart Bustard, Cranes and falcons have suffered to great extent[41]. Some of the animals found in Balochistan such as Leopard, Asiatic Cheetah, Wolf, Balochistan Black Bear, Chiltan Markhor and Straight Horned Markhor are listed in the International Red Data Book of IUCN.

The proposed project activities in the project area may not pose any direct threats to the wildlife habitat; however, biodiversity is generally recognized as conservation target all over the world. **Annex-B** list the ecologically protected areas[42] comprising wildlife sanctuaries, national parks, and game reserves as conservation targets in Balochistan province. The total area protected and conserved is approximately 44,500.23hectares.

4.15 Demographic Profile

Balochistan has clustered population and is smallest in proportion as compared to that of other provinces. Its estimated current population is 9.162million (population projected for 2011), having a density of 23.8 persons per square kilometer (based on 1998 census) with an average growth rate of 2.47 percent per annum. The fertility rate is approximately 4.08 percent. With the existing growth rate, the population is expected to double in 30 years. The Preliminary Census Report 2012 indicates that the population of province has increased up to 13.162 million[43] (yet to be officially verified). The main languages in the province are Balochi (40 percent), Pashto (40 percent) and Brahui (20 percent). Additionally, there are a small number of Persian speakers (in the capital

[40]Balochistan Conservation Strategy (May 19, 2000)

[41] Environmental Profile Balochistan, LARUS-IT, Enschede: Netherland, 1992

[42] Wildlife Department, Balochistan (May 2012)

[43](http://en.wikipedia.org/wiki/Balochistan,_Pakistan#Demographics)

Quetta) and Sindhi (in Lasbela Nasirabad and Jafferabad Districts)[44].The population density[45] in the project districts is given **Table-10-A.**

Table 9-A District Wise Population Density

Province /District	Population Density
Balochistan	**114.6**
Quetta Division	**118.1**
Chagai	115.9
K. Abdullah	121.8
Pishin	114.9
Quetta	118.5
Zhob Division	**117.2**
Barkhan	110.5
K. Saifullah	119.0
Loralai	113.5
Musakhail	123.7
Zhob	119.5
Sibi Division	**117.0**
Dera Bugti	115.9
Kohlu	122.1
Sibi	117.2
Ziarat	107.9
Nasirabad Division	**112.0**
Bolan	117.3
Jaffarabad	108.3
Jhal Magsi	115.3
Nasirabad	111.1
Kalat Division	**111.1**
Awaran	110.8
Kalat	107.0
Kharan	107.6
Khuzdar	111.4
Lasbela	115.3
Mastung	113.0
Mekran Division	**112.9**
Gwadar	115.5

[44] http://en.wikipedia.org/wiki/Balochistan,_Pakistan#Demographics
[45] Censes Report, 1998(http://en.wikipedia.org/wiki/Districts_of_Pakistan)

Province /District	Population Density
Kech	110.1
Punjgur	115.9

Source: Development Statistics of Balochistan (2010)

4.16 Agricultural and Livestock's Production

About 6 percent of the available land is currently being cultivated in Balochistan, mostly in small landholdings. Agriculture is the main stay of the economy and employs 67 percent of the total work- force. Approximately 60 percent of cultivated land is under dry land farming. Orchards in the upland valleys produce the highest returns. The production of orchards per unit of land fetches three to four times the income of grain or vegetable crops [46]. At intermediate elevations (500–1,500 metres) where there is perennial water and a marketing infrastructure, farmers can produce off-season vegetable crops that command a premium price in major urban areas. In valleys above 1,500 metres, farmers can obtain significant returns from fruit production if irrigation water is available[47].

Wheat is the most important crop grown in highlands of the province, followed by barley and rapeseed. In spite of potentially high yield of barley, wheat predominates because it provides food security. In addition, the local wheat varieties used in Balochistan yields good quantity of straw and stubble; livestock's mostly small ruminants graze the latter[48]. Onion, potato, Fodder, Gram and Cotton are also grown in some areas depending upon the availability of water for irrigation purposes.

Balochistan is the major producer of deciduous fruits and contribute about 70 percent of the total deciduous fruit production of the country. The varied nature and aridity of climate enables the province to produce a wide range of temperate and tropical fruits & vegetables in a comparatively disease free environment. A large number of people are engaged in Fruit Farming in the province. Agriculture contributes 52 percent to GDP and employs 65 percent (either full or part-time) of the labor force. Balochistan's diverse climate and topography create unique opportunities for agriculture (e.g., horticulture), but access to water is a key constraint. Rainfall is generally very low and uncertain, particularly in the upland areas that dominate the province. The rugged landscape and

[46] Balochistan Conservation Strategy (May 19, 2000)
[47] Ibid

[48] Land and Range Resource Management Issues and Food Security in Balochistan – AZRI, Quetta (1994)

lack of water render much of Balochistan's land area unsuitable for agriculture. Only about 17 percent is arable and a majority of that is not cultivated, primarily because of a lack of water. Even the huge uncultivable area is largely unproductive with only about 30 percent offering good grazing for livestock[49].

Livestock is also an important component of Balochistan agriculture system. The province's rangelands support as many as 22 million sheep and goats, although the exact number is difficult to determine because of the nomadic lifestyle of many herders. Livestock is an important source of income for many households in rural Balochistan. Livestock accounts for as much as 36 percent of the value of agricultural products and contributes substantially to livelihoods[50].

The rangelands of the province provide as much as 85 to 95 percent of the feed for its numerous livestock. The range is controlled by the tribes and suffers from the degradation typical of common property resources. The recent drought has exacerbated the problem, reducing the yield of range forage from 60 kg per hectare to 18 kg per hectare and putting additional pressure on households[51].

4.17 Drought

Balochistan has suffered from a prolonged drought that has significantly affected agriculture, environment and livelihoods Rainfall has been below normal in the past several years. A survey conducted by the International Water Management Institute (IWMI) in 2001 identified a number of consequences of the drought in Balochistan. These included a reduction in household income, greater dependence on other income sources, migration to other areas for work, and an increased burden on women to provide income and to fetch water and food from greater distances. The survey concluded that the drought had reduced yields on an average of 78 percent of farmers' rain-fed lands and 38 percent of their irrigated lands In addition to crops; the survey estimated a 76 percent reduction in livestock numbers in the province between 1997 and 2001[52]. Non availability of water is the ultimate problem throughout the province.

4.18 Healthcare Facilities

Balochistan has a very scattered population where the health facilities are limited and sanitation facilities are inadequate. The far-flung rural and the semi-urbanized slums

[49] USAID (March 2008) "Evaluation of Food Security, Poverty Alleviation in Arid Agriculture Balochistan Project Report
[50] USAID (March 2008) "Evaluation of Food Security, Poverty Alleviation in Arid Agriculture Balochistan Project Rep
[51] Ibid
[52] Ibid

faces the dilemma of the usual infections and viral attacks, which causes fatality for them. Balochistan has been rated high for the infant and mother mortality during the pregnancies. The health services are highly concentrated and centralized at the capital of the province, all the professional physicians, surgeons and specialists are gathered in Quetta, while there exists no reasonable human resource at the out skirts of the province.

Due to lack of social and physical infrastructures, the province is suffering from severe backwardness. Every sector of economy is undeveloped and under-developed including the health sector and primary health care services are minimal. The main reason for scarcity of health care services are; lack of qualified doctors and nurses, lack of hospitals and referral health services, lack of equipment in hospitals and non-availability of preventive and curative medicines in public health facilities. The availability of qualified doctors in hospitals is a very serious issue in all districts except major hospitals. The total number of public sector hospitals in Balochistan[53] are 45 with bed strength of 3803, Dispensaries are 584 with bed strength of 45, Rural Health Centre (RHC) are 85 with bed strength of 974 and Basic Health Units are 551 and 92 MCH Centers. A number of hospitals working in private sectors especially in Quetta fulfill the health care demands of the middle and higher middle class families[54].

Balochistan province lacks the required health care facilities and trained professionals. There are total 3211 qualified doctors and 662 nurses, 139 pharmacists, 410 Lady Health Visitors, and 1304 Midwives in public sector hospitals in the province[55]. About 328 private medical practitioners and 97 female private medical practitioners are also providing health care services mostly in the capital city. Details of district wise health facilities in the project area are given in **Table-11-A.**

Table 10-A District Wise Government and Private Health Facilities

	Hospital		Dispensary		
Province/Districts	**Public**	**Private**	**Public**	**Private**	**RHC**
Balochistan	45	77	570	39	85
Quetta	6	50	9	28	3
Awaran	1	0	15	0	2
Barkhan	1	0	10	0	0
Chagai	1	0	13	0	4

[53] Development Statistics of Balochistan (2010)
[54] Comparative Statistics by Province (2009), Bureau of Statistics, P&D Department, Government of Sindh

[55] Development Statistics of Balochistan (2010)

Province/Districts	Hospital		Dispensary		
	Public	Private	Public	Private	RHC
Dera Bugti	1	1	26	0	2
Gawadar	2	1	14	0	3
Harnai	1	0	8	0	1
Jaffarabad	3	0	38	0	1
Jhal Magsi	1	0	16	0	3
Kacchi/Bolan	3	1	18	7	3
Kalat	2	0	43	0	2
Kech/ Turbat	2	7	43	0	11
Kharan	1	1	12	0	0
Khuzdar	1	2	31	0	6
Killa Abdullah	1	2	11	0	3
Killa Saifullah	2	5	16	0	3
Kohlu	1	0	34	0	2
Lasbela	3	1	26	0	4
Loralai	2	0	45	0	2
Mastung	1	0	8	0	3
Musa khail	1	0	15	0	1
Nasirabad	1	0	9	0	3
Noshki	1	1	19	0	2
Panjgur	1	1	13	0	1
Pishin	1	2	13	0	7
Sherani	0	0	7	0	2
Sibi	1	1	16	4	3
Washuk	1	0	15	0	1
Zhob	1	1	19	0	4
Ziarat	1	0	8	0	3

Source: Development Statistics Balochistan (2010)

The infant mortality rates recorded in the province ranges from 78 to 121 is generally higher than accepted international standards and health indicators present a dismal status of the province[56]. Awareness about personal hygiene is very low. According to the MICS[57] survey only 41 percent household's use soap to wash their hands before eating and only 55 percent wash their hands adequately after attending toilet. Only 52 percent households are aware of the need for iodized salt.

[56] Health Indicators of Pakistan, Gateway Paper II (www.heartfile.org/gwhiop.htm)
[57] MICS Survey (2010), P&D Department, Government of Balochistan

4.19 Education and Social Issues

Balochistan has the worst education outcomes among the four provinces in Pakistan. Girls education is a particular challenge due to a combination of deficiencies in education service provision and demand side failures. The supply side challenges consist of lack of adequate schools for girls at each level of schooling, poor facilities in schools, lower rate of enrolment and lack of teaching staff. These factors hinder access to education for girls feeding into a lower literacy rate for girls.

On the demand side, social issues and challenges exert an influence on girls access to education. Foremost among these are patriarchal structure of society and the prevailing conflict situation. Patriarchal structures place restrictions on the mobility of girls, confine them to specific household related roles at an early stage of life and place lower value on their education. The impact of these factors is evident from a lower NER for girls indicating a larger number of out-of-school girls, higher drop-out rate for girls especially at primary level and lower number of girls completing school education. The situation is further influenced by the prevailing conflict that places further hindrances in both school operation and girls access to schools.

Given this situation, the Project will need to work in close collaboration with local communities to ensure that the establishment of schools does not contribute to any environmental and other social issues that can alienate it. It is essential to build a solid foundation with communities and eliminate and possible sources of conflict, nuisance and hazard to ensure that acceptance for girls schooling is promoted.

4.20 Education Facilities

The educational facilities in the province range from primary level schools up-to universities and specialized institutions such as technical and vocational institutions. The province has total 12578 schools out of which 10585 are primary schools, 1165 middle schools and 826 high schools, and 108 inter and degree colleges[58]. Out of the total educational facilities, 9124 are male and 3558 are female. Public sector enrolments at primary level are 867282, at middle level 141438, at high school level 62315, and at higher secondary school level 181. Enrolments by gender in public sector schools in the province stand at 61 percent for boys and 39 percent for girls. Details of the schools and Colleges in the project districts are listed in **Table-13- A** and **14-A.**

[58]Balochistan Education Management Information System 2013-14

Table 11-A District Wise Government Schools in Balochistan

DISTRICT	PRIMARY			MIDDLE			HIGH			BOYS H/SEC	GIRLS H/SEC	TOTAL		
	BOYS	GIRLS	TOTAL	BOYS	GIRLS	TOTAL	BOYS	GIRLS	TOTAL			BOYS	GIRLS	TOTAL
AWARAN	156	50	206	19	7	26	17	4	21	1		193	61	254
BARKHAN	408	159	567	13	11	24	14	4	18	1		436	174	610
CHAGHI	147	57	204	15	13	28	9	3	12	2		173	73	246
DERA BUGTI	231	49	280	29	7	36	21	3	24			281	59	340
GAWADAR	144	62	206	19	9	28	15	9	24	1		179	80	259
HARNAI	94	49	143	4	7	11	8	2	10	1		107	58	165
JAFAR ABAD	368	135	503	30	14	44	16	7	23	2		416	156	572
JHAL MAGSI	161	74	235	19	12	31	12	4	16	1		193	90	283
KACHHI	303	62	365	20	9	29	20	8	28		1	343	80	423
KALAT	251	121	372	23	23	46	21	8	29		1	295	153	448
KECH	306	163	469	49	36	85	38	19	57	3	2	396	220	616
KHARAN	132	43	175	20	7	27	12	5	17	1		165	55	220
KHUZDAR	423	148	571	23	33	56	23	7	30			469	188	657
KILLA ABDULLAH	356	51	407	21	14	35	25	6	31	1		403	71	474
KILLA SAIFULLAH	412	106	518	26	13	39	16	6	22	1		455	125	580
KOHLU	329	72	401	13	11	24	11	4	15	1		354	87	441
LASBELA	364	118	482	32	17	49	23	8	31	1	1	420	144	564
LORALAI	456	158	614	35	18	53	17	5	22		1	508	182	690
MASTUNG	203	90	293	24	21	45	12	15	27	1		240	126	366
MUSAKHEL	191	63	254	9	6	15	13	4	17	1		214	73	287
NASEER ABAD	288	136	424	15	12	27	20	1	21		1	323	150	473
NOSHKI	104	51	155	19	21	40	16	11	27	2	2	141	85	226
PANJGUR	177	115	292	20	17	37	20	11	31	1	1	218	144	362
PISHIN	585	183	768	53	52	105	36	11	47		1	674	247	921
QUETTA	249	109	358	36	53	89	37	40	77	1	4	323	206	529
SHERANI	139	18	157	11	2	13	4	1	5			154	21	175
SIBI	135	74	209	14	13	27	14	14	28	1		164	101	265
Lehri	Not Cleared													
SOHBATPUR	194	113	307	17	9	26	18	4	22			229	126	355
WASHUK	115	30	145	12	5	17	10	3	13	1		138	38	176
ZHOB	238	48	286	18	10	28	17	3	20	1	1	274	62	336

DISTRICT	PRIMARY			MIDDLE			HIGH			BOYS H/SEC	GIRLS H/SEC	TOTAL		
	BOYS	GIRLS	TOTAL	BOYS	GIRLS	TOTAL	BOYS	GIRLS	TOTAL			BOYS	GIRLS	TOTAL
ZIARAT	148	71	219	12	13	25	15	3	18		1	175	88	263
TOTAL	7807	2778	10585	670	495	1165	550	233	783	26	17	9053	3523	12576

DATA SOURCE BEMIS CENSUS OCTOBER, 2013

Table 12-A District Wise Government Colleges in Balochistan

DISTRICT	DEGREE COLLEGES			INTER COLLEGES			COMMERCIAL COLLEGES	PHYSICAL COLLEGES	TOTAL COLLEGES
	BOYS	GIRLS	TOTAL	BOYS	GIRLS	TOTAL			
AWARAN	0	0	**0**	2	0	**2**			**2**
BARKHAN	1	0	**1**	0	1	**1**			**2**
CHAGHI	0	0	**0**	1	1	**2**			**2**
DERA BUGTI		0	**0**	2	0	**2**			**2**
GAWADAR	1	0	**1**	2	2	**4**			**5**
HARNAI	1	0	**1**	0	0	**0**			**1**
JAFAR ABAD	1	1	**2**	3	2	**5**			**7**
JHAL MAGSI	0	0	**0**	1	0	**1**			**1**
KACHHI	0	0	**0**	4	1	**5**			**5**
KALAT	1	0	**1**	2	2	**4**			**5**
KECH	1	1	**2**	3	0	**3**			**5**
KHARAN	1	0	**1**	0	1	**1**			**2**
KHUZDAR	1	1	**2**	3	0	**3**			**5**
KILLA ABDULLAH	1	0	**1**	3	2	**5**			**6**
KILLA SAIFULLAH	2	0	**2**	0	2	**2**			**4**
KOHLU	0	0	**0**	1	0	**1**			**1**
LASBELA	1	0	**1**	2	1	**3**			**4**
LORALAI	1	1	**2**	2	0	**2**			**4**
MASTUNG	1	1	**2**	2	0	**2**			**4**
MUSAKHEL	1	0	**1**	2	1	**3**			**4**
NASEER ABAD	1	0	**1**	1	0	**1**			**2**
NOSHKI	1	1	**2**	0	0	**0**			**2**
PANJGUR	1	1	**2**	0	1	**1**			**3**

DISTRICT	DEGREE COLLEGES			INTER COLLEGES			COMMERCIAL COLLEGES	PHYSICAL COLLEGES	TOTAL COLLEGES
	BOYS	GIRLS	TOTAL	BOYS	GIRLS	TOTAL			
PISHIN	2	0	**2**	3	2	**5**			**7**
QUETTA	3	6	**9**	3	1	**4**	1	1	**15**
SHERANI	0	0	**0**	1	0	**1**			**1**
SIBI	1	1	**2**	0	0	**0**			**2**
Lehri									
Sohbatpur									
WASHUK	0	0	**0**	1	0	**1**			**1**
ZHOB	1	1	**2**	0	0	**0**			**2**
ZIARAT	0	0	**0**	2	0	**2**			**2**
TOTAL	**25**	**15**	**40**	**46**	**20**	**66**	**1**	**1**	**108**

The combined literacy rate in the province is 37 percent. While male literacy rate is 52 percent and female literacy rate is 19 percent in Balochistan[59]. Findings of the Multiple Indicator Cluster Survey (MICS) on "literacy among young women of age 15-24 years", show that around 33 percent of young women in the province were found literate on the basis of "ability to read a short simple statement". Further, women in the younger cohort had higher literacy levels at 35 percent than those in the next age bracket (30 percent) meaning that literacy rate has improved by 4 percent in the recent past[60]. Young women in urban areas had a much higher literacy rate to the tune of 59 percent than those residing in the rural areas at 23 percent.

Literacy rate by regions show variation ranging from as low as 16 percent in Zhob region to as high as 69 percent in Makran region; understanding the dynamics of these variations in terms of access to schools, institutional arrangements, and poverty levels in various regions. The relationship between literacy and poverty in terms of wealth quintiles is also very alarming; only 7.5 percent women in the poorest wealth quintile and 16.6 percent in next upper quintile were literate compared to 67 percent in the richest quintile[61]. This finding indicates that public sector expenditure on education is poorly targeted on poorest of the poor.

4.21 Infrastructure Profile

The infrastructure in Balochistan varies from urban to rural areas as well as in different

[59] UNESCO (2009): Paper Commissioned for Education for All (EFA) Global Monitoring Report
[60] MICS Survey (2010), Government of Balochistan

[61] Ibid

regions of the province. The roads networks in the province comprise of approximately 32046 km including 11826 km black topped roads and 20220 km shingle roads[62]reflecting poor connectivityinthe province.Thelargest expansion in roads network wasthatoffarm-to-markets roads. Thelengthof thenationalhighwaysremainedlargelyconstantat2,371km.Poorconnectivityandaccess continuetobeamajorproblem,whichparticularlyaffectthepoor,who livemostlyintherural areas. Shingle or gravel roads representing 77 percentofthenetwork is in very poorconditionand deterioratingrapidly owingtoincreased trafficandinsufficient maintenance[63]. The length of road network (in kilometers) in the project districts is given in **Table-14-A.**

Table 13-A District wise Roads in Balochistan

Province / Districts	Black-Top	Shingle	Total
BALOCHISTAN	13367	20220	33588
Quetta	915	402	1317
Pishin	783	648	1431
Killa Abdullah	537	1065	1602
Chagai/ Noshki	530	1162	1692
Zhob/ Sherani	392	916	1308
Loralai	571	603	1174
Musa Khail	138	306	444
Killa Saifullah	486	947	1433
Sibi/ Harnai	374	282	656
Ziarat	335	337	673
Kohlu	119	1192	1312
Barkhan	233	334	567
Dera Bugti	323	602	925
Nasirabad	540	252	792
Jaffarabad	1181	0	1181
Bloan	539	280	819

[62] Development Statistics Balochistan (2010)
[63] ADB (October, 2003), Balochistan Road Sector Development Project

Province / Districts	Black-Top	Shingle	Total
Jhal Magsi	601	97	698
Kalat	661	1286	1947
Mastung	581	307	888
Khuzdar	632	1452	2084
Kharan/ Washuk	635	1295	1930
Awaran	351	1282	1632
Lasbela	1057	1232	2289
Turbat	347	1515	1863
Gawader	289	934	1223
Panjgur	217	1492	1709
Source- Development Statistics of Balochistan 2010			

4.22 Socio-economic Conditions

Balochistan is relatively scarce in its endowments of human capital, agricultural growth and industrial investment comparing with rest of the provinces. For the last fifteen years, the overall share of Balochistan in the national GDP has remained constant at 4 percent. In the service sectors Balochistan's growth potential appears to be closely connected to its integration with the national economy and other regional economies[64]. Agriculture, both crops and livestock, is the main income generator as well as employment sector in Balochistan. Agriculture accounts for about 65 percent of GDP and employ about 65 percent of the workforce full or part time[65].

While agriculture continues a source of growth, its relative potential in Balochistan is circumscribed by the chronic scarcity of water over much of the province. The irrigated Kachhi plains account for a high proportion of all crop production. Livestock and horticulture dominate the agricultural sector in the rest of the province. Persistent droughts and chronic water scarcity has meant the loss of grazing land, and hence reduction in livestock's sector. Only one third of the total land of the province can be deemed reasonably productive grazing land[66].

[64] http://www.researchcollective.org/documents/balochistan-economic-report.pdf
[65] Environmental Profile Balochistan, LARUS-IT, Enschede: Netherland, 1992
[66] Ibid

Conditions for manufacturing growth are relatively unfavorable compared with the rest of Pakistan. Mineral sector is a potentially significant but as yet under-developed sector in Balochistan's economy. Currently 5 percent of GDP is earned through mining and employs only about 1.3 per cent of the employed persons in the province. Extraction of thirty-nine out of the fifty recorded mineral resources present in Balochistan generates annual revenue of close to Rs.3.4 billion.

Fisheries are significant in the economy of the small coastal towns, but not so far the GDP. Fisheries sector contributed to 9 percent of the national fisheries sector in 2004-2005. The catch is supplied to domestic and international markets through Karachi and Turbat. The fisheries sector is also a source of employment for many in the coastal areas. Nearly 70 percent of the total employed persons in the coastal districts are associated with the fisheries sector[67].

Human Development Index (HDI) ranking of districts for the province indicate highest for Panjgur to the lowest for Musakhel. Districts Panjgur (0.553), Gwadar (0.543), Kech (0.521), Ziarat (0.467), Sibi (0.459), Chagai (0.416), Quetta Zarghoon (0.410), Pishin (0.408) and Jafar Abad (0.405) fall in the highest (first) category. On the contrary, districts with terribly low HDI values include; Bolan (0.289), Kalat (0.282), Awaran (0.278), Zhob (0.271), Kharan (0.267), Washuk (0.265), Khuzdar (0.259), Sherani (0.255), Loralai (0.243) and Musakhel (0.193)[68].

4.23 Culture, Religion, and Customs

Balochistan has a very rich cultural heritage of ancient times reflected through specimens of art and craft, literature, and architect. The population is predominantly of Muslims but minorities populations of Hindu's, Sikh and Christian lives in urban and rural areas. Pashto, Balochi and Brahui are the native languages spoken widely, particularly in rural areas. However, in Kachhi and Sibi districts, people speak Seraiki and Sindhi. Quetta city, the confluence point of all linguistic groups accommodates not only Urdu, Balochi, Pashto, Brahvi and Sindhi speaking people but Punjabi, Darri and Persian speaking people as well. Majority of the population understand and speak Urdu, the national language.

A strong tribal system exist with number of tribes constitute to make people of Balochistan. Three major tribes are Baloch, Pashtoon and Brahvi. The Balochi speaking tribes include Rind, Lashar, Marri, Jamot, Ahmedzai, Bugti Domki, Magsi, Khosa,

[67] Environmental Profile Balochistan, LARUS-IT, Enschede: Netherland, 1992
[68] Govt. of Balochistan (November 28, 2011), Strengthening PRS Monitoring Project, P&D Department,

Rakhashani, Dashti, Umrani, Nosherwani, Gichki, Buledi, Sanjarani and Khidai. Each tribe is further sub-divided into various branches. The tribal chief is called Sardar while head of sub-tribe is known as Malik, Takari or Mir. Sardars and Maliks are members of district and other local Jirga's according to their status. The Balochi, are further divided in to two branches: the Sulemani and Mekrani as distinct from the Brahvis who mostly concentrate in central Balochistan. Among the eighteen major Balochi tribes, Bugtis and Marris are the principal ones who are settled in the buttresses of the Sulemania. Brahvi speaking tribes include Raisani, Shahwani, Sumulani, Bangulzai, Mohammad Shahi, Lehri, Bezenjo, Mohammad Hasni, Zehri, Mengal and Lango, most of these tribes are bi-lingual and are quite fluent both in the Balochi and Brahvi Languages. The Pashtoon tribes include Kakar, Ghilzai Tareen, Mandokhel, Sherani, Luni, Kasi and Achakzai[69]

Cultural landscape of Balochistan[70] portrays various ethnic groups. Though people speak different languages, there is a similarity in their literature, beliefs, moral order and customs. The cementing factor is religion which provides a base for unity and common social order. Brahvi, Balochi and Pashtoon tribes are known for their hospitality. Another adorable feature of Balochistan culture is faithfulness and sincerity in all relationships. There is no place or respect for unfaithful people in prevalent moral order. If fidelity is reciprocated with disloyalty or betrayal it is never forgotten.

Peoples dress among the Balochi, Pashtoon and Brahvi tribes is very similar having a few minor dissimilarities. Turban is the common headwear of the men. Wide loose shalwar and knee-long shirts are worn by all. The dress of the woman consists of the typical shirt having embroidery work with embedded small round mirror pieces. Big ‘Dopatta’ or ‘Chaddar’, a long rectangular piece of cloth cascading down the shoulders and used to cover head, are used by the women.

The religious and social festivals are celebrated by the people of Balochistan. Besides, major religious festivals, colorful social festivals are also source of jubilation. Sibi festival that traces its roots to Mehergar, an archeological site of ancient human civilization, attracts people from across the country. It is attended by common folks, ministers and other government officials. Folk music performance, cultural dances, handicrafts stalls, cattle shows and a number of other amusing activities present a perfect riot of color. Buzkashi is a peculiar festival showing velour of Balochistan people. It is celebrated on horse-back by two teams that use their skills to snatch a goat from the each other.

[69] http://www.balochistan.gov.pk/menu-culture-and-heritage.html
[70] http://www.balochistan.gov.pk/menu-culture-and-heritage.html

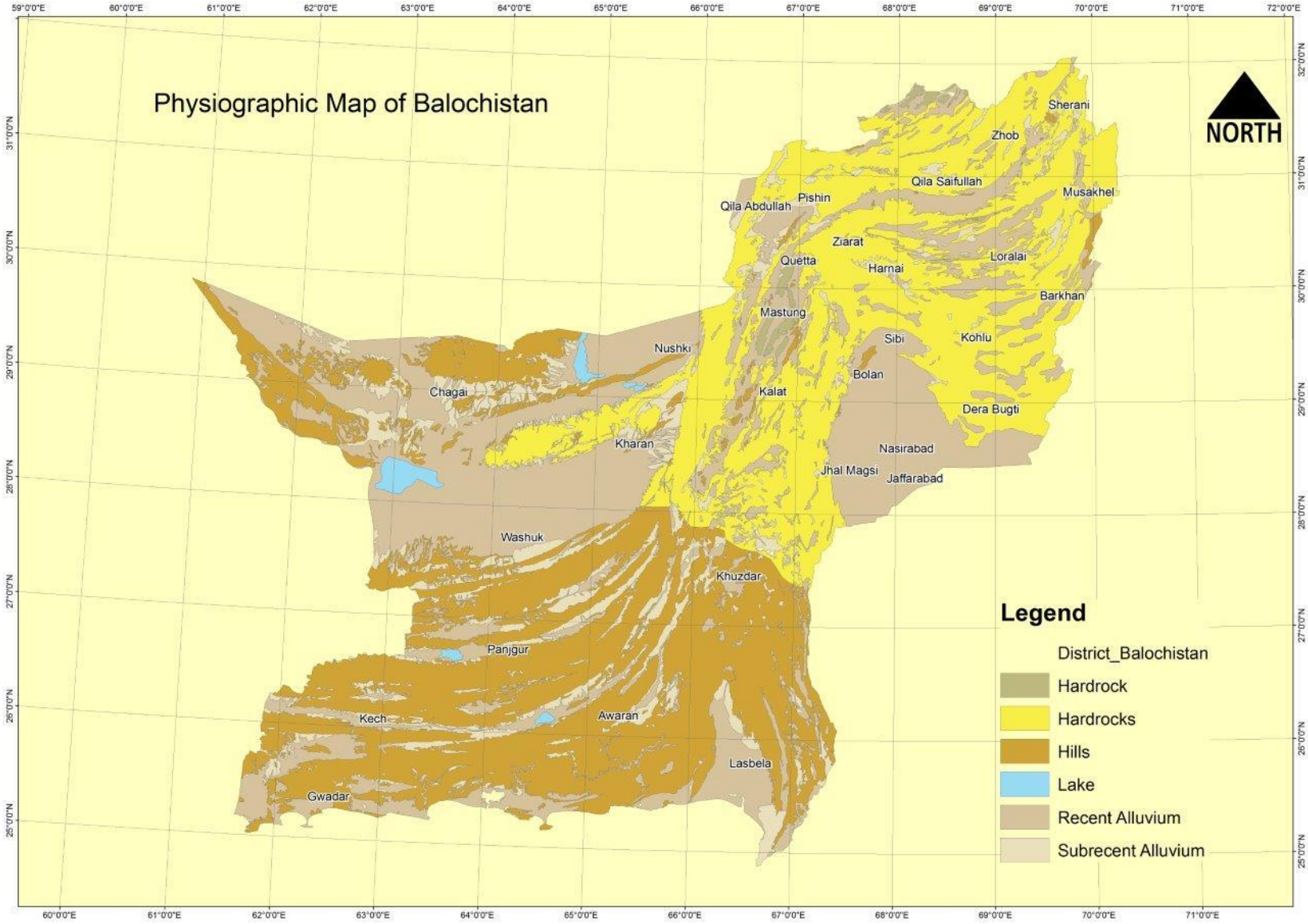


Exhibit 3-A Geo-Physical Features of Balochistan (Source

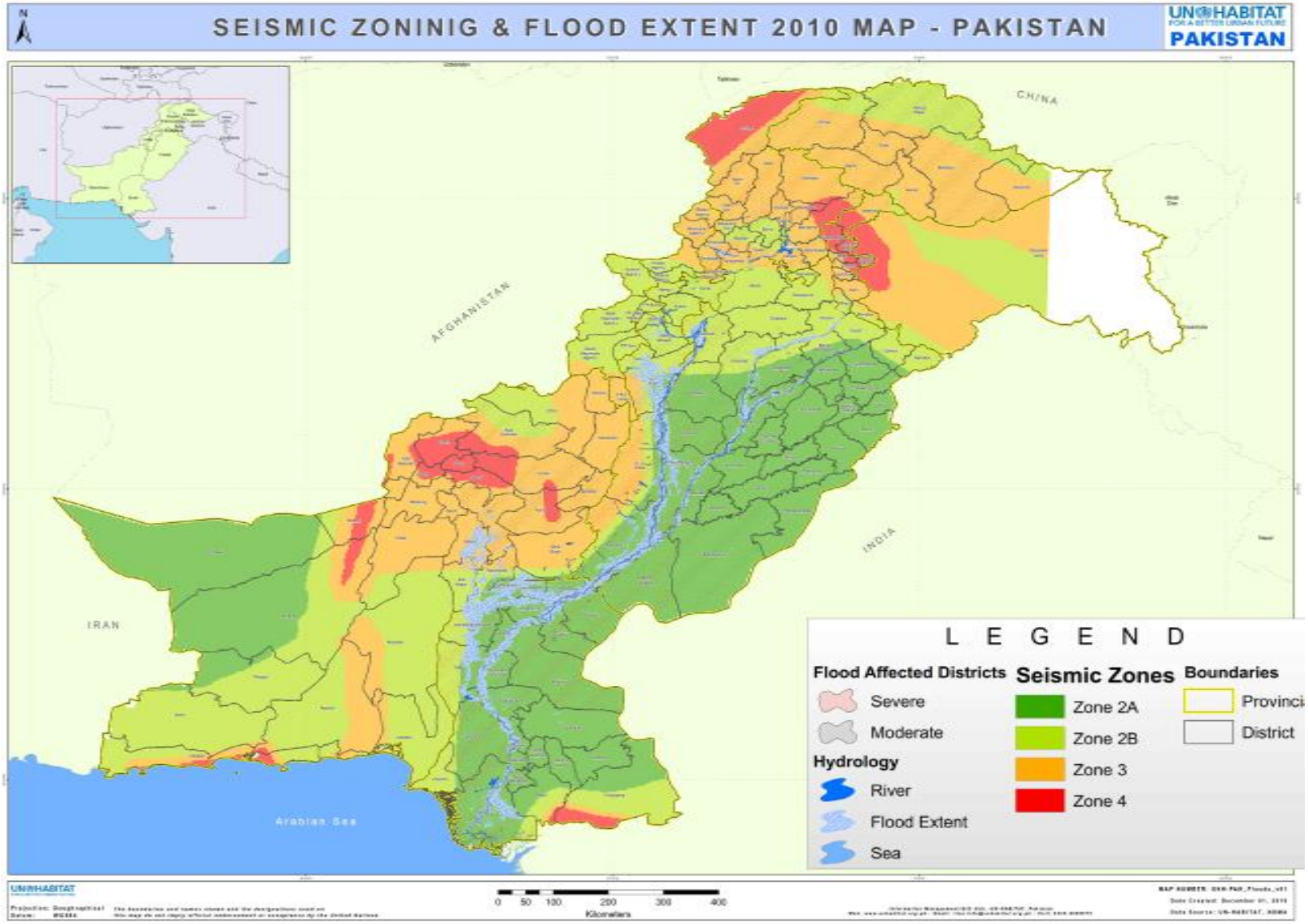


Exhibit 4-A Seismic Zones of Pakistan (Source UN-Habitat)

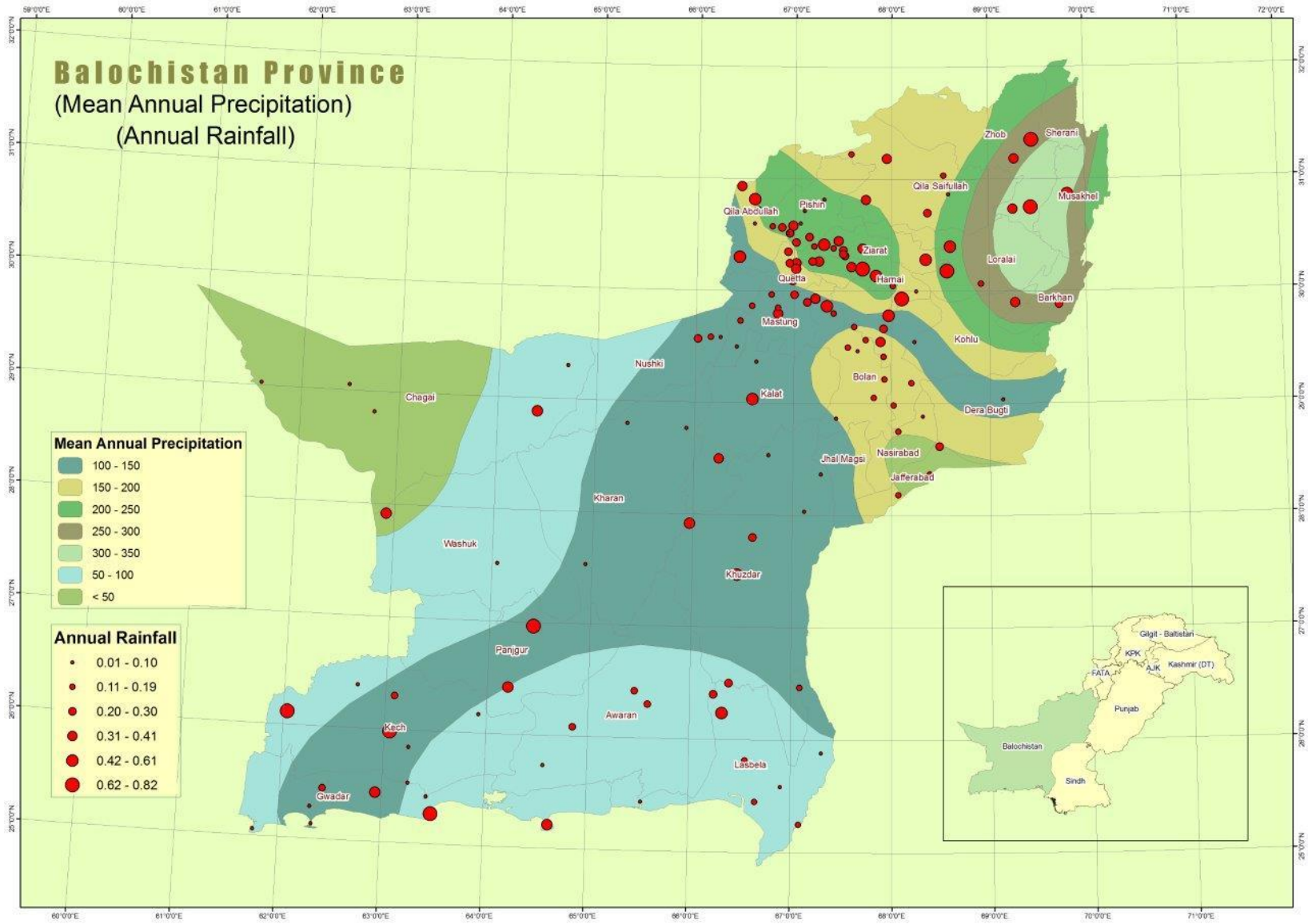


Exhibit:5-A Annual Precipitation

5 REVIEW OF IMPLEMENTATION OF ESIA/ ESMP IN PROMOTING GIRLS EDUCATION BALOCHISTAN PROJECT (PGEB)

The implementation of the ESIA and associated ESMP of Promoting Girls Education Balochistan project was reviewed. The review process included, review of the ESIA/ESMP of PGEB, the institutional arrangement, review of Adie-Memoires of WB, documentation and reporting and monitoring of the ESMP during the span of the project.The review of the processes and discussion with the concerned officials lead to the followingobservations:-

a. Review of ESIA/ESMPof PGEB

The review of ESIA/ESMP revealed that the assessment made in ESIAwas complete in all respect, as it covered all possible environmental and social adverse impacts associated with the project activities. Similarly, the ESMP was found robust as it addressed all possible environmentaland social impacts as well as health and safety issues related to execution of project activities. Therefore, any gap in implementationcannot not be attributed to ESIA/ESMP.

b. Institutional Arrangement

- Adequate institutional arrangement, and defined roles and responsibilities are central to effective implementation of ESMP. However, during the project life, the position of Environmental Focal Person (EFP) remained vacant for extended periods. Initially the position was filled soon after the effectiveness of the project, but after a year, due to staff turnover, the position remained vacant for several months.Even after the designation of the EFP, the attention to the ESMP implementation remained weak since the person was assigned multiple responsibilities in addition to environmental management. This resulted not only in delay in the implementation of ESMP but also resulted in weak environmental monitoring.

- The review of the Bank's Mission Ade-Memoires revealed that the implementation of ESMP was rated only "Moderately Satisfactory" as significant gaps were identified by the Bank's Mission in implementation of ESMP.

c. Environmental Training and Capacity Building

For a successful implementation of an ESMP, it is essential that the key stakeholders and implementation partners have adequate knowledge about

environmental concerns of the Project, the right attitude about the environmental practices and capacity for implementing the ESMPs. It is because of this each ESMP entails a training and capacity building plan.

However, after detailed discussion with the different officials of PMU, the construction supervision consultants, representative of the contractor and review of the World Banks' Aide-Memoirs, it was learned that a few trainings were conducted. Resultantly, the capacity of the staff involved in ESMP implementation and other implementing partners was not built to the required level.Because of having limited capacity the staffsfelt utmost difficulty in implementing the ESMP and preparing monitoring reports.

d. Monitoring and Reporting

- It was envisaged in the ESMP of PGEB that the District Education Officer will monitor the implementation of mitigation plan at the district level with the community participation and shall be responsible for compiling monitoring reports of the district and its submission to Safeguard Officer.

- On the contrary no such report came forth during the review process which leads to the conclusion that either the DEOsdo not know their role in implementation of ESMP or they do not have the required capacity and skills to carry out effective environmental monitoring.

- As part of Monitoring Process, it was also envisaged in the ESMP of PGEB, to carry out third party validation through an independent monitoring agency on annual basis with a view to evaluate the overall ESMP implementation progress and to ensure that the mitigation measures are implemented as per mitigation plan.Only one such validation was carried out by the project.

- The monitoring reports were neither on proper format nor contained the required information.Similarly, the checklists prepared for monitoring the mitigation plan were not consistent with the ESMP and were not properly conformed for collecting and generating required information.

- It was also observed that the checklist were filled in without following any implementation schedule e.g. the checklist for site-selection and design, construction and operation stage were filled at the same time.

In lieu of mentioned observations, it is concluded that ESMP could have been satisfactorily implemented if the designated position in PMU had been filled in timely, with a suitable person, the training and capacity of staff had been carried out as per planned spirit and monitoring and reporting mechanism, devised in the ESMP, had been put in place properly.

The action plan to address the above observations id discussed later in the document.

6. STAKEHOLDER CONSULTATIONS

This section describes the stakeholder consultations, Focusdiscussions andstakeholder workshop which were carried out during preparation of PGEB. Additionally this section give detail of the consultations carried out during preparation of this addendum and the proposed consultations which shall be carried out during the project implementation.

6.1 Objective of Consultations

The objectives of stakeholder consultations were to i) inform the stakeholder about the project and its potential impacts, ii) to obtain views, concerns and suggestions of the stakeholders about the project and its design; and iii) address these concerns / suggestions in designing the mitigation measures.

6.2 Consultations Carried out for during preparation of ESIA of PGEB.

During preparation of ESIA consultations were held with relevant officials of the Education and Environmental Protection Departments of Government of Balochistan, functionaries, interest groups, beneficiaries, affected communities and NGOs working in the project area. These consultations were held through a series of individual meetings to ascertain their perceptions and views about the project. A consultative workshop was also arranged in Quetta wherein, the project objectives, activities, its likely social and environmental aspects were discussed, and views/concerns of potential stakeholders were noted. Focus Group Discussions (FGDs)were also conductedwith affected and beneficiary communities during field investigation in the project area to know their specific concerns relating to environmental and social issues. The detail of these consultations can be referred to in section-5 of the ESIA of PGEB. Additionally the list of stakeholders consulted during the study can also be reviewed at **Annex-E of ESIA of PGEB.**

6.3 Consultations carried out during preparation of Addendum

The consultations carried out during the preparation of this addendum included, discussion with the Official of Environmental Protection Department (EPA) Balochistan and Balochistan University of Information Technology, Engineering and Management Sciences (BUITEMS).

EPA Balochistan

The Director (EIA), Balochistan EPA was apprised of the project, its scope and the purpose of ESIA study. He appreciated that Environmental and social assessment of the project is being conducted which is legal obligation under the Pakistan Environmental Protection Act, 1997 and said that EPA will facilitate the project in achieving the objective of environment protection in the province. He also requested that the Existing ESIA of PGEB and the addendum may be shared with the EPA for information.

BUITEMS Balochistan

The consultation with the BUITEMS Staff mainly focused the environmental impacts of the low cost school design prepared by the BUITEMS for GPE-BEP. It was informed by the person in-charge of the design team that the design of low cost school building for establishment of transitional schools has been prepared while considering all possible environmental impacts associated with its construction and keeping in view the diverse environmental and social conditions of Balochistan.

They also affirmed their continued support during the implementation of the project and requested that they may be provided the addendum when finalized and approved, for their information and record.

6.4 Proposed Consultations during implementation of GPE-BEP

The following consultation is proposed to be carried out with the stakeholders of the project, interest groups and beneficiaries in order to incorporate their suggestions and concerns during execution of project interventions; and also to manage a two way communication between the project, its stake holders and the beneficiary communities.

1. Consultation with the communities providing space and/or land for establishment of schools
2. Consultation with the Local administration department and local government representatives for ensuring their ownership of the project in their respective areas.
3. Consultation with the Local and International NGOs for obtaining their views on the environmental and social impacts of the interventions.

7. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

This section describes the Environmental and Social Management Plan work (ESMP) which has been devised with the objective to ensure that the adverse environmental and social impacts of GPE-BEP are avoided and / or appropriately mitigated, monitored

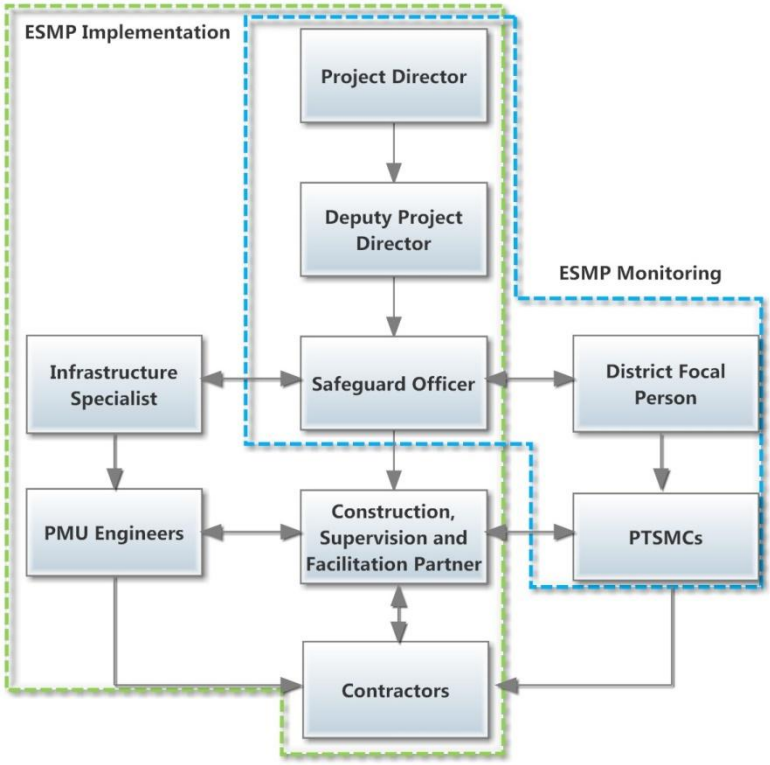
and compensated for through its implementation. It is pertinent to mention this ESMP, shall make Environmental mitigation and monitoring plan, institutional arrangements and documentation and reporting requirementsto address and the significantly adverse environmental and social impacts of GPE-BEP.

7.1 Institutional Setup for ESMPImplementation

The ESMP will be implemented under the overall supervision of Project Director, (PMU) GPE-BEP. The Project Director will be responsible for the implementation, monitoring and reporting of ESMP through the Safeguard Officer to be appointed by the project. The Construction, Supervision and Facilitation Partner (CSFP) will be carrying out construction work through contractors. CSFP will also be responsible for supervision of the contractors work on the sites.

The Safeguard Officer will act as focal person at the provincial level to coordinate with all stakeholders and at district level, the ESMP implementation responsibility will rest with the District Focal Person (DFP) of the concerned district. PTSMCs will be motivated to take active part in the monitoring of contractors work on the site to ensure community participation in ESMP implementation. **Exhibit-6** shows the proposed institutional mechanism for ESMP implementation from top to bottom level contractor, with assigned role and responsibilities.

Exhibit 6-A: Institutional Mechanism for ESMP Implementation and Monitoring



7.2 Roles and Responsibilities of Designated Officers

The role and responsibilities of the designated officers and other partners have been described in **Table-15-A**. However, in cases of overlapping roles by more than one officer, the higher officer will have the authority to re-designate the roles and responsibilities of those officers in the best

interest of the project and to ensure clarity of responsibilities for ESMP implementation.

Table 14-A Role and Responsibility of Designated Officer

Organization	Position	Responsibility	Jurisdiction
PMU	Project Director,	Ensure ESMP implementation	Entire Project Area
PMU	Deputy Project Director	Coordination with all stakeholders in ESMP implementation	Entire Project Area
PMU	Safeguard Officer	Ensure that mitigation checklists are filled during various stages of each school design and construction; Ensure that environmental monitoring is carried out in the field and associated checklists are filled; Ensure that the construction contracts include clauses for ESMP implementation; Ensure that environmental trainings are planned and implemented; Monitoring and reporting of ESMP at provincial level	Entire Project Area
Secondary Education Department, Balochistan	District Focal Person	Monitoring and Reporting of ESMP at district level	District Concerned
PMU	Infrastructure Specialist	Responsible for eco-friendly designing of buildings	Entire Project Area
PMU	Engineers (PMU)	Monitoring the implementation of eco-friendly designs in the school buildings	Entire Project Area
Private Firm	Construction, Supervision and Facilitation Partner	Supervision of construction work on sites	Entire Project Area
PTSMC	Members	Monitoring on site construction and operation of school	School level
Contractor	Contractor	Compliance with ESMP guidelines	School level

The Safeguard Officer in the PMU at the provincial level will be responsible for ESMP implementation. He/she will liaise with all stakeholders including the District Education Officers, Infrastructure Specialist, CSFP and Contractors for implementation and compliance with ESMP guidelines and mitigation measures. Safeguard Officer will also be responsible for progress reporting to the Project Coordination Committee (PCC) and World Bank through the Project Director (PD).

The District Focal Person (DFP) will be responsible for coordinating and monitoring activities at the district level and maintaining upward and downward linkages with the

PMU and the field staff including contractor for ensuring smooth implementation of the ESMP and timely reporting of the environment and social issues arising in the wake of implementation. Coordination with other stakeholders including PTSMCs in the district and troubleshooting resolution will also fall in his/her responsibilities.

Community will be organized in shape of Parent Teacher School Management Committee (PTSMC). The PTSMCs will have a monitoring oversight role in the ESMP implementation during construction and operation of the schools. PTSMC will closely liaison with construction contractor at the site and report environment related issues to the District Education Officer for resolution and reporting.

The Infrastructure Specialist will be responsible for ensuring eco-friendly designing of school buildings compatible with local climate and seismic zoning. S/He will maintain close liaise with Construction, Supervision and Facilitation Partner and contractors to ensure compliance with ESMP during construction activities.

Four engineers will be responsible for ensuring the implementation and monitoring of eco-friendly designs of school buildings during construction stage by the contractors. S/He will be responsible to ensure that the contractor follow and comply with appropriate buildings codes for seismic zoning during construction of buildings. S/He will maintain close liaison with contractor and Safeguard Officer on design related issues.

Construction, Supervision and Facilitation Partner (CSFP) will be responsible for construction work through contractors. CSFP will also be responsible for supervision of the contractors and construction work on the sites. CSFP will work under the guidance of Infrastructure Specialist and Safeguard Officer in the PMU.

7.3 Mitigation Measures and Environmental Mitigation Plan

The environmental impacts of GPE-BEP activities shall be isolated, small-scale and site specific in nature and shall be of low to moderate in significance, similar to the impacts assessed for PGEB Project. These impacts, described in detail in section 7 of PGEB, pertaining to site selection, design, construction and operation, will be on soil stability and contamination, vegetative cover, surface and ground water quality, air quality, noise and vibrations, health and hygiene issues and in inconvenience to public from improper stock piling of the construction materials at construction sites. Most of these impacts are of low to medium level and can be managed properly, during project implementation through adopting appropriate mitigation measuresentailed in section 7 of the ESIA of PEGB and described briefly herein.

The sitting and design stage measures would include implementation of site selection guidelines, adopting eco-friendly designing and applying appropriate building codes in

the designing of school buildings located in the earthquake prone areas and flood plains. Appropriate water efficient design of toilets with septic tank and soaking pit, sewerage connection and provision of proper ventilation for lighting in classrooms are some of the cardinal mitigation measures for avoiding contamination surface and ground water bodies. The construction stage measures would include preemptive actions by the construction contractor to avoid the adverse impacts, for example, covering the stockpiled materials, limiting excavation activities after schooling hours, and ensuring worksite safety. The mitigation measures relating to school operation include proper disposal of the solid waste, proper maintenance of water supply and sanitation system and ensuring the supply of safe drinking water.

The PMU through the Safeguard Officer will ensure that the construction contracts include appropriate clauses for ESMP implementation.

7.4 Environmental Mitigation, Health and Safety Management Plan

The Environmental Mitigation and Health and Safety Management Plan describes the implementation of environmental and social impacts, proposed mitigation measures and health and safety management measures for construction workers, during design, construction and operation stage of the project. The environmental mitigation and monitoring planfor GPE-BEP is given in **Table-16-A and Table-17-A (Columns 1-3).**

7.5 Monitoring Plan

A Comprehensive monitoring plan for monitoring of Environmental Mitigation and Health and Safety Management, comprising monitoring parameters, frequency and responsibility of monitoring is outlined in **Table-16-A and Table-17-A (Columns 4-6).**

7.5.1 Internal Monitoring

District Focal Person (DFP) will monitor the implementation of mitigation plan at the district level with community participation. PTSMCs will regularly check the observance of proposed mitigation measures and guidelines by the construction contractor at worksites. PTSMCs will also be responsible for ESMP compliance during school operation phase. DFPs will make routine as well as surprise visits of the schools in their operational areas, both during construction and operation phases to ensure ESMP compliance. He/she will closely liaise with PTSMCs to get regular feedback from each school regarding ESMP. He/she will send monthly reports to the Safeguard Officer at PMU for evaluation and compliance.

Repair, rehabilitation and minor construction activities, if any, involved in providing missing facilities to the existing schools shall also follow the mitigation plan proposed in Table-16-A and health and safety management plan proposed in Table-17-A. Guidelines given in **Section 8.4 and 6.5 of ESIA-PGEB** will be followed for electricity

provision, toilets, water supply and construction of additional classrooms. Compliance monitoring of these activities will be carried out by the DFP and PTSMCs at the community level to ensure the implementation of mitigation measures and guidelines for environmental enhancement opportunities.

Capacity building training for DFPs and PTSMCs will ensure effective monitoring and reporting of ESMP compliance. Necessary resources such as vehicle and fuel will be provided to the DFPs for monitoring. The Monitoring and Evaluation Officer, PMU will also randomly conduct monitoring of the school sites in the project areas, both during construction and school operation phases and submit their monitoring reports to the Safeguard Officer in the PMU for necessary corrective action.

7.5.2 External Monitoring/Third Party Validation

The primary purpose of the external monitoring will be to see that both construction and the operational phase activities have been undertaken in line with the ESMP recommendations. Third Party Validation (TPV) through an independent monitoring agency will be carried out on annual basis to evaluate the overall ESMP implementation progress, and to ensure that the mitigation measures are implemented as per mitigation plan. In case of any deviation, corrective actions will be taken where necessary. For TPV, environmental and social specialists having relevant expertise and previous experience will be engaged. A detailed Terms of Reference for hiring the services of TPV is given at **Annex-F of ESIA of PGEB.**

The PMU may hire the services of environmental and social expert (consultant), if so required on any issue related to environmental and social impact mitigation or non-conformity surfaced up from monitoring activities.

7.6 Environmental Enhancement Guidelines

In order to improve the environmental conditions and minimize the risk factors in design and construction / rehabilitation of schools, the guidelines for environmental enhancement opportunities, contained in **section 8.4 of the ESIA of PGEB**, will also be following during implementing this ESMP.

7.7 Land Donations

Under GPE-BEP no land shall be acquired during the establishment of schools in community provided spaces and for construction of transitional school, however, these activitieswill be executed on community donated. For donated land/space an agreement will be signed between the donor and the Secondary Education Department that among other will ensure that:-

i. the donation is voluntary

ii. the land/space is appropriate for the construction of school.
iii. The land/space does not belong to any other donor who is below the poverty line or whose remaining holdings would be reduced below the minimum acreage, as stipulated to be economically viable (2.5 acres).
iv. There are no encumbrance on the land
v. it does not negatively impact on the livelihood of any vulnerable group.
vi. no compensation will be paid for the land; and
vii. the owner will give up all claims on the land and the title will be transferred to Secondary Education Department, as per prevailing laws of Government of Balochistan.

7.8 Capacity Building and Training Programme

Capacity building and training of the staff associated with ESMP implementation play an important role towards achieving its objectives. The staff designated for implementation of this ESMP implementation at the PMU and district level may not have the desired technical expertise to carry out monitoring of the proposed environmental and social mitigation measures without capacity building and trainings. Specific training on environmental and social mitigation plan will be arranged for the Safeguard Officer, District Focal Person, PTSMC members and Project Management Unit team to deliver their monitoring responsibilities in an organized and effective manner as per requirement of the monitoring plan. **Table-18-A** gives a tentative schedule of capacity building and trainings programme for GPE-BEP project. The prime objective of the trainings is to enhance the technical capacity of staff associated with ESMP implementation and to keep the Project Management Team, Implementing Staff of Education Department, and PTSMCs aware of the emerging environmental and social issues, and enabled them to resolve those issues through proposed mitigation measures.

Thirty Four (34) training workshops, two at provincial level and 32 at district level, are proposed in the first year of the project. In second and third year, 3 refreshers, trainings at provincial level would be arranged on annual basis. The Provincial and District level officers involved in the ESMP implementation will primarily attend these workshops. These workshops will focus on environmental as well as social issues, confronted during ESMP implementation. Besides, these will also focus on sensitizing the participants about environmental and social stakes of the project, managing the on-ground problems, and assuring implementation of the ESMP.

7.9 Reporting

The DFO will compile monitoring reports, submitted by the Site Engineers of Construction Supervision and facilitation partners and Engineers of PMU and will send it to the Safeguard Officer for evaluation and mid-course correction, if required. Similarly,

The Safeguard Officer will process, analyze and forward the consolidated report of all districts to the Project Director, PCC and World Bank for usage and decision-making. The Safeguard Officer will be responsible to prepare and circulate ESMP progress reports on a quarterly basis. These quarterly progress reports (QPRs) will provide progress on implementation of mitigation measures, safeguard monitoring, capacity building, and any other ESMP implementation activity carried out during the reporting quarter. These reports will be shared with, among others, the World Bank within one month of the completion of each quarter.

7.10 Disclosure

This Addendum has beendisclosed on the website of Education Department, Government of Balochistan. It has also been disclosed on the World Bank InfoShop. Hard copies of this Addendum will also be shared with the Provincial EPA, Implementing Partner NGOs and Construction Contractors, Civil Society Organizations. A copy of the Addendum will be placed in the Project Management Unit, GPE-BEP project for public access. The executive summary of the Addendum will also be translated into Urdu and distributed to all relevant stakeholders more particularly to the communities in the project areas. The purpose will be to inform them about the project activities, negative environmental and social impacts expected from the project and proposed mitigation measures.

7.11 Action Plan for Improvement in ESMP Compliance

The following specific actions have been included in the present ESMP to address the weaknesses and shortcomings identified in the implementation of the PGEB ESA (discussed in Section 5 of this Addendum):

- A fulltime Safeguard Officer will be employed in the PMU (Section 7.1)
- A comprehensive training plan has been included in ESMP (Section 7.8)
- The trainings will also address the inadequate reporting and documentation carried out during the previous project.

7.12 ESMP Cost

The estimated cost of ESMP implementation include the capacity building training of staff including payments to the resource persons, training module and materials, internal monitoring costs and external monitoring/Third Party Validation (TPV). The cost of mitigation measures will be included in the tender documents of the project to be floated in the press and executed by the Education Department through contractors. The total estimated cost for ESMP implementation and monitoring is **PKR 19.93**million for three year project period. This estimate has been included in the overall project cost.

Table 15-A Environmental Impact Mitigation Implementation and Monitoring Plan

	Implementation Plan			Monitoring Plan		
	Environmental Impacts	**Proposed Mitigation Measures**	**Responsibility**	**Monitoring Parameter (s)**	**Frequency**	**Responsibility**
Siting and Design Stage						
A	**Impacts on soil and land**					
1	Improper siting can lead to loss of vegetative cover, removal of trees, erosion and loss of useful agricultural land	Appropriate site selection and designing for school will be done according to the guidelines provided in **Section 6.2.1 and 8.4.4of ESIA of PGEB,** in order to entail no or minimal disturbance to the soil and land.	Education Deptt/PMU	Implementation of site selection guidelines are verified	Two times (one at the time of site selection and second at design stage)	Distsrict Focal Person(DFP)/ Safeguard Officer
2	The location and siting of school in difficult terrain and far away from the population may lead to accessibility and easement problem for girls	Primary school particularly girls school shall not be located in difficult terrain and very far away from the population to ensure easy and equal access for all girls students and teachers. Site selection of school will be done according to guidelines provided in **Section 6.2.1of ESIA of PGEB** to ensure minimum disturbance to environment.	Education Deptt/PMU	Implementation of site selection guidelines are verified	Once at the time of site selection	Safeguard Officer/DFP
B	**Impacts on surface water**					
3	Siting close to river and streams can cause surface water quality degradation and	Site adjacent to river and stream will be avoided to prevent surface water	Education Deptt	Site location is verified	Once at the time of site	DFP/ PTSMC

	Implementation Plan			Monitoring Plan		
	Environmental Impacts	**Proposed Mitigation Measures**	**Responsibility**	**Monitoring Parameter (s)**	**Frequency**	**Responsibility**
	contamination of water resources	contamination.			selection	
4	Improper design without tolilets and sewage treatment and disposal system can lead to surface water contamination.	The design of school building will include sewage treatment (such as septic tank with soaking pit).	Engineer (PMU)	Design of school for sewerage treatment system is verified	One time (at the design stage)	Safeguard Officer
5	Excessive use of water can lead to depletion of surface water resources in the area.	Water efficient design of toilets will be provided to reduce impact on the surface water resources.	Engineer (PMU)	Water efficient toilet design will be verified	Two times (one at design and then at operation stage)	Safeguard Officer
		Rainwater harvesting facility, particularly in water scarce areas, will be provided in schools building to reduce impact on surface water resources.	Engieer/CSFP/ SQA	Raainwater harvesting will be verified	Two times (one at construction stage and second at operational stage)	DFP
C	**Impacts on ground water quality**					
6	Design of toilets close to hand pump or tube well base can increase risk of ground	The toilet will not be located close to the hand pump, tube well or any other ground water source to avoid seepage	Engineer	Design & location of toilets in	Two times (one at the design stage	Safeguard Officer

	Implementation Plan			Monitoring Plan		
	Environmental Impacts	**Proposed Mitigation Measures**	**Responsibility**	**Monitoring Parameter (s)**	**Frequency**	**Responsibility**
	water contamination through natural percolation and downward seepage of contaminated water	and contamination of ground water.		school building is verified	and second at construction stage)	
D	**Impacts on natural vegetation**					
7	Improper site selection and design can leads to removal of vegetation and cutting of trees for school construction.	Sites located in ecologically sensitive areas (**Annex-3 of ESIA of PGEB)** will not be approved for schools to avoid impact on flora and fauna.	Engineer (PMU)	Site is checked against Annex-3 to ensure compliance.	One time (during site selection stage)	Safeguard Officer
		Tree plantation plan will be included in the school design to reduce the impact.	(PMU)	Tree plantation is verified	Once (design of school is checked for open spaces)	DFP
Construction Stage						
A	**Impacts on soil and land**					
8	Excavations and removal of trees can lead to soil erosion and landslides in hilly terrain.	Removal of vegetation and trees will be avoided to the extent possible. The exposed soil will be re-vegetated quickly and compensatory plantation, (five sapling for each tree felled), will be	Contractor	Tree plantation is monitored	Two times (one during excavation and second after plantation is done)	DFP/ PTSMC

	Implementation Plan			Monitoring Plan		
	Environmental Impacts	**Proposed Mitigation Measures**	**Responsibility**	**Monitoring Parameter (s)**	**Frequency**	**Responsibility**
		carried out after construction is over				
		The contractor will ensure prevention of soil erosion and destabilization by applying batched excavation technique.	Contractor	Soil erosion is monitored	Once (during excavation and digging of foundations)	DFP/ PTSMC
		Excavation, if required for foundation, will only be carried out in specified area, as per the engineering drawings. The excavated earth will be used for filling and compaction.	Contractor	Exposed soil compaction is monitored	Once (after excavation and foundation work completed)	DFP/ PTSMC
9	The excavation and digging of earth for construction of school may likely to discover sites and artefacts of cultural and archaeological importance	Unexpected discovery of cultural and archaeological artefacts shall be reported to the concerned authorities according to procedure given in Section **2.10.5 of ESIA of PGEB.**	Contractor and PMU	Procedure for chance find management is verified	Two times (one after discovery and then handing over of site to concerned authorities)	PMU/ Safeguard Officer
10	Disposal of contaminated construction wastes can lead to soil	Construction wastes will be collected and disposed of in	Contractor	Disposal of construction wastes	One time (during construction	DFP/PTSMC

	Implementation Plan			Monitoring Plan		
	Environmental Impacts	**Proposed Mitigation Measures**	**Responsibility**	**Monitoring Parameter (s)**	**Frequency**	**Responsibility**
	contamination	designated landfill areas		monitored	stage)	
11	Disposal of left over construction material and excavated soil can lead to soil contamination	Left over construction and excavated materials will be disposed of in designated landfill to avoid soil contamination.	Contractor	Disposal of construction wastes monitored	Once (at completion of construction work)	DFP/PTSMC
12	The used borrow pits may lead to soil degradation and erosion.	Used borrow pits will be restored and levelled back to control soil degradation.	Contractor	Restoration of borrow area checked	Once (after construction work is over)	DFP/PTSMC
B	**Impacts on surface water**					
13	Excessive use of water may lead to generate large quantity if wastewater	Minimum quantity of water shall be use to meet the essential construction requirements. The contractor will ensure to avoid unnecessary use of water for washing of equipment and vehicles during construction.	Contractor	Water consumption is monitored	One time (during middle of construction work)	PTSMC
14	Disposal of large quantity of wastewater during construction into a nearby water body can pollute the waters source.	The contractor will dispose the construction wastewater and toilet wastewater through a soaking pit of appropriate capacity, which be levelled back after completion of construction work.	Contractor	Monitor wastewater disposal during construction	One time (during construction work is in progress at the site)	DFP/ PTSMC

	Implementation Plan			Monitoring Plan		
	Environmental Impacts	**Proposed Mitigation Measures**	**Responsibility**	**Monitoring Parameter (s)**	**Frequency**	**Responsibility**
		Appropriate sewage disposal arrangements (such as septic tank with soaking pit) will be made for temporary toilets if built at the site.	Contractor	Septic tank and soaking pit is verified	Once (during middle of construction work)	DFP/ PTSMC
C	**Impacts on air quality**					
15	Dust emission from construction work can lead to deterioration of local ambient air quality	Stockpiled materials will be covered to avoid dust/particulate emission.	Contractor	Dust (SPM) and vehicles emissions monitored	Two times (at start of construction work and then in the middle of construction stage)	DFP/PTSMC
		Vehicles speed will be kept to the minimum low to avoid blowing of dust and suspended particulate matter.				
		Demolition and excavation will be carried out in batches to avoid dust emissions.	Contractor	Excavation work is monitored	Two times (during demolition and then excavation stage)	DFP/PTSMC
16	Emissions from construction machinery and carriage vehicles exhaust can lead to increase air pollution	The contractor will ensure to keep vehicles and machinery tuned and lubricated to reduce air emissions.	Contractor	Monitor vehicles and machinery emssions	Monthly (Vehicle emission certificate verified)	DFP/PTSMC

	Implementation Plan			Monitoring Plan		
	Environmental Impacts	**Proposed Mitigation Measures**	**Responsibility**	**Monitoring Parameter (s)**	**Frequency**	**Responsibility**
D	**Impacts on flora and fauna**					
17	Excavation work can lead to removal of trees and vegetation	Cutting of trees will be avoided during construction. In case of unavoidable choice, compensatory tree plantation, (five saplings for each tree felled) will be carried out to reduce the impacts	Contractor	Tree plantation is monitored	Two times (tree cuting during construction and plantation after construction is over)	DFP/PTSMC
E	**Noise and vibration impacts**					
18	Construction activities can lead to unpleasant noise during school hours and at night times.	The contractor will avoid use of noise generating machinery, equipment during school hours and at night	Contractor	Use and timimgs of noisy equipment monitored	Twice a week (during construction)	DFP/PTSMC
		The contractor will use proper and good quality lubricants in machinery and equipment to minimize noise pollution.	Contractor	Use of lubricant checked randomly	Monthly 4 times (once in a week)	DFP/PTSMC
19	Movement of vehicles and use of pressure horn can be a source of unpleasant noise	The contractor will maintain and tune up all the vehicles and equipment during construction work. The community will be	Contractor	Noise level is monitored	Monthly (once in a month noise pollution is observed)	DFP/PTSMC

	Implementation Plan			Monitoring Plan		
	Environmental Impacts	**Proposed Mitigation Measures**	**Responsibility**	**Monitoring Parameter (s)**	**Frequency**	**Responsibility**
		sensitized to observe silence zone in the school premises. Proper signboard will be installed indicating ban on use of pressure horns by moving vehicles around the school.				
Operation Stage						
A	**Impacts on soil and lands**					
20	Disposal of municipal wastes and toilet wastewater can contaminate the land.	It will be ensured that toilets and associated sewage treatment systems are maintained in proper working condition.	PTSMC	Sewerage treatment is monitored	Quarterly (Wastewater sample is collected and anamysed in laboratory)	DFP
		Municipal wastes are disposed off in designated landfill area.	PTSMC	Waste disposal is monitored	Quarterly (landfill site is inspected)	DFP
		Tree plantation around the periphery of school building will be carried out to ensure soil stability and control erosion	Local community	Tree plantation verified	One time (after plantation is completed by locals)	DFP
B	**Impacts on surface water**					

	Implementation Plan			Monitoring Plan		
	Environmental Impacts	**Proposed Mitigation Measures**	**Responsibility**	**Monitoring Parameter (s)**	**Frequency**	**Responsibility**
21	Open discharge of sewage into nearby water bodies can contaminate water quality.	Sewage will not be dispose directly to river and stream in surrounding area.	Contractor	Disposal of sewage monitored	Quarterly (sewage sample taken and analysed in laboratory)	DFP/PTSMC
		The local community and PTSMC will be sensitized through health and hygiene sessions to protect water resources from contamination.	Education Deptt and IPs	Training sessions are monitored	Randomly (once during the training session)	Safeguard Officer/DFP
C	**Impacts on groundwater**					
22	Stagnation of spilled water around the base of hand pump or tube well can leads to groundwater contamination through percolation and seepage.	The surrounding base of hand pump or tube-well is sealed off from the exterior by grouting with cement mortar to control percolation and seepage. Periodic testing of drinking water supply source at the schools will be carried out for timely detection of contamination	Contractor Education Deptt	Ground water sample analysed	Two times in year (one in January and then in July)	TPV/EPA
D	**Impacts on air quality**					

	Implementation Plan			Monitoring Plan		
	Environmental Impacts	**Proposed Mitigation Measures**	**Responsibility**	**Monitoring Parameter (s)**	**Frequency**	**Responsibility**
23	Dust from vehicles movement around the school premises can create minor adverse impact on air quality in surroundings of the school.	Community will be sensitized to observe low speed limits in premises of school	Education Deptt and IP	Awareness session monitored	Randomly (once during project period)	DFP/PTSMC
		The exposed soil in/around school premises will be re-vegetated and landscaped with community participation to control dust blowing.	Local Community and PTSMC	Plantation and re-vegetation verified	Annual (during school inspection by education)	DFP
E	**Noise Pollution**					
24	Moving vehicles and use of pressure horns around the schools could be source of unpleasant noise	Community will be sensitized to observe silence zone in the school premises and proper signboard will be installed indicating ban on use of pressure horns by moving vehicles around the school	Education Deptt and IP	Installation of sign board verified	Annual (during school inspection by education deptt)	DFP/PTSMC

Table 16-A Health and Safety Management Implementation and Monitoring Plan for Construction Worksite

	Implementation Plan			Monitoring Plan		
	Health and Safety issue	**Proposed Mitigation Measures**	**Responsibility**	**Monitoring Parameter (s)**	**Frequency**	**Responsibility**
A	**Siting and design stage**					
1	Improper siting can lead to accessibility problems for school childrens	Site selection guidelines in **Section 6.2.1ESIA-PGEB** will be followed for construction of new school buildings.	Education Department	Site is inspected for compliance	One time (during site selection)	Safeguard Officer/DFP
2	Improper building design with poor ventilation and sunlight can affect the health and learning ability of childrens	Guidelines for eco-friendly designing of building in **Section 8.4.4 ESIA-PGEB** will be followed to provide ventilation and natural lighting in the class rooms.	Engineer	Design is verified for ventilation & sunlight	Once (after design is completed)	Safeguard Officer/DFP
3	Improper building design in earthquake zone or flood plain can lead to increase vulnerability to disasters, health and safety risks.	School designs will follow guidelines in **Section 8.4.3 ESIA-PGEB** for seismic zoning and flood resistant buildings to avoid risks to life, health and property.	Engineer	Design is verified for seismic codes and flood proof buildings	Once (after design is complete)	Safeguard Officer/DFP
4	In sufficient quantity of water in toilets can lead to health hygiene problems.	Water storage tank will be included in the design of school to ensure availability of water in toilets for hand wash.	Engineer	Water storage tank verified in the designs	Once (after design is complete)	Safeguard Officer/DFP
		Eco-san toilet design mentioned in Section 6.5 will be followed for construction of toilets to minimise water consumption.	Engineer	Eco-san design of toilet is verified in the design	Once (after design is complete)	Safeguard Officer/DFP

	Implementation Plan			Monitoring Plan		
	Health and Safety issue	**Proposed Mitigation Measures**	**Responsibility**	**Monitoring Parameter (s)**	**Frequency**	**Responsibility**
		Rain-water harvesting guidelines in **Section 8.4.1 ESIA-PGEB** will be followed to provide alternate source of water for toilets and handwashing in water scarce areas to ensure personal hygiene	Engineer	Rain-water harvesting facility is verified at design stage	Once (after design is complete)	Safeguard Officer/DFP
5	Improper building design can lead to difficulties and safety issues for special children.	The building designs will cater to the needs of special children (such as ramps and hand rails will be provided where needed)	Engineer	School designs verified for ramps, hand rail	Once (after design is complete)	Safeguard Officer/DFP
6	School design without safe drinking water facility may lead to compromise health and safety of children's	Facility for storage of safe drinking water will be provided in the school design	Education department	School design is verified safe water storage tank	Once (after design is complete)	Safeguard Officer/DFP
B. Construction Stage						
7	Ill planned and haphazard excavation of foundation may lead to damaging underground pipes/utility lines and pose a risk to the health and life of workers	Foundations areas for excavation will be properly marked with lime and physical barriers will be erected around the excavated areas to restrict access.	Contractors	Marking of foundation area verified	Once (before excavation is started)	DFP/PTSMC

	Implementation Plan			Monitoring Plan		
	Health and Safety issue	**Proposed Mitigation Measures**	**Responsibility**	**Monitoring Parameter (s)**	**Frequency**	**Responsibility**
		All utilities supply lines present in the excavation area shall be closed from the manhole before starting excavation. Fire extinguisher and gas spill control equipment shall be provided at the site.				
8	Open dumping and stockpiling of construction materials in open spaces and streets can result in blocking of route and inconvenience for passersby, neighbors, and residents	Stockpiled construction materials will be covered in separate place or corner in the premises of school. .	Contractor	Covering of stock materials checked	Randomly (during construction stage)	DFP/PTSMC
9	Ignorance about site specific hazards may pose a potential threat to the health and safety of workers	Detail hazard assessment shall be carried out to identify all site specific hazards and labeled before starting construction work on the site	Contractors	Hazards mapping verified	Once (before starting construction work on the site)	DFP
10	The construction work and equipment may lead to safety hazards for workers and nearby communities	The contractor will provide protective equipments such as gloves and boots to the labors to avoid worksite hazards and accidents	Contractor	Provision of safety equipments checked	Randomly (at least once during the construction stage)	DFP/PTSMC

	Implementation Plan			Monitoring Plan		
	Health and Safety issue	**Proposed Mitigation Measures**	**Responsibility**	**Monitoring Parameter (s)**	**Frequency**	**Responsibility**
		Protective fencing will be used around the construction sites, excavated areas, and voids.	Contractor	Fencing around worksite is verified	Once (during construction stage)	DFP/PTSMC
11	The operation of construction machinery and equipment such as excavators, lifters and dumpers by untrained personals may leads to compromise the health and safety of workers at sites.	Proper trained and certified staff shall be deployed to operate machinery and equipment at worksite. Health and safety training shall be provided to all staff working on the site.	Contractor	Health and safety trainings and certification of staff verified	Once (before starting construction work on the site)	DFP
12	Welding and cutting operation during construction poses a serious health and safety risk for workers	i. Welding and cutting shall only be performed by authorized and properly trained persons. ii. Butane Lighters shall not be carried by welders or their helpers when engaged in welding or cutting operations. iii. Welder shall wear an approved helmet or goggles, proper protective gloves, and clothing. iv. Fire extinguishing equipment shall be within 6m (20ft) of all locations where welding andcutting equipment is used.	Contractor	Wearing of Personal Protective Equipments shall be verified	Randomly (during construction work on the site)	DFP
Operation Stage						
13	Poor hygiene conditions during school operation can increase	Awareness about personal hygiene will be raised among the students and	Education	Health Hygiene sessions	Randomly	DFP/PTSMC

	Implementation Plan			Monitoring Plan		
	Health and Safety issue	**Proposed Mitigation Measures**	**Responsibility**	**Monitoring Parameter (s)**	**Frequency**	**Responsibility**
	vulnerability of school children's to diseases.	surrounding community through health and hygiene sessions.	Deptt and IP	monitored	(during training session)	
14	Contamination of drinking water source can lead to health hazards for school children.	Cleanliness of schools and regular checking of drinking water quality will be ensured.	PTSMC	Cleanliness randomly checked	Weekly inspection of school childrens	DFP
		Working of the sewer line and septic tanks to ensure timely repair	PTSMC	Functioning of sewer line checked	Quartely (septic tank and sewer lines inspected)	DFP/PTSMC
		Supply of safe drinking water will be ensured	PTSMC	water quality is checked	Biannual (Januray and July of the year)	DFP/PTSMC
		Awareness raising will be carried out on health and hygiene aspects including hand wash with soap after going to toilets	Education Deptt and IP	Awareness sessions monitored	Once (during project period)	DFP/PTSMC
15	Non-availability of soap in school toilets may lead to health and hygiene problems in children's	Availability of soap outside the toilets will be ensured	Education Department and IPs	Provision of soap is verified	Weekly (during inspection)	Teachers/ PTSMC
16	Exposed electrical wiring and cables in the school building may pose health and safety risks for school children's	All exposed wiring and cables shall be covered with plastic and labeled as DANDEROUS to avoid contacts.	Education Department	Checking of electrical installation is done regularly	Annual (during maintenance work)	DFP

	Implementation Plan			Monitoring Plan		
	Health and Safety issue	**Proposed Mitigation Measures**	**Responsibility**	**Monitoring Parameter (s)**	**Frequency**	**Responsibility**
17	Overcrowding of students in class rooms may leads to compromise the health of students and transmission of diseases	The number of students in class rooms shall not exceeds 40. Proper ventilation and seating arrangements shall be observed in class rooms during school operation	Teacher PTSMC/	Number of student roll verified	Biannual (April and November)	DFP
18	Non-availability of traffic signals around the schools may lead to traffic accidents and pose serious threat to the safety of children's.	Traffic signals will be provided on the main road and access road leading to school	Education deptt and IP	Installation of traffic signals verified	Annual (during school inspection)	DFP
19	Nonfunctioning of sewage treatment facility in school may lead to contamination of drinking water supplies and results in health hazard problems.	Proper functioning of sewage treatment facility such as septic tank will be ensured during school operation.	Education Deptt/ IP	Functioning of septic tank monitored	Weekly (cleaning of septic tank checked by sweeper)	PTSMC

Table 17-A Capacity-building and Training Programme

Description of Training	Training module	Location	Frequency	Participation
Two-day Training Workshop	▪ Objectives and need of ESIA study and preparation of Addendum for GPE-BEP ▪ Management of environmental issues and mitigation strategies ▪ Legal requirements of the ESMP ▪ Monitoring Mechanism ▪ Documentation and reporting procedures	PMU Quetta	One training workshops in a year,	45 Participants including PD, DPD, Safeguard Officer, DFPs, Infrastructure Specialist, Engineers and Management of Education Department, Balochistan
One Days Training Workshop	▪ ESMP with special focus on mitigation measures during construction stage	PMU, Quetta	One training workshops in a year	All contractors, sub-contractors, and supervision consultants
One Day Training Workshop	▪ ESMP with special focus on mitigation measures during operational phase of schools and health hygiene issues	32 training sessions at district level (one session each in district)	Once in project period	PTSMCs members and local community activists
One Day Refresher Training	• ESMPImplementation and Reporting	PMU Quetta	3 workshops each, in year 2 and year 3	All stakeholders

Table 18-A Estimated Costs of Capacity Building Trainings

Training Component	**Cost (Rs.)**	
	One-day W/shop	**Two-day W/shop**
Training Design / Module Development	35,000	70,000
Training Manual and Reading Material	50,000	260,000
Resource Person Fee	30,000	45,000
Miscellaneous (Refreshments, venue arrangement, audio-visuel)	35,000	200,000
Total (for a single training)	150,000	575,000
Annual cost for 33 one-day and 01 two-days trainings in the first year	5,525,000	
Total Cost for three year project period (40 training workshops)	6,425,000	

Table 19-A Table ESMP Implementation Cost

Type of input	**Description**	**Annual Cost (PKR)**	**Total Cost for project duration (PKR)**
Capacity Building Trainings	Training of project staff	5,525,000	6,425,000
External Monitoring/ Third Party Validation	Independent Monitoring Consultants	4,500,000	13,500,000
Mitigation Costs	Built in BOQ/Bidding Document	Part of project costs	Part of project costs
Total		10,025,000	19,925,000
Total (PKR in Millions)		**19.93**	

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Annexure-A-CONTENTS of ESIA-PGEB

Environmental, Health, and Safety General Guidelines

Introduction

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP)[1]. When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These **General EHS Guidelines** are designed to be used together with the relevant **Industry Sector EHS Guidelines** which provide guidance to users on EHS issues in specific industry sectors. For complex projects, use of multiple industry-sector guidelines may be necessary. A complete list of industry-sector guidelines can be found at: www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them. The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment[2] in which site-specific variables, such as host country context, assimilative capacity of the environment, and other project factors, are taken into account. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment.

The **General EHS Guidelines** are organized as follows:

[1] Defined as the exercise of professional skill, diligence, prudence and foresight that would be reasonably expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally. The circumstances that skilled and experienced professionals may find when evaluating the range of pollution prevention and control techniques available to a project may include, but are not limited to, varying levels of environmental degradation and environmental assimilative capacity as well as varying levels of financial and technical feasibility.

[2] For IFC, such assessment is carried out consistent with Performance Standard 1, and for the World Bank, with Operational Policy 4.01.

General Approach to the Management of EHS Issues at the Facility or Project Level

Effective management of environmental, health, and safety (EHS) issues entails the inclusion of EHS considerations into corporate- and facility-level business processes in an organized, hierarchical approach that includes the following steps:

Identifying EHS project hazards[3] and associated risks[4] as early as possible in the facility development or project cycle, including the incorporation of EHS considerations into the site selection process, product design process, engineering planning process for capital requests, engineering work orders, facility modification authorizations, or layout and process change plans.

Involving EHS professionals, who have the experience, competence, and training necessary to assess and manage EHS impacts and risks, and carry out specialized environmental management functions including the preparation of project or activity-specific plans and procedures that incorporate the technical recommendations presented in this document that are relevant to the project.

Understanding the likelihood and magnitude of EHS risks, based on:

- The nature of the project activities, such as whether the project will generate significant quantities of emissions or effluents, or involve hazardous materials or processes;
- The potential consequences to workers, communities, or the environment if hazards are not adequately managed, which may depend on the proximity of project activities to people or to the environmental resources on which they depend.

Prioritizing risk management strategies with the objective of achieving an overall reduction of risk to human health and the environment, focusing on the prevention of irreversible and / or significant impacts.

Favoring strategies that eliminate the cause of the hazard at its source, for example, by selecting less hazardous materials or processes that avoid the need for EHS controls.

When impact avoidance is not feasible, incorporating engineering and management controls to reduce or minimize the possibility and magnitude of undesired consequences, for example, with the application of pollution controls to reduce the levels of emitted contaminants to workers or environments.

Preparing workers and nearby communities to respond to accidents, including providing technical and financial resources to effectively and safely control such events, and restoring workplace and community environments to a safe and healthy condition.

Improving EHS performance through a combination of ongoing monitoring of facility performance and effective accountability.

[3] Defined as "threats to humans and what they value" (Kates, et al., 1985).

[4] Defined as "quantitative measures of hazard consequences, usually expressed as conditional probabilities of experiencing harm" (Kates, et. al., 1985)

1.0 Environmental

1.1 Air Emissions and Ambient Air Quality

Applicability and Approach

This guideline applies to facilities or projects that generate emissions to air at any stage of the project life-cycle. It complements the industry-specific emissions guidance presented in the Industry Sector Environmental, Health, and Safety (EHS) Guidelines by providing information about common techniques for emissions management that may be applied to a range of industry sectors. This guideline provides an approach to the management of significant sources of emissions, including specific guidance for assessment and monitoring of impacts. It is also intended to provide additional information on approaches to emissions management in projects located in areas of poor air quality, where it may be necessary to establish project-specific emissions standards.

Emissions of air pollutants can occur from a wide variety of activities during the construction, operation, and decommissioning phases of a project. These activities can be categorized based on the spatial characteristic of the source including point sources, fugitive sources, and mobile sources and, further, by process, such as combustion, materials storage, or other industry sector-specific processes.

Where possible, facilities and projects should avoid, minimize, and control adverse impacts to human health, safety, and the environment from emissions to air. Where this is not possible, the generation and release of emissions of any type should be managed through a combination of:

- Energy use efficiency
- Process modification
- Selection of fuels or other materials, the processing of which may result in less polluting emissions
- Application of emissions control techniques

The selected prevention and control techniques may include one or more methods of treatment depending on:

- Regulatory requirements
- Significance of the source
- Location of the emitting facility relative to other sources
- Location of sensitive receptors
- Existing ambient air quality, and potential for degradation of the airshed from a proposed project
- Technical feasibility and cost effectiveness of the available options for prevention, control, and release of emissions

Ambient Air Quality

General Approach

Projects with significant[5,6] sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimize impacts by ensuring that:

Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards[9] by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines[10] (see Table 1.1.1), or other internationally recognized sources[11];

Emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards. As a general rule, this Guideline suggests 25 percent of the applicable air quality standards to allow additional, future sustainable development in the same airshed.[12]

At facility level, impacts should be estimated through qualitative or quantitative assessments by the use of baseline air quality assessments and atmospheric dispersion models to assess potential ground level concentrations. Local atmospheric, climatic, and air quality data should be applied when modeling dispersion, protection against atmospheric downwash, wakes, or eddy effects of the source, nearby[13] structures, and terrain features. The dispersion model applied should be internationally recognized, or comparable. Examples of acceptable emission estimation and dispersion modeling approaches for point and fugitive sources are

Table 1.1.1: WHO Ambient Air Quality Guidelines[7,8]

	Averaging Period	Guideline value in $\mu g/m^3$
Sulfur dioxide (SO_2)	24-hour	125 (Interim target-1) 50 (Interim target-2) 20 (guideline)
	10 minute	500 (guideline)
Nitrogen dioxide (NO_2)	1-year	40 (guideline)
	1-hour	200 (guideline)
Particulate Matter PM_{10}	1-year	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline)
	24-hour	150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
Particulate Matter $PM_{2.5}$	1-year	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline)
	24-hour	75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
Ozone	8-hour daily maximum	160 (Interim target-1) 100 (guideline)

[5] Significant sources of point and fugitive emissions are considered to be general sources which, for example, can contribute a net emissions increase of one or more of the following pollutants within a given airshed: PM10: 50 tons per year (tpy); NOx: 500 tpy; SO2: 500 tpy; or as established through national legislation; and combustion sources with an equivalent heat input of 50 MWth or greater. The significance of emissions of inorganic and organic pollutants should be established on a project-specific basis taking into account toxic and other properties of the pollutant.

[6] United States Environmental Protection Agency, Prevention of Significant Deterioration of Air Quality, 40 CFR Ch. 1 Part 52.21. Other references for establishing significant emissions include the European Commission. 2000. "Guidance Document for EPER implementation." http://ec.europa.eu/environment/ippc/eper/index.htm ; and Australian Government. 2004. "National Pollutant Inventory Guide." http://www.npi.gov.au/handbooks/pubs/npiguide.pdf

[7] World Health Organization (WHO). Air Quality Guidelines Global Update, 2005. PM 24-hour value is the 99th percentile.

[8] Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines.

[9] Ambient air quality standards are ambient air quality levels established and published through national legislative and regulatory processes, and ambient quality guidelines refer to ambient quality levels primarily developed through clinical, toxicological, and epidemiological evidence (such as those published by the World Health Organization).

[10] Available at World Health Organization (WHO). http://www.who.int/en

[11] For example the United States National Ambient Air Quality Standards (NAAQS) (http://www.epa.gov/air/criteria.html) and the relevant European Council Directives (Council Directive 1999/30/EC of 22 April 1999 / Council Directive 2002/3/EC of February 12 2002).

[12] US EPA Prevention of Significant Deterioration Increments Limits applicable to non-degraded airsheds.

included in Annex 1.1.1. These approaches include screening models for single source evaluations (SCREEN3 or AIRSCREEN), as well as more complex and refined models (AERMOD OR ADMS). Model selection is dependent on the complexity and geo-morphology of the project site (e.g. mountainous terrain, urban or rural area).

Projects Located in Degraded Airsheds or Ecologically Sensitive Areas

Facilities or projects located within poor quality airsheds[14], and within or next to areas established as ecologically sensitive (e.g. national parks), should ensure that any increase in pollution levels is as small as feasible, and amounts to a fraction of the applicable short-term and annual average air quality guidelines or standards as established in the project-specific environmental assessment. Suitable mitigation measures may also include the relocation of significant sources of emissions outside the airshed in question, use of cleaner fuels or technologies, application of comprehensive pollution control measures, offset activities at installations controlled by the project sponsor or other facilities within the same airshed, and buy-down of emissions within the same airshed.

Specific provisions for minimizing emissions and their impacts in poor air quality or ecologically sensitive airsheds should be established on a project-by-project or industry-specific basis. Offset provisions outside the immediate control of the project sponsor or buy-downs should be monitored and enforced by the local agency responsible for granting and monitoring emission permits. Such provisions should be in place prior to final commissioning of the facility / project.

Point Sources

Point sources are discrete, stationary, identifiable sources of emissions that release pollutants to the atmosphere. They are typically located in manufacturing or production plants. Within a given point source, there may be several individual 'emission points' that comprise the point source.[15]

Point sources are characterized by the release of air pollutants typically associated with the combustion of fossil fuels, such as nitrogen oxides (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), and particulate matter (PM), as well as other air pollutants including certain volatile organic compounds (VOCs) and metals that may also be associated with a wide range of industrial activities.

Emissions from point sources should be avoided and controlled according to good international industry practice (GIIP) applicable to the relevant industry sector, depending on ambient conditions, through the combined application of process modifications and emissions controls, examples of which are provided in Annex 1.1.2. Additional recommendations regarding stack height and emissions from small combustion facilities are provided below.

Stack Height

The stack height for all point sources of emissions, whether 'significant' or not, should be designed according to GIIP (see Annex 1.1.3) to avoid excessive ground level concentrations due to downwash, wakes, and eddy effects, and to ensure reasonable diffusion to minimize impacts. For projects where there are multiple sources of emissions, stack heights should be established with due consideration to emissions from all other project sources, both point and fugitive. Non-significant sources of emissions,

[13] "Nearby" generally considers an area within a radius of up to 20 times the stack height.

[14] An airshed should be considered as having poor air quality if nationally legislated air quality standards or WHO Air Quality Guidelines are exceeded significantly.

[15] Emission points refer to a specific stack, vent, or other discrete point of pollution release. This term should not be confused with point source, which is a regulatory distinction from area and mobile sources. The characterization of point sources into multiple emissions points is useful for allowing more detailed reporting of emissions information.

including small combustion sources,[16] should also use GIIP in stack design.

Small Combustion Facilities Emissions Guidelines

Small combustion processes are systems designed to deliver electrical or mechanical power, steam, heat, or any combination of these, regardless of the fuel type, with a total, rated heat input capacity of between three Megawatt thermal (MWth) and 50 MWth.

The emissions guidelines in Table 1.1.2 are applicable to small combustion process installations operating more than 500 hours per year, and those with an annual capacity utilization of more than 30 percent. Plants firing a mixture of fuels should compare emissions performance with these guidelines based on the sum of the relative contribution of each applied fuel[17]. Lower emission values may apply if the proposed facility is located in an ecologically sensitive airshed, or airshed with poor air quality, in order to address potential cumulative impacts from the installation of more than one small combustion plant as part of a distributed generation project.

[16] Small combustion sources are those with a total rated heat input capacity of 50MWth or less.

[17] The contribution of a fuel is the percentage of heat input (LHV) provided by this fuel multiplied by its limit value.

Table 1.1.2 - Small Combustion Facilities Emissions Guidelines (3MWth – 50MWth) – (in mg/Nm^3 or as indicated)				
Combustion Technology / Fuel	**Particulate Matter (PM)**	**Sulfur Dioxide (SO_2)**	**Nitrogen Oxides (NOx)**	**Dry Gas, Excess O_2 Content (%)**
Engine				
Gas	N/A	N/A	200 (Spark Ignition) 400 (Dual Fuel) 1,600 (Compression Ignition)	15
Liquid	50 or up to 100 if justified by project specific considerations (e.g. Economic feasibility of using lower ash content fuel, or adding secondary treatment to meet 50, and available environmental capacity of the site)	1.5 percent Sulfur or up to 3.0 percent Sulfur if justified by project specific considerations (e.g. Economic feasibility of using lower S content fuel, or adding secondary treatment to meet levels of using 1.5 percent Sulfur, and available environmental capacity of the site)	If bore size diameter [mm] < 400: 1460 (or up to 1,600 if justified to maintain high energy efficiency.) If bore size diameter [mm] > or = 400: 1,850	15
Turbine				
Natural Gas =3MWth to < 15MWth	N/A	N/A	42 ppm (Electric generation) 100 ppm (Mechanical drive)	15
Natural Gas =15MWth to < 50MWth	N/A	N/A	25 ppm	15
Fuels other than Natural Gas =3MWth to < 15MWth	N/A	0.5 percent Sulfur or lower percent Sulfur (e.g. 0.2 percent Sulfur) if commercially available without significant excess fuel cost	96 ppm (Electric generation) 150 ppm (Mechanical drive)	15
Fuels other than Natural Gas =15MWth to < 50MWth	N/A	0.5% S or lower % S (0.2%S) if commercially available without significant excess fuel cost	74 ppm	15
Boiler				
Gas	N/A	N/A	320	3
Liquid	50 or up to 150 if justified by environmental assessment	2000	460	3
Solid	50 or up to 150 if justified by environmental assessment	2000	650	6

Notes: -N/A/ - no emissions guideline; Higher performance levels than these in the Table should be applicable to facilities located in urban / industrial areas with degraded airsheds or close to ecologically sensitive areas where more stringent emissions controls may be needed.; MWth is heat input on HHV basis; Solid fuels include biomass; Nm^3 is at one atmosphere pressure, 0 C.; MWth category is to apply to the entire facility consisting of multiple units that are reasonably considered to be emitted from a common stack except for NOx and PM limits for turbines and boilers. Guidelines values apply to facilities operating more than 500 hours per year with an annual capacity utilization factor of more than 30 percent.

Fugitive Sources

Fugitive source air emissions refer to emissions that are distributed spatially over a wide area and not confined to a specific discharge point. They originate in operations where exhausts are not captured and passed through a stack. Fugitive emissions have the potential for much greater ground-level impacts per unit than stationary source emissions, since they are discharged and dispersed close to the ground. The two main types of fugitive emissions are Volatile Organic Compounds (VOCs) and particulate matter (PM). Other contaminants (NO_x, SO_2 and CO) are mainly associated with combustion processes, as described above. Projects with potentially significant fugitive sources of emissions should establish the need for ambient quality assessment and monitoring practices.

Open burning of solid wastes, whether hazardous or non-hazardous, is not considered good practice and should be avoided, as the generation of polluting emissions from this type of source cannot be controlled effectively.

Volatile Organic Compounds (VOCs)

The most common sources of fugitive VOC emissions are associated with industrial activities that produce, store, and use VOC-containing liquids or gases where the material is under pressure, exposed to a lower vapor pressure, or displaced from an enclosed space. Typical sources include equipment leaks, open vats and mixing tanks, storage tanks, unit operations in wastewater treatment systems, and accidental releases. Equipment leaks include valves, fittings, and elbows which are subject to leaks under pressure. The recommended prevention and control techniques for VOC emissions associated with equipment leaks include:

Equipment modifications, examples of which are presented in Annex 1.1.4;

Implementing a leak detection and repair (LDAR) program that controls fugitive emissions by regularly monitoring to detect leaks, and implementing repairs within a predefined time period.[18]

For VOC emissions associated with handling of chemicals in open vats and mixing processes, the recommended prevention and control techniques include:

Substitution of less volatile substances, such as aqueous solvents;

Collection of vapors through air extractors and subsequent treatment of gas stream by removing VOCs with control devices such as condensers or activated carbon absorption;

Collection of vapors through air extractors and subsequent treatment with destructive control devices such as:

- Catalytic Incinerators: Used to reduce VOCs from process exhaust gases exiting paint spray booths, ovens, and other process operations
- Thermal Incinerators: Used to control VOC levels in a gas stream by passing the stream through a combustion chamber where the VOCs are burned in air at temperatures between 700º C to 1,300º C
- Enclosed Oxidizing Flares: Used to convert VOCs into CO_2 and H_2O by way of direct combustion

Use of floating roofs on storage tanks to reduce the opportunity for volatilization by eliminating the headspace present in conventional storage tanks.

Particulate Matter (PM)

The most common pollutant involved in fugitive emissions is dust or particulate matter (PM). This is released during certain operations, such as transport and open storage of solid materials, and from exposed soil surfaces, including unpaved roads.

[18] For more information, see Leak Detection and Repair Program (LDAR), at: http://www.ldar.net

Recommended prevention and control of these emissions sources include:

- Use of dust control methods, such as covers, water suppression, or increased moisture content for open materials storage piles, or controls, including air extraction and treatment through a baghouse or cyclone for material handling sources, such as conveyors and bins;
- Use of water suppression for control of loose materials on paved or unpaved road surfaces. Oil and oil by-products is not a recommended method to control road dust. Examples of additional control options for unpaved roads include those summarized in Annex 1.1.5.

Ozone Depleting Substances (ODS)

Several chemicals are classified as ozone depleting substances (ODSs) and are scheduled for phase-out under the Montreal Protocol on Substances that Deplete the Ozone Layer.[19] No new systems or processes should be installed using CFCs, halons, 1,1,1-trichloroethane, carbon tetrachloride, methyl bromide or HBFCs. HCFCs should only be considered as interim / bridging alternatives as determined by the host country commitments and regulations.[20]

Mobile Sources – Land-based

Similar to other combustion processes, emissions from vehicles include CO, NO_x, SO_2, PM and VOCs. Emissions from on-road and off-road vehicles should comply with national or regional programs. In the absence of these, the following approach should be considered:

- Regardless of the size or type of vehicle, fleet owners / operators should implement the manufacturer recommended engine maintenance programs;
- Drivers should be instructed on the benefits of driving practices that reduce both the risk of accidents and fuel consumption, including measured acceleration and driving within safe speed limits;
- Operators with fleets of 120 or more units of heavy duty vehicles (buses and trucks), or 540 or more light duty vehicles[21] (cars and light trucks) within an airshed should consider additional ways to reduce potential impacts including:
  - Replacing older vehicles with newer, more fuel efficient alternatives
  - Converting high-use vehicles to cleaner fuels, where feasible
  - Installing and maintaining emissions control devices, such as catalytic converters
  - Implementing a regular vehicle maintenance and repair program

Greenhouse Gases (GHGs)

Sectors that may have potentially significant emissions of greenhouse gases (GHGs)[22] include energy, transport, heavy industry (e.g. cement production, iron / steel manufacturing, aluminum smelting, petrochemical industries, petroleum refining, fertilizer manufacturing), agriculture, forestry and waste management. GHGs may be generated from direct emissions

[19] Examples include: chlorofluorocarbons (CFCs); halons; 1,1,1-trichloroethane (methyl chloroform); carbon tetrachloride; hydrochlorofluorocarbons (HCFCs); hydrobromofluorocarbons (HBFCs); and methyl bromide. They are currently used in a variety of applications including: domestic, commercial, and process refrigeration (CFCs and HCFCs); domestic, commercial, and motor vehicle air conditioning (CFCs and HCFCs); for manufacturing foam products (CFCs); for solvent cleaning applications (CFCs, HCFCs, methyl chloroform, and carbon tetrachloride); as aerosol propellants (CFCs); in fire protection systems (halons and HBFCs); and as crop fumigants (methyl bromide).

[20] Additional information is available through the Montreal Protocol Secretariat web site available at: http://ozone.unep.org/

[21] The selected fleet size thresholds are assumed to represent potentially significant sources of emissions based on individual vehicles traveling 100,000 km / yr using average emission factors.

[22] The six greenhouse gases that form part of the Kyoto Protocol to the United Nations Framework Convention on Climate Change include carbon dioxide ($C0_2$); methane (CH_4); nitrous oxide (N_2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); and sulfur hexafluoride (SF_6).

from facilities within the physical project boundary and indirect emissions associated with the off-site production of power used by the project.

Recommendations for reduction and control of greenhouse gases include:

- Carbon financing;[23]
- Enhancement of energy efficiency (see section on 'Energy Conservation');
- Protection and enhancement of sinks and reservoirs of greenhouse gases;
- Promotion of sustainable forms of agriculture and forestry;
- Promotion, development and increased use of renewable forms of energy;
- Carbon capture and storage technologies;[24]
- Limitation and / or reduction of methane emissions through recovery and use in waste management, as well as in the production, transport and distribution of energy (coal, oil, and gas).

Monitoring

Emissions and air quality monitoring programs provide information that can be used to assess the effectiveness of emissions management strategies. A systematic planning process is recommended to ensure that the data collected are adequate for their intended purposes (and to avoid collecting unnecessary data). This process, sometimes referred to as a data quality objectives process, defines the purpose of collecting the data, the decisions to be made based on the data and the consequences of making an incorrect decision, the time and geographic boundaries, and the quality of data needed to make a correct decision.[25] The air quality monitoring program should consider the following elements:

Monitoring parameters: The monitoring parameters selected should reflect the pollutants of concern associated with project processes. For combustion processes, indicator parameters typically include the quality of inputs, such as the sulfur content of fuel.

Baseline calculations: Before a project is developed, baseline air quality monitoring at and in the vicinity of the site should be undertaken to assess background levels of key pollutants, in order to differentiate between existing ambient conditions and project-related impacts.

Monitoring type and frequency: Data on emissions and ambient air quality generated through the monitoring program should be representative of the emissions discharged by the project over time. Examples of time-dependent variations in the manufacturing process include batch process manufacturing and seasonal process variations. Emissions from highly variable processes may need to be sampled more frequently or through composite methods. Emissions monitoring frequency and duration may also range from continuous for some combustion process operating parameters or inputs (e.g. the quality of fuel) to less frequent, monthly, quarterly or yearly stack tests.

Monitoring locations: Ambient air quality monitoring may consists of off-site or fence line monitoring either by the project sponsor, the competent government agency, or by collaboration between both. The location of ambient air

[23] Carbon financing as a carbon emissions reduction strategy may include the host government-endorsed Clean Development Mechanism or Joint Implementation of the United Nations Framework Convention on Climate Change.

[24] Carbon dioxide capture and storage (CCS) is a process consisting of the separation of CO_2 from industrial and energy-related sources; transport to a storage location; and long-term isolation from the atmosphere, for example in geological formations, in the ocean, or in mineral carbonates (reaction of CO_2 with metal oxides in silicate minerals to produce stable carbonates). It is the object of intensive research worldwide (Intergovernmental Panel on Climate Change (IPCC), Special Report, Carbon Dioxide Capture and Storage (2006).

[25] See, for example, United States Environmental Protection Agency, Guidance on Systematic Planning Using the Data Quality Objectives Process EPA QA/G-4, EPA/240/B-06/001 February 2006.

quality monitoring stations should be established based on the results of scientific methods and mathematical models to estimate potential impact to the receiving airshed from an emissions source taking into consideration such aspects as the location of potentially affected communities and prevailing wind directions.

Sampling and analysis methods: Monitoring programs should apply national or international methods for sample collection and analysis, such as those published by the International Organization for Standardization,[26] the European Committee for Standardization,[27] or the U.S. Environmental Protection Agency.[28] Sampling should be conducted by, or under, the supervision of trained individuals. Analysis should be conducted by entities permitted or certified for this purpose. Sampling and analysis Quality Assurance / Quality Control (QA/QC) plans should be applied and documented to ensure that data quality is adequate for the intended data use (e.g., method detection limits are below levels of concern). Monitoring reports should include QA/QC documentation.

Monitoring of Small Combustion Plants Emissions

Additional recommended monitoring approaches for **boilers**:

Boilers with capacities between =3 MWth and < 20 MWth:

- Annual Stack Emission Testing: SO_2, NO_x and PM. For gaseous fuel-fired boilers, only NO_x. SO_2 can be calculated based on fuel quality certification if no SO_2 control equipment is used.
- If Annual Stack Emission Testing demonstrates results consistently and significantly better than the required levels, frequency of Annual Stack Emission Testing can be reduced from annual to every two or three years.
- Emission Monitoring: None

Boilers with capacities between =20 MWth and < 50 MWth

- Annual Stack Emission Testing: SO_2, NO_x and PM. For gaseous fuel-fired boilers, only NO_x. SO_2 can be calculated based on fuel quality certification (if no SO_2 control equipment is used)
- Emission Monitoring: SO_2. Plants with SO_2 control equipment: Continuous. NO_x: Continuous monitoring of either NO_x emissions or indicative NO_x emissions using combustion parameters. PM: Continuous monitoring of either PM emissions, opacity, or indicative PM emissions using combustion parameters / visual monitoring.

Additional recommended monitoring approaches for **turbines**:

- Annual Stack Emission Testing: NO_x and SO_2 (NO_x only for gaseous fuel-fired turbines).
- If Annual Stack Emission Testing results show constantly (3 consecutive years) and significantly (e.g. less than 75 percent) better than the required levels, frequency of Annual Stack Emission Testing can be reduced from annual to every two or three years.
- Emission Monitoring: NO_x: Continuous monitoring of either NO_x emissions or indicative NO_x emissions using combustion parameters.SO_2: Continuous monitoring if SO_2 control equipment is used.

Additional recommended monitoring approaches for **engines**:

- Annual Stack Emission Testing: NO_x ,SO_2 and PM (NO_x only for gaseous fuel-fired diesel engines).

[26] An on-line catalogue of ISO standards relating to the environment, health protection, and safety is available at: http://www.iso.org/iso/en/CatalogueListPage.CatalogueList?ICS1=13&ICS2=&ICS3=&scopelist=

[27] An on-line catalogue of European Standards is available at: http://www.cen.eu/catweb/cwen.htm .

[28] The National Environmental Methods Index provides a searchable clearinghouse of U.S. methods and procedures for both regulatory and non-regulatory monitoring purposes for water, sediment, air and tissues, and is available at http://www.nemi.gov/.

- If Annual Stack Emission Testing results show constantly (3 consecutive years) and significantly (e.g. less than 75 percent) better than the required levels, frequency of Annual Stack Emission Testing can be reduced from annual to every two or three years.
- Emission Monitoring: NO_x: Continuous monitoring of either NO_x emissions or indicative NO_x emissions using combustion parameters. SO_2: Continuous monitoring if SO_2 control equipment is used. PM: Continuous monitoring of either PM emissions or indicative PM emissions using operating parameters.

Annex 1.1.1 – Air Emissions Estimation and Dispersion Modeling Methods

The following is a partial list of documents to aid in the estimation of air emissions from various processes and air dispersion models:

Australian Emission Estimation Technique Manuals
http://www.npi.gov.au/handbooks/

Atmospheric Emission Inventory Guidebook, UN / ECE / EMEP and the European Environment Agency
http://www.aeat.co.uk/netcen/airqual/TFEI/unece.htm

Emission factors and emission estimation methods, US EPA Office of Air Quality Planning & Standards
http://www.epa.gov/ttn/chief

Guidelines on Air Quality Models (Revised), US Environmental Protection Agency (EPA), 2005
http://www.epa.gov/scram001/guidance/guide/appw_05.pdf

Frequently Asked Questions, Air Quality Modeling and Assessment Unit (AQMAU), UK Environment Agency
http://www.environment-agency.gov.uk/subjects/airquality/236092/?version=1&lang=_e

OECD Database on Use and Release of Industrial Chemicals
http://www.olis.oecd.org/ehs/urchem.nsf/

Annex 1.1.2 – Illustrative Point Source Air Emissions Prevention and Control Technologies

Principal Sources and Issues	General Prevention / Process Modification Approach	Control Options	Reduction Efficiency (%)	Gas Condition	Comments
Particulate Matter (PM)					
Main sources are the combustion of fossil fuels and numerous manufacturing processes that collect PM through air extraction and ventilation systems. Volcanoes, ocean spray, forest fires and blowing dust (most prevalent in dry and semiarid climates) contribute to background levels.	Fuel switching (e.g. selection of lower sulfur fuels) or reducing the amount of fine particulates added to a process.	Fabric Filters	99 - 99.7%	Dry gas, temp <400F	Applicability depends on flue gas properties including temperature, chemical properties, abrasion and load. Typical air to cloth ratio range of 2.0 to 3.5 cfm/ft^2 Achievable outlet concentrations of 23 mg/Nm^3
		Electrostatic Precipitator (ESP)	97 – 99%	Varies depending of particle type	Precondition gas to remove large particles. Efficiency dependent on resistivity of particle. Achievable outlet concentration of 23 mg/Nm^3
		Cyclone	74 – 95%	None	Most efficient for large particles. Achievable outlet concentrations of 30 - 40 mg/Nm^3
		Wet Scrubber	93 – 95%	None	Wet sludge may be a disposal problem depending on local infrastructure. Achievable outlet concentrations of 30 - 40 mg/Nm3
Sulfur Dioxide (SO_2)					
Mainly produced by the combustion of fuels such as oil and coal and as a by-product from some chemical production or wastewater treatment processes.	Control system selection is heavily dependent on the inlet concentration. For SO2 concentrations in excess of 10%, the stream is passed through an acid plant not only to lower the SO2 emissions but also to generate high grade sulfur for sale. Levels below 10% are not rich enough for this process and should therefore utilize absorption or 'scrubbing,' where SO2 molecules are captured into a liquid phase or adsorption, where SO2 molecules are captured on the surface of a solid adsorbent.	Fuel Switching	>90%		Alternate fuels may include low sulfur coal, light diesel or natural gas with consequent reduction in particulate emissions related to sulfur in the fuel. Fuel cleaning or beneficiation of fuels prior to combustion is another viable option but may have economic consequences.
		Sorbent Injection	30% - 70%		Calcium or lime is injected into the flue gas and the SO_2 is adsorbed onto the sorbent
		Dry Flue Gas Desulfurization	70%-90%		Can be regenerable or throwaway.
		Wet Flue Gas Desulfurization	>90%		Produces gypsum as a by-product

Annex 1.1.2: Illustrative Point Source Air Emissions Prevention and Control Technologies (continued)

Oxides of Nitrogen (NOx)		Percent Reduction by Fuel Type			Comments
Associated with combustion of fuel. May occur in several forms of nitrogen oxide; namely nitric oxide (NO), nitrogen dioxide (NO_2) and nitrous oxide (N_2O), which is also a greenhouse gas. The term NOx serves as a composite between NO and NO_2 and emissions are usually reported as NOx. Here the NO is multiplied by the ratio of molecular weights of NO_2 to NO and added to the NO_2 emissions. Means of reducing NOx emissions are based on the modification of operating conditions such as minimizing the resident time at peak temperatures, reducing the peak temperatures by increasing heat transfer rates or minimizing the availability of oxygen.	**Combustion modification** (Illustrative of boilers)	**Coal**	**Oil**	**Gas**	These modifications are capable of reducing NOx emissions by 50 to 95%. The method of combustion control used depends on the type of boiler and the method of firing fuel.
	Low-excess-air firing	10–30	10–30	10–30	
	Staged Combustion	20–50	20–50	20–50	
	Flue Gas Recirculation	N/A	20–50	20–50	
	Water/Steam Injection	N/A	10–50	N/A.	
	Low-NOx Burners	30–40	30–40	30–40	
	Flue Gas Treatment	**Coal**	**Oil**	**Gas**	Flue gas treatment is more effective in reducing NOx emissions than are combustion controls. Techniques can be classified as SCR, SNCR, and adsorption. SCR involves the injection of ammonia as a reducing agent to convert NOx to nitrogen in the presence of a catalyst in a converter upstream of the air heater. Generally, some ammonia slips through and is part of the emissions. SNCR also involves the injection of ammonia or urea based products without the presence of a catalyst.
	Selective Catalytic Reduction (SCR)	60–90	60–90	60–90	
	Selective Non-Catalytic Reduction (SNCR)	N/A	30–70	30–70	

Note: Compiled by IFC based on inputs from technical experts.

Annex 1.1.3 - Good International Industry Practice (GIIP) Stack Height

(Based on United States 40 CFR, part 51.100 (ii)).

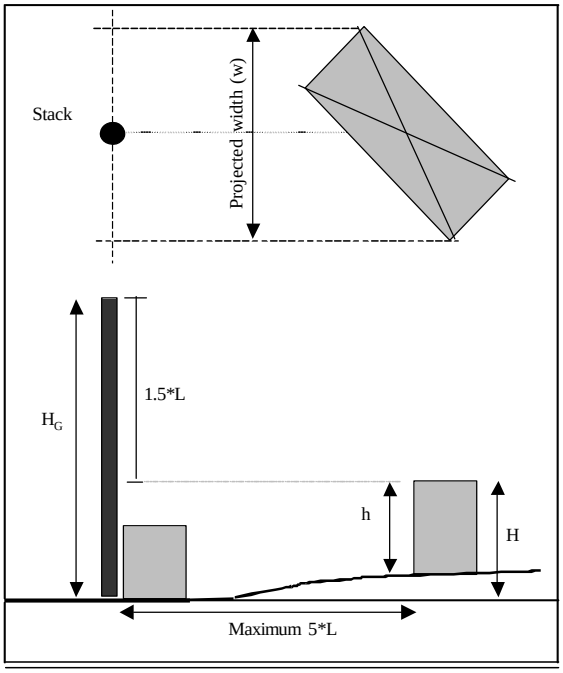
$H_G = H + 1.5L$; where

H_G = GEP stack height measured from the ground level elevation at the base of the stack

H = Height of nearby structure(s) above the base of the stack.

L = Lesser dimension, height (h) or width (w), of nearby structures

"Nearby structures" = Structures within/touching a radius of 5L but less than 800 m.



Annex 1.1.4 - Examples of VOC Emissions Controls

Equipment Type	Modification	Approximate Control Efficiency (%)
Pumps	Seal-less design	100[29]
	Closed-vent system	90[30]
	Dual mechanical seal with barrier fluid maintained at a higher pressure than the pumped fluid	100
Compressors	Closed-vent system	90
	Dual mechanical seal with barrier fluid maintained at a higher pressure than the compressed gas	100
Pressure Relief Devices	Closed-vent system	Variable[31]
	Rupture disk assembly	100
Valves	Seal-less design	100
Connectors	Weld together	100
Open-ended Lines	Blind, cap, plug, or second valve	100
Sampling Connections	Closed-loop sampling	100

Note: Examples of technologies are provided for illustrative purposes. The availability and applicability of any particular technology will vary depending on manufacturer specifications.

29 Seal-less equipment can be a large source of emissions in the event of equipment failure.
30 Actual efficiency of a closed-vent system depends on percentage of vapors collected and efficiency of control device to which the vapors are routed.
31 Control efficiency of closed vent-systems installed on a pressure relief device may be lower than other closed-vent systems.

Annex 1.1.5 - Fugitive PM Emissions Controls

Control Type	Control Efficiency
Chemical Stabilization	0% - 98%
Hygroscopic salts Bitumens/adhesives	60% - 96%
Surfactants	0% - 68%
Wet Suppression – Watering	12% - 98%
Speed Reduction	0% - 80%
Traffic Reduction	Not quantified
Paving (Asphalt / Concrete)	85% - 99%
Covering with Gravel, Slag, or "Road Carpet"	30% - 50%
Vacuum Sweeping	0% - 58%
Water Flushing/Broom Sweeping	0% - 96%

1.2 Energy Conservation

Applicability and Approach

This guideline applies to facilities or projects that consume energy in process heating and cooling; process and auxiliary systems, such as motors, pumps, and fans; compressed air systems and heating, ventilation and air conditioning systems (HVAC); and lighting systems. It complements the industry-specific emissions guidance presented in the Industry Sector Environmental, Health, and Safety (EHS) Guidelines by providing information about common techniques for energy conservation that may be applied to a range of industry sectors.

Energy management at the facility level should be viewed in the context of overall consumption patterns, including those associated with production processes and supporting utilities, as well as overall impacts associated with emissions from power sources. The following section provides guidance on energy management with a focus on common utility systems often representing technical and financially feasible opportunities for improvement in energy conservation. However, operations should also evaluate energy conservation opportunities arising from manufacturing process modifications.

Energy Management Programs

Energy management programs should include the following elements:

Identification, and regular measurement and reporting of principal energy flows within a facility at unit process level

Preparation of mass and energy balance;

Definition and regular review of energy performance targets, which are adjusted to account for changes in major influencing factors on energy use

Regular comparison and monitoring of energy flows with performance targets to identify where action should be taken to reduce energy use

Regular review of targets, which may include comparison with benchmark data, to confirm that targets are set at appropriate levels

Energy Efficiency

For any energy-using system, a systematic analysis of energy efficiency improvements and cost reduction opportunities should include a hierarchical examination of opportunities to:

Demand/Load Side Management by reducing loads on the energy system

Supply Side Management by:

- Reduce losses in energy distribution
- Improve energy conversion efficiency
- Exploit energy purchasing opportunities
- Use lower-carbon fuels

Common opportunities in each of these areas are summarized below.[32]

Process Heating

Process heating is vital to many manufacturing processes, including heating for fluids, calcining, drying, heat treating, metal heating, melting, melting agglomeration, curing, and forming[33].

In process heating systems, a system heat and mass balance will show how much of the system's energy input provides true process heating, and quantify fuel used to satisfy energy losses caused by excessive parasitic loads, distribution, or conversion losses. Examination of savings opportunities should be directed by the results of the heat and mass balance, though the following techniques are often valuable and cost-effective.

Heating Load Reduction

Ensure adequate insulation to reduce heat losses through furnace/oven etc. structure

Recover heat from hot process or exhaust streams to reduce system loads

In intermittently-heated systems, consider use of low thermal mass insulation to reduce energy required to heat the system structure to operating temperature

Control process temperature and other parameters accurately to avoid, for example, overheating or overdrying

Examine opportunities to use low weight and/or low thermal mass product carriers, such as heated shapers, kiln cars etc.

Review opportunities to schedule work flow to limit the need for process reheating between stages

Operate furnaces/ovens at slight positive pressure, and maintain air seals to reduce air in-leakage into the heated system, thereby reducing the energy required to heat unnecessary air to system operating temperature

Reduce radiant heat losses by sealing structural openings and keep viewing ports closed when not in use

Where possible, use the system for long runs close to or at operating capacity

Consider use of high emissivity coatings of high temperature insulation, and consequent reduction in process temperature

Near net weight and shape heat designs

Robust Quality assurance on input material

Robust Scheduled maintenance programs

Heat Distribution Systems

Heat distribution in process heating applications typically takes place through steam, hot water, or thermal fluid systems. Losses can be reduced through the following actions:

Promptly repair distribution system leaks

Avoid steam leaks despite a perceived need to get steam through the turbine. Electricity purchase is usually cheaper overall, especially when the cost to treat turbine-quality boiler feed water is included. If the heat-power ratio of the distribution process is less than that of power systems, opportunities should be considered to increase the ratio; for example, by using low-pressure steam to drive absorption cooling systems rather than using electrically-driven vapor-compression systems.

Regularly verify correct operation of steam traps in steam systems, and ensure that traps are not bypassed. Since

[32] Additional guidance on energy efficiency is available from sources such as Natural Resources Canada (NRCAN http://oee.nrcan.gc.ca/commercial/financial-assistance/new-buildings/mnecb.cfm?attr=20); the European Union (EUROPA. http://europa.eu.int/scadplus/leg/en/s15004.htm), and United States Department of Energy (US DOE, http://www.eere.energy.gov/consumer/industry/process.html).

[33] US DOE. http://www.eere.energy.gov/consumer/industry/process.html

steam traps typically last approximately 5 years, 20% should be replaced or repaired annually

Insulate distribution system vessels, such as hot wells and de-aerators, in steam systems and thermal fluid or hot water storage tanks

Insulate all steam, condensate, hot water and thermal fluid distribution pipework, down to and including 1" (25 mm) diameter pipe, in addition to insulating all hot valves and flanges

In steam systems, return condensate to the boiler house for re-use, since condensate is expensive boiler-quality water and valuable beyond its heat content alone

Use flash steam recovery systems to reduce losses due to evaporation of high-pressure condensate

Consider steam expansion through a back-pressure turbine rather than reducing valve stations

Eliminate distribution system losses by adopting point-of-use heating systems

Energy Conversion System Efficiency Improvements

The following efficiency opportunities should be examined for process furnaces or ovens, and utility systems, such as boilers and fluid heaters:

Regularly monitor CO, oxygen or CO2 content of flue gases to verify that combustion systems are using the minimum practical excess air volumes

Consider combustion automation using oxygen-trim controls

Minimize the number of boilers or heaters used to meet loads. It is typically more efficient to run one boiler at 90% of capacity than two at 45%. Minimize the number of boilers kept at hot–standby

Use flue dampers to eliminate ventilation losses from hot boilers held at standby

Maintain clean heat transfer surfaces; in steam boilers, flue gases should be no more than 20 K above steam temperature)

In steam boiler systems, use economizers to recover heat from flue gases to pre-heat boiler feed water or combustion air

Consider reverse osmosis or electrodialysis feed water treatment to minimize the requirement for boiler blowdown

Adopt automatic (continuous) boiler blowdown

Recover heat from blowdown systems through flash steam recovery or feed-water preheat

Do not supply excessive quantities of steam to the de-aerator

With fired heaters, consider opportunities to recover heat to combustion air through the use of recuperative or regenerative burner systems

For systems operating for extended periods (> 6000 hours/year), cogeneration of electrical power, heat and /or cooling can be cost effective

Oxy Fuel burners

Oxygen enrichment/injection

Use of turbolators in boilers

Sizing design and use of multiple boilers for different load configurations

Fuel quality control/fuel blending

Process Cooling

The general methodology outlined above should be applied to process cooling systems. Commonly used and cost-effective measures to improve process cooling efficiency are described below.

Load Reduction

Ensure adequate insulation to reduce heat gains through cooling system structure and to below-ambient temperature refrigerant pipes and vessels

Control process temperature accurately to avoid overcooling

Operate cooling tunnels at slight positive pressure and maintain air seals to reduce air in-leakage into the cooled system, thus reducing the energy required to cool this unnecessary air to system operating temperature

Examine opportunities to pre-cool using heat recovery to a process stream requiring heating, or by using a higher temperature cooling utility

In cold and chill stores, minimize heat gains to the cooled space by use of air curtains, entrance vestibules, or rapidly opening/closing doors. Where conveyors carry products into chilled areas, minimize the area of transfer openings, for example, by using strip curtains

Quantify and minimize "incidental" cooling loads, for example, those due to evaporator fans, other machinery, defrost systems and lighting in cooled spaces, circulation fans in cooling tunnels, or secondary refrigerant pumps (e.g. chilled water, brines, glycols)

Do not use refrigeration for auxiliary cooling duties, such as compressor cylinder head or oil cooling

While not a thermal load, ensure there is no gas bypass of the expansion valve since this imposes compressor load while providing little effective cooling

In the case of air conditioning applications, energy efficiency techniques include:

- Placing air intakes and air-conditioning units in cool, shaded locations
- Improving building insulation including seals, vents, windows, and doors
- Planting trees as thermal shields around buildings
- Installing timers and/or thermostats and/or enthalpy-based control systems
- Installing ventilation heat recovery systems[34]

Energy Conversion

The efficiency of refrigeration service provision is normally discussed in terms of Coefficient of Performance ("COP"), which is the ratio of cooling duty divided by input power. COP is maximized by effective refrigeration system design and increased refrigerant compression efficiency, as well as minimization of the temperature difference through which the system works and of auxiliary loads (i.e. those in addition to compressor power demand) used to operate the refrigeration system.

System Design

If process temperatures are above ambient for all, or part, of the year, use of ambient cooling systems, such as provided by cooling towers or dry air coolers, may be appropriate, perhaps supplemented by refrigeration in summer conditions.

Most refrigeration systems are electric-motor driven vapor compression systems using positive displacement or centrifugal compressors. The remainder of this guideline relates primarily to vapor-compression systems. However, when a cheap or free heat source is available (e.g. waste heat from an engine-driven generator—low-pressure steam

[34] More information on HVAC energy efficiency can be found at the British Columbia Building Corporation (Woolliams, 2002. http://www.greenbuildingsbc.com/new_buildings/pdf_files/greenbuild_strategies_guide.pdf), NRCAN's EnerGuide (http://oee.nrcan.gc.ca/equipment/english/index.cfm?PrintView=N&Text=N) and NRCAN's Energy Star Programs (http://oee.nrcan.gc.ca/energystar/english/consumers/heating.cfm?text=N&printview=N#AC), and the US Energy Star Program (http://www.energystar.gov/index.cfm?c=guidelines.download_guidelines).

that has passed through a back-pressure turbine), absorption refrigeration may be appropriate.

Exploit high cooling temperature range: precooling by ambient and/or 'high temperature' refrigeration before final cooling can reduce refrigeration capital and running costs. High cooling temperature range also provides an opportunity for countercurrent (cascade) cooling, which reduces refrigerant flow needs.

Keep 'hot' and 'cold' fluids separate, for example, do not mix water leaving the chiller with water returning from cooling circuits.

In low-temperature systems where high temperature differences are inevitable, consider two-stage or compound compression, or economized screw compressors, rather than single-stage compression.

Minimizing Temperature Differences

A vapor-compression refrigeration system raises the temperature of the refrigerant from somewhat below the lowest process temperature (the evaporating temperature) to provide process cooling, to a higher temperature (the condensing temperature), somewhat above ambient, to facilitate heat rejection to the air or cooling water systems. Increasing evaporating temperature typically increases compressor cooling capacity without greatly affecting power consumption. Reducing condensing temperature increases evaporator cooling capacity and substantially reduces compressor power consumption.

Elevating Evaporating Temperature

Select a large evaporator to permit relatively low temperature differences between process and evaporating temperatures. Ensure that energy use of auxiliaries (e.g. evaporator fans) does not outweigh compression savings.

In air-cooling applications, a design temperature difference of 6-10 K between leaving air temperature and evaporating temperature is indicative of an appropriately sized evaporator. When cooling liquids, 2K between leaving liquid and evaporating temperatures can be achieved, though a 4K difference is generally indicative of a generously-sized evaporator.

Keep the evaporator clean. When cooling air, ensure correct defrost operation. In liquid cooling, monitor refrigerant/process temperature differences and compare with design expectations to be alert to heat exchanger contamination by scale or oil.

Ensure oil is regularly removed from the evaporator, and that oil additions and removals balance.

Avoid the use of back-pressure valves.

Adjust expansion valves to minimize suction superheat consistent with avoidance of liquid carry-over to compressors.

Ensure that an appropriate refrigerant charge volume is present.

Reducing Condensing Temperature

Consider whether to use air-cooled or evaporation-based cooling (e.g. evaporative or water cooled condensers and cooling towers). Air-cooled evaporators usually have higher condensing temperatures, hence higher compressor energy use, and auxiliary power consumption, especially in low humidity climates. If a wet system is used, ensure adequate treatment to prevent growth of *legionella* bacteria.

Whichever basic system is chosen, select a relatively large condenser to minimize differences between condensing and the heat sink temperatures. Condensing temperatures with air cooled or evaporative condensers should not be more than 10K above design ambient condition, and a 4K approach in a liquid-cooled condenser is possible.

Avoid accumulation of non-condensable gases in the condenser system. Consider the installation of refrigerated non-condensable purgers, particularly for systems operating below atmospheric pressure.

Keep condensers clean and free from scale. Monitor refrigerant/ambient temperature differences and compare with design expectations to be alert to heat exchanger contamination.

Avoid liquid backup, which restricts heat transfer area in condensers. This can be caused by installation errors such as concentric reducers in horizontal liquid refrigerant pipes, or "up and over" liquid lines leading from condensers.

In multiple condenser applications, refrigerant liquid lines should be connected via drop-leg traps to the main liquid refrigerant line to ensure that hot gases flow to all condensers.

Avoid head pressure control to the extent possible. Head pressure control maintains condensing temperature at, or near, design levels. It therefore prevents reduction in compressor power consumption, which accompanies reduced condensing temperature, by restricting condenser capacity (usually by switching off the condenser, or cooling tower fans, or restricting cooling water flow) under conditions of less severe than design load or ambient temperature conditions. Head pressure is often kept higher than necessary to facilitate hot gas defrost or adequate liquid refrigerant circulation. Use of electronic rather than thermostatic expansion valves, and liquid refrigerant pumps can permit effective refrigerant circulation at much reduced condensing temperatures.

Site condensers and cooling towers with adequate spacing so as to prevent recirculation of hot air into the tower.

Refrigerant Compression Efficiency

Some refrigerant compressors and chillers are more efficient than others offered for the same duty. Before purchase, identify the operating conditions under which the compressor or chiller is likely to operate for substantial parts of its annual cycle. Check operating efficiency under these conditions, and ask for estimates of annual running cost. Note that refrigeration and HVAC systems rarely run for extended periods at design conditions, which are deliberately extreme. Operational efficiency under the most commonly occurring off-design conditions is likely to be most important.

Compressors lose efficiency when unloaded. Avoid operation of multiple compressors at part-load conditions. Note that package chillers can gain coefficient of performance (COP) when slightly unloaded, as loss of compressor efficiency can be outweighed by the benefits of reduced condensing and elevated evaporating temperature. However, it is unlikely to be energy efficient to operate a single compressor-chiller at less than 50% of capacity.

Consider turndown efficiency when specifying chillers. Variable speed control or multiple compressor chillers can be highly efficient at part loads.

Use of thermal storage systems (e.g., ice storage) can avoid the need for close load-tracking and, hence, can avoid part-loaded compressor operation.

Refrigeration System Auxiliaries

Many refrigeration system auxiliaries (e.g. evaporator fans and chilled water pumps) contribute to refrigeration system load, so reductions in their energy use have a double benefit. General energy saving techniques for pumps and fans, listed in the next section of these guidelines, should be applied to refrigeration auxiliaries.

Additionally, auxiliary use can be reduced by avoidance of part-load operation and in plant selection (e.g. axial fan evaporative condensers generally use less energy than equivalent centrifugal fan towers).

Under extreme off-design conditions, reduction in duty of cooling system fans and pumps can be worthwhile, usually when the lowest possible condensing pressure has been achieved.

Compressed Air Systems

Compressed air is the most commonly found utility service in industry, yet in many compressed air systems, the energy contained in compressed air delivered to the user is often 10% or less of energy used in air compression. Savings are often possible through the following techniques:

Load reduction

Examine each true user of compressed air to identify the air volume needed and the pressure at which this should be delivered.

Do not mix high volume low pressure and low volume high pressure loads. Decentralize low volume high-pressure applications or provide dedicated low-pressure utilities, for example, by using fans rather than compressed air.

Review air use reduction opportunities, for example:

- Use air amplifier nozzles rather than simple open-pipe compressed air jets
- Consider whether compressed air is needed at all
- Where air jets are required intermittently (e.g. to propel product), consider operating the jet via a process-related solenoid valve, which opens only when air is required
- Use manual or automatically operated valves to isolate air supply to individual machines or zones that are not in continuous use
- Implement systems for systematic identification and repair of leaks
- All condensate drain points should be trapped. Do not leave drain valves continuously 'cracked open'
- Train workers never to direct compressed air against their bodies or clothing to dust or cool themselves down.

Distribution

Monitor pressure losses in filters and replace as appropriate

Use adequately sized distribution pipework designed to minimize pressure losses

1.3 Wastewater and Ambient Water Quality

Applicability and Approach

This guideline applies to projects that have either direct or indirect discharge of process wastewater, wastewater from utility operations or stormwater to the environment. These guidelines are also applicable to industrial discharges to sanitary sewers that discharge to the environment without any treatment. Process wastewater may include contaminated wastewater from utility operations, stormwater, and sanitary sewage. It provides information on common techniques for wastewater management, water conservation, and reuse that can be applied to a wide range of industry sectors. This guideline is meant to be complemented by the industry-specific effluent guidelines presented in the Industry Sector Environmental, Health, and Safety (EHS) Guidelines. Projects with the potential to generate process wastewater, sanitary (domestic) sewage, or stormwater should incorporate the necessary precautions to avoid, minimize, and control adverse impacts to human health, safety, or the environment.

In the context of their overall ESHS management system, facilities should:

Understand the quality, quantity, frequency and sources of liquid effluents in its installations. This includes knowledge about the locations, routes and integrity of internal drainage systems and discharge points

Plan and implement the segregation of liquid effluents principally along industrial, utility, sanitary, and stormwater categories, in order to limit the volume of water requiring specialized treatment. Characteristics of individual streams may also be used for source segregation.

Identify opportunities to prevent or reduce wastewater pollution through such measures as recycle/reuse within their facility, input substitution, or process modification (e.g. change of technology or operating conditions/modes).

Assess compliance of their wastewater discharges with the applicable: (i) discharge standard (if the wastewater is discharged to a surface water or sewer), and (ii) water quality standard for a specific reuse (e.g. if the wastewater is reused for irrigation).

Additionally, the generation and discharge of wastewater of any type should be managed through a combination of:

Water use efficiency to reduce the amount of wastewater generation

Process modification, including waste minimization, and reducing the use of hazardous materials to reduce the load of pollutants requiring treatment

If needed, application of wastewater treatment techniques to further reduce the load of contaminants prior to discharge, taking into consideration potential impacts of cross-media transfer of contaminants during treatment (e.g., from water to air or land)

When wastewater treatment is required prior to discharge, the level of treatment should be based on:

- Whether wastewater is being discharged to a sanitary sewer system, or to surface waters
- National and local standards as reflected in permit requirements and sewer system capacity to convey and treat wastewater if discharge is to sanitary sewer
- Assimilative capacity of the receiving water for the load of contaminant being discharged wastewater if discharge is to surface water
- Intended use of the receiving water body (e.g. as a source of drinking water, recreation, irrigation, navigation, or other)
- Presence of sensitive receptors (e.g., endangered species) or habitats
- Good International Industry Practice (GIIP) for the relevant industry sector

General Liquid Effluent Quality

Discharge to Surface Water

Discharges of process wastewater, sanitary wastewater, wastewater from utility operations or stormwater to surface water should not result in contaminant concentrations in excess of local ambient water quality criteria or, in the absence of local criteria, other sources of ambient water quality.[35] Receiving water use[36] and assimilative capacity[37], taking other sources of discharges to the receiving water into consideration, should also influence the acceptable pollution loadings and effluent discharge quality. Additional considerations that should be included in the setting of project-specific performance levels for wastewater effluents include:

- Process wastewater treatment standards consistent with applicable Industry Sector EHS Guidelines. Projects for which there are no industry-specific guidelines should reference the effluent quality guidelines of an industry sector with suitably analogous processes and effluents;
- Compliance with national or local standards for sanitary wastewater discharges or, in their absence, the indicative guideline values applicable to sanitary wastewater discharges shown in Table 1.3.1 below;
- Temperature of wastewater prior to discharge does not result in an increase greater than 3°C of ambient temperature at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use and assimilative capacity among other considerations.

Discharge to Sanitary Sewer Systems

Discharges of industrial wastewater, sanitary wastewater, wastewater from utility operations or stormwater into public or private wastewater treatment systems should:

- Meet the pretreatment and monitoring requirements of the sewer treatment system into which it discharges.
- Not interfere, directly or indirectly, with the operation and maintenance of the collection and treatment systems, or pose a risk to worker health and safety, or adversely impact

[35] An example is the US EPA National Recommended Water Quality Criteria http://www.epa.gov/waterscience/criteria/wqcriteria.html

[36] Examples of receiving water uses as may be designated by local authorities include: drinking water (with some level of treatment), recreation, aquaculture, irrigation, general aquatic life, ornamental, and navigation. Examples of health-based guideline values for receiving waters include World Health Organization (WHO) guidelines for recreational use (http://www.who.int/water_sanitation_health/dwq/guidelines/en/index.html)

[37] The assimilative capacity of the receiving water body depends on numerous factors including, but not limited to, the total volume of water, flow rate, flushing rate of the water body and the loading of pollutants from other effluent sources in the area or region. A seasonally representative baseline assessment of ambient water quality may be required for use with established scientific methods and mathematical models to estimate potential impact to the receiving water from an effluent source.

characteristics of residuals from wastewater treatment operations.

Be discharged into municipal or centralized wastewater treatment systems that have adequate capacity to meet local regulatory requirements for treatment of wastewater generated from the project. Pretreatment of wastewater to meet regulatory requirements before discharge from the project site is required if the municipal or centralized wastewater treatment system receiving wastewater from the project does not have adequate capacity to maintain regulatory compliance.

Land Application of Treated Effluent

The quality of treated process wastewater, wastewater from utility operations or stormwater discharged on land, including wetlands, should be established based on local regulatory requirements. . Where land is used as part of the treatment system and the ultimate receptor is surface water, water quality guidelines for surface water discharges specific to the industry sector process should apply.[38] Potential impact on soil, groundwater, and surface water, in the context of protection, conservation and long term sustainability of water and land resources should be assessed when land is used as part of any wastewater treatment system.

Septic Systems

Septic systems are commonly used for treatment and disposal of domestic sanitary sewage in areas with no sewerage collection networks, Septic systems should only be used for treatment of sanitary sewage, and unsuitable for industrial wastewater treatment. When septic systems are the selected form of wastewater disposal and treatment, they should be:

Properly designed and installed in accordance with local regulations and guidance to prevent any hazard to public health or contamination of land, surface or groundwater.

Well maintained to allow effective operation.

Installed in areas with sufficient soil percolation for the design wastewater loading rate.

Installed in areas of stable soils that are nearly level, well drained, and permeable, with enough separation between the drain field and the groundwater table or other receiving waters.

Wastewater Management

Wastewater management includes water conservation, wastewater treatment, stormwater management, and wastewater and water quality monitoring.

Industrial Wastewater

Industrial wastewater generated from industrial operations includes process wastewater, wastewater from utility operations,, runoff from process and materials staging areas, and miscellaneous activities including wastewater from laboratories, equipment maintenance shops, etc.. The pollutants in an industrial wastewater may include acids or bases (exhibited as low or high pH), soluble organic chemicals causing depletion of dissolved oxygen, suspended solids, nutrients (phosphorus, nitrogen), heavy metals (e.g. cadmium, chromium, copper, lead, mercury, nickel, zinc), cyanide, toxic organic chemicals, oily materials, and volatile materials. , as well as from thermal characteristics of the discharge (e.g., elevated temperature). Transfer of pollutants to another phase, such as air, soil, or the sub-surface, should be minimized through process and engineering controls.

Process Wastewater – – Examples of treatment approaches typically used in the treatment of industrial wastewater are summarized in Annex 1.3.1. While the choice of treatment

[38] Additional guidance on water quality considerations for land application is available in the WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater. Volume 2: Wastewater Use in Agriculture http://www.who.int/water_sanitation_health/wastewater/gsuweg2/en/index.html

technology is driven by wastewater characteristics, the actual performance of this technology depends largely on the adequacy of its design, equipment selection, as well as operation and maintenance of its installed facilities. Adequate resources are required for proper operation and maintenance of a treatment facility, and performance is strongly dependent on the technical ability and training of its operational staff. One or more treatment technologies may be used to achieve the desired discharge quality and to maintain consistent compliance with regulatory requirements. The design and operation of the selected wastewater treatment technologies should avoid uncontrolled air emissions of volatile chemicals from wastewaters. Residuals from industrial wastewater treatment operations should be disposed in compliance with local regulatory requirements, in the absence of which disposal has to be consistent with protection of public health and safety, and conservation and long term sustainability of water and land resources.

Wastewater from Utilities Operations - Utility operations such as cooling towers and demineralization systems may result in high rates of water consumption, as well as the potential release of high temperature water containing high dissolved solids, residues of biocides, residues of other cooling system anti-fouling agents, etc. Recommended water management strategies for utility operations include:

- Adoption of water conservation opportunities for facility cooling systems as provided in the Water Conservation section below;
- Use of heat recovery methods (also energy efficiency improvements) or other cooling methods to reduce the temperature of heated water prior to discharge to ensure the discharge water temperature does not result in an increase greater than 3°C of ambient temperature at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity among other considerations;
- Minimizing use of antifouling and corrosion inhibiting chemicals by ensuring appropriate depth of water intake and use of screens. Least hazardous alternatives should be used with regards to toxicity, biodegradability, bioavailability, and bioaccumulation potential. Dose applied should accord with local regulatory requirements and manufacturer recommendations;
- Testing for residual biocides and other pollutants of concern should be conducted to determine the need for dose adjustments or treatment of cooling water prior to discharge.

Stormwater Management - Stormwater includes any surface runoff and flows resulting from precipitation, drainage or other sources. Typically stormwater runoff contains suspended sediments, metals, petroleum hydrocarbons, Polycyclic Aromatic Hydrocarbons (PAHs), coliform, etc. Rapid runoff, even of uncontaminated stormwater, also degrades the quality of the receiving water by eroding stream beds and banks. In order to reduce the need for stormwater treatment, the following principles should be applied:

- Stormwater should be separated from process and sanitary wastewater streams in order to reduce the volume of wastewater to be treated prior to discharge
- Surface runoff from process areas or potential sources of contamination should be prevented
- Where this approach is not practical, runoff from process and storage areas should be segregated from potentially less contaminated runoff
- Runoff from areas without potential sources of contamination should be minimized (e.g. by minimizing the area of impermeable surfaces) and the peak discharge rate should

be reduced (e.g. by using vegetated swales and retention ponds);

Where stormwater treatment is deemed necessary to protect the quality of receiving water bodies, priority should be given to managing and treating the first flush of stormwater runoff where the majority of potential contaminants tend to be present;

When water quality criteria allow, stormwater should be managed as a resource, either for groundwater recharge or for meeting water needs at the facility;

Oil water separators and grease traps should be installed and maintained as appropriate at refueling facilities, workshops, parking areas, fuel storage and containment areas.

Sludge from stormwater catchments or collection and treatment systems may contain elevated levels of pollutants and should be disposed in compliance with local regulatory requirements, in the absence of which disposal has to be consistent with protection of public health and safety, and conservation and long term sustainability of water and land resources.

Sanitary Wastewater

Sanitary wastewater from industrial facilities may include effluents from domestic sewage, food service, and laundry facilities serving site employees. Miscellaneous wastewater from laboratories, medical infirmaries, water softening etc. may also be discharged to the sanitary wastewater treatment system. Recommended sanitary wastewater management strategies include:

Segregation of wastewater streams to ensure compatibility with selected treatment option (e.g. septic system which can only accept domestic sewage);

Segregation and pretreatment of oil and grease containing effluents (e.g. use of a grease trap) prior to discharge into sewer systems;

If sewage from the industrial facility is to be discharged to surface water, treatment to meet national or local standards for sanitary wastewater discharges or, in their absence, the indicative guideline values applicable to sanitary wastewater discharges shown in Table 1.3.1;

If sewage from the industrial facility is to be discharged to either a septic system, or where land is used as part of the treatment system, treatment to meet applicable national or local standards for sanitary wastewater discharges is required.

Sludge from sanitary wastewater treatment systems should be disposed in compliance with local regulatory requirements, in the absence of which disposal has to be consistent with protection of public health and safety, and conservation and long term sustainability of water and land resources.

Table 1.3.1 Indicative Values for Treated Sanitary Sewage Discharges[a]

Pollutants	Units	Guideline Value
pH	pH	6 – 9
BOD	mg/l	30
COD	mg/l	125
Total nitrogen	mg/l	10
Total phosphorus	mg/l	2
Oil and grease	mg/l	10
Total suspended solids	mg/l	50
Total coliform bacteria	MPN[b] / 100 ml	400[a]

Notes:
[a] Not applicable to centralized, municipal, wastewater treatment systems which are included in EHS Guidelines for Water and Sanitation.
[b] MPN = Most Probable Number

Emissions from Wastewater Treatment Operations

Air emissions from wastewater treatment operations may include hydrogen sulfide, methane, ozone (in the case of ozone disinfection), volatile organic compounds (e.g., chloroform generated from chlorination activities and other volatile organic compounds (VOCs) from industrial wastewater), gaseous or volatile chemicals used for disinfection processes (e.g., chlorine and ammonia), and bioaerosols. Odors from treatment facilities can also be a nuisance to workers and the surrounding community. Recommendations for the management of emissions are presented in the Air Emissions and Ambient Air Quality section of this document and in the EHS Guidelines for Water and Sanitation.

Residuals from Wastewater Treatment Operations

Sludge from a waste treatment plant needs to be evaluated on a case-by-case basis to establish whether it constitutes a hazardous or a non-hazardous waste and managed accordingly as described in the Waste Management section of this document.

Occupational Health and Safety Issues in Wastewater Treatment Operations

Wastewater treatment facility operators may be exposed to physical, chemical, and biological hazards depending on the design of the facilities and the types of wastewater effluents managed. Examples of these hazards include the potential for trips and falls into tanks, confined space entries for maintenance operations, and inhalation of VOCs, bioaerosols, and methane, contact with pathogens and vectors, and use of potentially hazardous chemicals, including chlorine, sodium and calcium hypochlorite, and ammonia. Detailed recommendations for the management of occupational health and safety issues are presented in the relevant section of this document. Additional guidance specifically applicable to wastewater treatment systems is provided in the EHS Guidelines for Water and Sanitation.

Monitoring

A wastewater and water quality monitoring program with adequate resources and management oversight should be developed and implemented to meet the objective(s) of the monitoring program. The wastewater and water quality monitoring program should consider the following elements:

Monitoring parameters: The parameters selected for monitoring should be indicative of the pollutants of concern from the process, and should include parameters that are regulated under compliance requirements;

Monitoring type and frequency: Wastewater monitoring should take into consideration the discharge characteristics from the process over time. Monitoring of discharges from processes with batch manufacturing or seasonal process variations should take into consideration of time-dependent

variations in discharges and, therefore, is more complex than monitoring of continuous discharges. Effluents from highly variable processes may need to be sampled more frequently or through composite methods. Grab samples or, if automated equipment permits, composite samples may offer more insight on average concentrations of pollutants over a 24-hour period. Composite samplers may not be appropriate where analytes of concern are short-lived (e.g., quickly degraded or volatile).

Monitoring locations: The monitoring location should be selected with the objective of providing representative monitoring data. Effluent sampling stations may be located at the final discharge, as well as at strategic upstream points prior to merging of different discharges. Process discharges should not be diluted prior or after treatment with the objective of meeting the discharge or ambient water quality standards.

Data quality: Monitoring programs should apply internationally approved methods for sample collection, preservation and analysis. Sampling should be conducted by or under the supervision of trained individuals. Analysis should be conducted by entities permitted or certified for this purpose. Sampling and Analysis Quality Assurance/Quality Control (QA/QC) plans should be prepared and, implemented. QA/QC documentation should be included in monitoring reports.

Annex 1.3.1 - Examples of Industrial Wastewater Treatment Approaches

Pollutant/Parameter	Control Options / Principle	Common End of Pipe Control Technology
pH	Chemical, Equalization	Acid/Base addition, Flow equalization
Oil and Grease / TPH	Phase separation	Dissolved Air Floatation, oil water separator, grease trap
TSS - Settleable	Settling, Size Exclusion	Sedimentation basin, clarifier, centrifuge, screens
TSS - Non-Settleable	Floatation, Filtration - traditional and tangential	Dissolved air floatation, Multimedia filter, sand filter, fabric filter, ultrafiltration, microfiltration
Hi - BOD (> 2 Kg/m^3)	Biological - Anaerobic	Suspended growth, attached growth, hybrid
Lo - BOD (< 2 Kg/m^3)	Biological - Aerobic, Facultative	Suspended growth, attached growth, hybrid
COD - Non-Biodegradable	Oxidation, Adsorption, Size Exclusion	Chemical oxidation, Thermal oxidation, Activated Carbon, Membranes
Metals - Particulate and Soluble	Coagulation, flocculation, precipitation, size exclusion	Flash mix with settling, filtration - traditional and tangential
Inorganics / Non-metals	Coagulation, flocculation, precipitation, size exclusion, Oxidation, Adsorption	Flash mix with settling, filtration - traditional and tangential, Chemical oxidation, Thermal oxidation, Activated Carbon, Reverse Osmosis, Evaporation
Organics - VOCs and SVOCs	Biological - Aerobic, Anaerobic, Facultative; Adsorption, Oxidation	Biological : Suspended growth, attached growth, hybrid; Chemical oxidation, Thermal oxidation, Activated Carbon
Emissions – Odors and VOCs	Capture – Active or Passive; Biological; Adsorption, Oxidation	Biological : Attached growth; Chemical oxidation, Thermal oxidation, Activated Carbon
Nutrients	Biological Nutrient Removal, Chemical, Physical, Adsorption	Aerobic/Anoxic biological treatment, chemical hydrolysis and air stripping, chlorination, ion exchange
Color	Biological - Aerobic, Anaerobic, Facultative; Adsorption, Oxidation	Biological Aerobic, Chemical oxidation, Activated Carbon
Temperature	Evaporative Cooling	Surface Aerators, Flow Equalization
TDS	Concentration, Size Exclusion	Evaporation, crystallization, Reverse Osmosis
Active Ingredients/Emerging Contaminants	Adsorption, Oxidation, Size Exclusion, Concentration	Chemical oxidation, Thermal oxidation, Activated Carbon, Ion Exchange, Reverse Osmosis, Evaporation, Crystallization
Radionuclides	Adsorption,Size Exclusion, Concentration	Ion Exchange, Reverse Osmosis, Evaporation, Crystallization
Pathogens	Disinfection, Sterilization	Chlorine, Ozone, Peroxide, UV, Thermal
Toxicity	Adsorption, Oxidation, Size Exclusion, Concentration	Chemical oxidation, Thermal oxidation, Activated Carbon, Evaporation, crystallization, Reverse Osmosis

1.4 Water Conservation

Applicability and Approach

Water conservation programs should be implemented commensurate with the magnitude and cost of water use. These programs should promote the continuous reduction in water consumption and achieve savings in the water pumping, treatment and disposal costs. Water conservation measures may include water monitoring/management techniques; process and cooling/heating water recycling, reuse, and other techniques; and sanitary water conservation techniques.

General recommendations include:

- Storm/Rainwater harvesting and use
- Zero discharge design/Use of treated waste water to be included in project design processes
- Use of localized recirculation systems in plant/facility/shops (as opposed to centralized recirculation system), with provision only for makeup water
- Use of dry process technologies e.g. dry quenching
- Process water system pressure management
- Project design to have measures for adequate water collection, spill control and leakage control system

Water Monitoring and Management

The essential elements of a water management program involve:

- Identification, regular measurement, and recording of principal flows within a facility;
- Definition and regular review of performance targets, which are adjusted to account for changes in major factors affecting water use (e.g. industrial production rate);
- Regular comparison of water flows with performance targets to identify where action should be taken to reduce water use.

Water measurement (metering) should emphasize areas of greatest water use. Based on review of metering data, 'unaccounted' use–indicating major leaks at industrial facilities–could be identified.

Process Water Reuse and Recycling

Opportunities for water savings in industrial processes are highly industry-specific. However, the following techniques have all been used successfully, and should be considered in conjunction with the development of the metering system described above.

- *Washing Machines:* Many washing machines use large quantities of hot water. Use can increase as nozzles become enlarged due to repeated cleaning and /or wear. Monitor machine water use, compare with specification, and replace nozzles when water and heat use reaches levels warranting such work.
- *Water reuse:* Common water reuse applications include countercurrent rinsing, for example in multi-stage washing

and rinsing processes, or reusing waste water from one process for another with less exacting water requirements. For example, using bleaching rinse water for textile washing, or bottle-washer rinse water for bottle crate washing, or even washing the floor. More sophisticated reuse projects requiring treatment of water before reuse are also sometimes practical.

Water jets/sprays: If processes use water jets or sprays (e.g. to keep conveyors clean or to cool product) review the accuracy of the spray pattern to prevent unnecessary water loss.

Flow control optimization: Industrial processes sometimes require the use of tanks, which are refilled to control losses. It is often possible to reduce the rate of water supply to such tanks, and sometimes to reduce tank levels to reduce spillage. If the process uses water cooling sprays, it may be possible to reduce flow while maintaining cooling performance. Testing can determine the optimum balance.

- If hoses are used in cleaning, use flow controls to restrict wasteful water flow
- Consider the use of high pressure, low volume cleaning systems rather than using large volumes of water sprayed from hosepipes
- Using flow timers and limit switches to control water use
- Using 'clean-up' practices rather than hosing down

Building Facility Operations

Consumption of building and sanitary water is typically less than that used in industrial processes. However, savings can readily be identified, as outlined below:

Compare daily water use per employee to existing benchmarks taking into consideration the primary use at the facility, whether sanitary or including other activities such as showering or catering

Regularly maintain plumbing, and identify and repair leaks

Shut off water to unused areas

Install self-closing taps, automatic shut-off valves, spray nozzles, pressure reducing valves, and water conserving fixtures (e.g. low flow shower heads, faucets, toilets, urinals; and spring loaded or sensored faucets)

Operate dishwashers and laundries on full loads, and only when needed

Install water-saving equipment in lavatories, such as low-flow toilets

Cooling Systems

Water conservation opportunities in cooling systems include:

Use of closed circuit cooling systems with cooling towers rather than once-through cooling systems

Limiting condenser or cooling tower blowdown to the minimum required to prevent unacceptable accumulation of dissolved solids

Use of air cooling rather than evaporative cooling, although this may increase electricity use in the cooling system

Use of treated waste water for cooling towers

Reusing/recycling cooling tower blowdown

Heating Systems

Heating systems based on the circulation of low or medium pressure hot water (which do not consume water) should be closed. If they do consume water, regular maintenance should be conducted to check for leaks. However, large quantities of water may be used by steam systems, and this can be reduced by the following measures:

Repair of steam and condensate leaks, and repair of all failed steam traps

Return of condensate to the boilerhouse, and use of heat exchangers (with condensate return) rather than direct steam injection where process permits

Flash steam recovery

Minimizing boiler blowdown consistent with maintaining acceptably low dissolved solids in boiler water. Use of reverse osmosis boiler feed water treatment substantially reduces the need for boiler blowdown

Minimizing deaerator heating

1.5 Hazardous Materials Management

Applicability and Approach

These guidelines apply to projects that use, store, or handle any quantity of hazardous materials (Hazmats), defined as materials that represent a risk to human health, property, or the environment due to their physical or chemical characteristics. Hazmats can be classified according to the hazard as explosives; compressed gases, including toxic or flammable gases; flammable liquids; flammable solids; oxidizing substances; toxic materials; radioactive material; and corrosive substances. Guidance on the transport of hazardous materials is covered in Section 3 of this document.

When a hazardous material is no longer usable for its original purpose and is intended for disposal, but still has hazardous properties, it is considered a *hazardous waste* (see Section 1.4).

This guidance is intended to be applied in conjunction with traditional occupational health and safety and emergency preparedness programs which are included in Section 2.0 on Occupational Health and Safety Management, and Section 3.7 on Emergency Preparedness and Response. Guidance on the Transport of Hazardous Materials is provided in Section 3.5.

This section is divided into two main subsections:

General Hazardous Materials Management: Guidance applicable to all projects or facilities that handle or store any quantity of hazardous materials.

Management of Major Hazards: Additional guidance for projects or facilities that store or handle hazardous materials at, or above, threshold quantities[39], and thus require special treatment to prevent accidents such as fire, explosions, leaks or spills, and to prepare and respond to emergencies.

The overall objective of hazardous materials management is to avoid or, when avoidance is not feasible, minimize uncontrolled releases of hazardous materials or accidents (including explosion and fire) during their production, handling, storage and use. This objective can be achieved by:

[39] For examples, threshold quantities should be those established for emergency planning purposes such as provided in the US Environmental Protection Agency. *Protection of Environment* (Title Threshold quantities are provided in the US Environmental Protection Agency. *Protection of Environment* (Title 40 CFR Parts 68, 112, and 355).

Establishing hazardous materials management priorities based on hazard analysis of risky operations identified through Social and Environmental Assessment;

Where practicable, avoiding or minimizing the use of hazardous materials. For example, non-hazardous materials have been found to substitute asbestos in building materials, PCBs in electrical equipment, persistent organic pollutants (POPs) in pesticides formulations, and ozone depleting substances in refrigeration systems;

Preventing uncontrolled releases of hazardous materials to the environment or uncontrolled reactions that might result in fire or explosion;

Using engineering controls (containment, automatic alarms, and shut-off systems) commensurate with the nature of hazard;

Implementing management controls (procedures, inspections, communications, training, and drills) to address residual risks that have not been prevented or controlled through engineering measures.

General Hazardous Materials Management

Projects which manufacture, handle, use, or store hazardous materials should establish management programs that are commensurate with the potential risks present. The main objectives of projects involving hazardous materials should be the protection of the workforce and the prevention and control of releases and accidents. These objectives should be addressed by integrating prevention and control measures, management actions, and procedures into day-to-day business activities. Potentially applicable elements of a management program include the following:

Hazard Assessment

The level of risk should be established through an on-going assessment process based on:

The types and amounts of hazardous materials present in the project. This information should be recorded and should include a summary table with the following information:

- Name and description (e.g. composition of a mixture) of the Hazmat
- Classification (e.g. code, class or division) of the Hazmat
- Internationally accepted regulatory reporting threshold quantity or national equivalent[40] of the Hazmat
- Quantity of Hazmat used per month
- Characteristic(s) that make(s) the Hazmat hazardous (e.g. flammability, toxicity)

Analysis of potential spill and release scenarios using available industry statistics on spills and accidents where available

Analysis of the potential for uncontrolled reactions such as fire and explosions

Analysis of potential consequences based on the physical-geographical characteristics of the project site, including aspects such as its distance to settlements, water resources, and other environmentally sensitive areas

Hazard assessment should be performed by specialized professionals using internationally-accepted methodologies such as Hazardous Operations Analysis (HAZOP), Failure Mode and Effects Analysis (FMEA), and Hazard Identification (HAZID).

Management Actions

The management actions to be included in a Hazardous Materials Management Plan should be commensurate with the level of

[40] Threshold quantities are provided in the US Environmental Protection Agency. *Protection of Environment* (Title 40 CFR Parts 68, 112, and 355).

potential risks associated with the production, handling, storage, and use of hazardous materials.

Release Prevention and Control Planning

Where there is risk of a spill of uncontrolled hazardous materials, facilities should prepare a spill control, prevention, and countermeasure plan as a specific component of their Emergency Preparedness and Response Plan (described in more detail in Section 3.7). The plan should be tailored to the hazards associated with the project, and include:

Training of operators on release prevention, including drills specific to hazardous materials as part of emergency preparedness response training

Implementation of inspection programs to maintain the mechanical integrity and operability of pressure vessels, tanks, piping systems, relief and vent valve systems, containment infrastructure, emergency shutdown systems, controls and pumps, and associated process equipment

Preparation of written Standard Operating Procedures (SOPs) for filling USTs, ASTs or other containers or equipment as well as for transfer operations by personnel trained in the safe transfer and filling of the hazardous material, and in spill prevention and response

SOPs for the management of secondary containment structures, specifically the removal of any accumulated fluid, such as rainfall, to ensure that the intent of the system is not accidentally or willfully defeated

Identification of locations of hazardous materials and associated activities on an emergency plan site map

Documentation of availability of specific personal protective equipment and training needed to respond to an emergency

Documentation of availability of spill response equipment sufficient to handle at least initial stages of a spill and a list of external resources for equipment and personnel, if necessary, to supplement internal resources

Description of response activities in the event of a spill, release, or other chemical emergency including:

- Internal and external notification procedures
- Specific responsibilities of individuals or groups
- Decision process for assessing severity of the release, and determining appropriate actions
- Facility evacuation routes
- Post-event activities such as clean-up and disposal, incident investigation, employee re-entry, and restoration of spill response equipment.

Occupational Health and Safety

The Hazardous Materials Management Plan should address applicable, essential elements of occupational health and safety management as described in Section 2.0 on Occupational Health and Safety, including:

Job safety analysis to identify specific potential occupational hazards and industrial hygiene surveys, as appropriate, to monitor and verify chemical exposure levels, and compare with applicable occupational exposure standards[41]

Hazard communication and training programs to prepare workers to recognize and respond to workplace chemical hazards. Programs should include aspects of hazard identification, safe operating and materials handling procedures, safe work practices, basic emergency procedures, and special hazards unique to their jobs.

[41] Including: Threshold Limit Value (TLV®) occupational exposure guidelines and Biological Exposure Indices (BEIs®), American Conference of Governmental Industrial Hygienists (ACGIH), http://www.acgih.org/TLV/; U.S. National Institute for Occupational Health and Safety (NIOSH), http://www.cdc.gov/niosh/npg/; Permissible Exposure Limits (PELs), U.S. Occupational Safety and Health Administration (OSHA), http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992; Indicative Occupational Exposure Limit Values, European Union, http://europe.osha.eu.int/good_practice/risks/ds/oel/; and other similar sources.

Training should incorporate information from Material Safety Data Sheets[42] (MSDSs) for hazardous materials being handled. MSDSs should be readily accessible to employees in their local language.

Definition and implementation of permitted maintenance activities, such as hot work or confined space entries

Provision of suitable personal protection equipment (PPE) (footwear, masks, protective clothing and goggles in appropriate areas), emergency eyewash and shower stations, ventilation systems, and sanitary facilities

Monitoring and record-keeping activities, including audit procedures designed to verify and record the effectiveness of prevention and control of exposure to occupational hazards, and maintaining accident and incident investigation reports on file for a period of at least five years

Process Knowledge and Documentation

The Hazardous Materials Management Plan should be incorporated into, and consistent with, the other elements of the facility ES/OHS MS and include:

Written process safety parameters (i.e., hazards of the chemical substances, safety equipment specifications, safe operation ranges for temperature, pressure, and other applicable parameters, evaluation of the consequences of deviations, etc.)

Written operating procedures

Compliance audit procedures

[42] MSDSs are produced by the manufacturer, but might not be prepared for chemical intermediates that are not distributed in commerce. In these cases, employers still need to provide workers with equivalent information.

Preventive Measures

Hazardous Materials Transfer

Uncontrolled releases of hazardous materials may result from small cumulative events, or from more significant equipment failure associated with events such as manual or mechanical transfer between storage systems or process equipment. Recommended practices to prevent hazardous material releases from processes include:

Use of dedicated fittings, pipes, and hoses specific to materials in tanks (e.g., all acids use one type of connection, all caustics use another), and maintaining procedures to prevent addition of hazardous materials to incorrect tanks

Use of transfer equipment that is compatible and suitable for the characteristics of the materials transferred and designed to ensure safe transfer

Regular inspection, maintenance and repair of fittings, pipes and hoses

Provision of secondary containment, drip trays or other overflow and drip containment measures, for hazardous materials containers at connection points or other possible overflow points.

Overfill Protection

Overfills of vessels and tanks should be prevented as they are among the most common causes of spills resulting in soil and water contamination, and among the easiest to prevent. Recommended overfill protection measures include:

Prepare written procedures for transfer operations that includes a checklist of measures to follow during filling operations and the use of filling operators trained in these procedures

Installation of gauges on tanks to measure volume inside

Use of dripless hose connections for vehicle tank and fixed connections with storage tanks

Provision of automatic fill shutoff valves on storage tanks to prevent overfilling

Use of a catch basin around the fill pipe to collect spills

Use of piping connections with automatic overfill protection (float valve)

Pumping less volume than available capacity into the tank or vessel by ordering less material than its available capacity

Provision of overfill or over pressure vents that allow controlled release to a capture point

Reaction, Fire, and Explosion Prevention Reactive, flammable, and explosive materials should also be managed to avoid uncontrolled reactions or conditions resulting in fire or explosion. Recommended prevention practices include:

Storage of incompatible materials (acids, bases, flammables, oxidizers, reactive chemicals) in separate areas, and with containment facilities separating material storage areas

Provision of material-specific storage for extremely hazardous or reactive materials

Use of flame arresting devices on vents from flammable storage containers

Provision of grounding and lightning protection for tank farms, transfer stations, and other equipment that handles flammable materials

Selection of materials of construction compatible with products stored for all parts of storage and delivery systems, and avoiding reuse of tanks for different products without checking material compatibility

Storage of hazardous materials in an area of the facility separated from the main production works. Where proximity is unavoidable, physical separation should be provided using structures designed to prevent fire, explosion, spill, and other emergency situations from affecting facility operations

Prohibition of all sources of ignition from areas near flammable storage tanks

Control Measures

Secondary Containment (Liquids)

A critical aspect for controlling accidental releases of liquid hazardous materials during storage and transfer is the provision of secondary containment. It is not necessary for secondary containment methods to meet long term material compatibility as with primary storage and piping, but their design and construction should hold released materials effectively until they can be detected and safely recovered. Appropriate secondary containment structures consist of berms, dikes, or walls capable of containing the larger of 110 percent of the largest tank or 25% percent of the combined tank volumes in areas with above-ground tanks with a total storage volume equal or greater than 1,000 liters and will be made of impervious, chemically resistant material. Secondary containment design should also consider means to prevent contact between incompatible materials in the event of a release.

Other secondary containment measures that should be applied depending on site-specific conditions include:

Transfer of hazardous materials from vehicle tanks to storage in areas with surfaces sufficiently impervious to avoid loss to the environment and sloped to a collection or a containment structure not connected to municipal wastewater/stormwater collection system

Where it is not practical to provide permanent, dedicated containment structures for transfer operations, one or more alternative forms of spill containment should be provided, such as portable drain covers (which can be deployed for the duration of the operations), automatic shut-off valves on storm water basins, or shut off valves in drainage or sewer facilities, combined with oil-water separators

Storage of drummed hazardous materials with a total volume equal or greater than 1,000 liters in areas with impervious surfaces that are sloped or bermed to contain a minimum of 25 percent of the total storage volume

Provision of secondary containment for components (tanks, pipes) of the hazardous material storage system, to the extent feasible

Conducting periodic (e.g. daily or weekly) reconciliation of tank contents, and inspection of visible portions of tanks and piping for leaks;

Use of double-walled, composite, or specially coated storage and piping systems particularly in the use of underground storage tanks (USTs) and underground piping. If double-walled systems are used, they should provide a means of detecting leaks between the two walls.

Storage Tank and Piping Leak Detection

Leak detection may be used in conjunction with secondary containment, particularly in high-risk locations[43]. Leak detection is especially important in situations where secondary containment is not feasible or practicable, such as in long pipe runs. Acceptable leak detection methods include:

Use of automatic pressure loss detectors on pressurized or long distance piping

Use of approved or certified integrity testing methods on piping or tank systems, at regular intervals

Considering the use of SCADA[44] if financially feasible

Underground Storage Tanks (USTs)[45]

Although there are many environmental and safety advantages of underground storage of hazardous materials, including reduced risk of fire or explosion, and lower vapor losses into the atmosphere, leaks of hazardous materials can go undetected for long periods of time with potential for soil and groundwater contamination. Examples of techniques to manage these risks include:

Avoiding use of USTs for storage of highly soluble organic materials

Assessing local soil corrosion potential, and installing and maintaining cathodic protection (or equivalent rust protection) for steel tanks

For new installations, installing impermeable liners or structures (e.g., concrete vaults) under and around tanks and lines that direct any leaked product to monitoring ports at the lowest point of the liner or structure

Monitoring the surface above any tank for indications of soil movement

Reconciling tank contents by measuring the volume in store with the expected volume, given the stored quantity at last stocking, and deliveries to and withdrawals from the store

Testing integrity by volumetric, vacuum, acoustic, tracers, or other means on all tanks at regular intervals

Considering the monitoring groundwater of quality down gradient of locations where multiple USTs are in use

Evaluating the risk of existing UST in newly acquired facilities to determine if upgrades are required for USTs that will be continued to be used, including replacement with new systems or permanent closure of abandoned USTs.

Ensuring that new USTs are sited away from wells,

[43] High-risk locations are places where the release of product from the storage system could result in the contamination of drinking water source or those located in water resource protection areas as designated by local authorities.

[44] Supervisory Control and Data Acquisition

[45] Additional details on the management of USTs is provided in the EHS Guidelines for Retail Petroleum Stations.

reservoirs and other source water protection areas and floodplains, and maintained so as to prevent corrosion.

Management of Major Hazards

In addition to the application of the above-referenced guidance on prevention and control of releases of hazardous materials, projects involving production, handling, and storage of hazardous materials *at or above threshold limits*[46] should prepare a Hazardous Materials Risk Management Plan, in the context of its overall ES/OHS MS, containing all of the elements presented below.[47] The objective of this guidance is the prevention and control of catastrophic releases of toxic, reactive, flammable, or explosive chemicals that may result in toxic, fire, or explosion hazards.[48]

Management Actions

Management of Change: These procedures should address:

- The technical basis for changes in processes and operations
- The impact of changes on health and safety
- Modification to operating procedures
- Authorization requirements
- Employees affected
- Training needs

Compliance Audit: A compliance audit is a way to evaluate compliance with the prevention program requirements for each process. A compliance audit covering each element of the prevention measures (see below) should be conducted at least every three years and should include:

- Preparation of a report of the findings
- Determination and documentation of the appropriate response to each finding
- Documentation that any deficiency has been corrected

Incident Investigation: Incidents can provide valuable information about site hazards and the steps needed to prevent accidental releases. An incident investigation mechanism should include procedures for:

- Initiation of the investigation promptly
- Summarizing the investigation in a report
- Addressing the report findings and recommendations
- A review of the report with staff and contractors

Employee Participation: A written plan of action should describe an active employee participation program for the prevention of accidents.

Contractors: There should be a mechanism for contractor control which should include a requirement for them to develop hazard materials management procedures that meet the requirements of the hazardous materials management plan. Their procedures should be consistent with those of the contracting company and the contractor workforce should undergo the same training. Additionally, procedures should require that contractors are:

- Provided with safety performance procedures and safety and hazard information
- Observe safety practices
- Act responsibly
- Have access to appropriate training for their employees
- Ensure that their employees know process hazards and applicable emergency actions

[46] Threshold quantities should be those established for emergency planning purposes such as provided in the US Environmental Protection Agency. *Protection of Environment* (Title 40 CFR Parts 300-399 and 700 to 789).

[47] For further information and guidance, please refer to International Finance Corporation (IFC) Hazardous Materials Risk Management Manual. Washington, D.C. December 2000.

[48] The approach to the management of major hazards is largely based on an approach to Process Safety Management developed by the American Institute of Chemical Engineers.

- Prepare and submit training records for their employees to the contracting company
- Inform their employees about the hazards presented by their work
- Assess trends of repeated similar incidents
- Develop and implement procedures to manage repeated similar incidents

Training: Project employees should be provided training on Hazmat management. The training program should include:

- A list of employees to be trained
- Specific training objectives
- Mechanisms to achieve the objectives (i.e., hands-on workshops, videos, etc.)
- The means to determine whether the training program is effective
- Training procedures for new hires and refresher courses for existing employees

Preventive Measures

The purpose of preventive measures is to ensure that safety-related aspects of the process and equipment are considered, limits to be placed on the operations are well known, and accepted standards and codes are adopted, where they apply.

Process Safety Information: Procedures should be prepared for each hazardous materials and include:

- Compilation of Material Safety Data Sheets (MSDS)
- Identification of maximum intended inventories and safe upper/lower parameters
- Documentation of equipment specifications and of codes and standards used to design, build and operate the process

Operating Procedures: SOPs should be prepared for each step of all processes or operations within the project (e.g. initial startup, normal operations, temporary operations, emergency shutdown, emergency operations, normal shutdown, and start-up following a normal or emergency shutdown or major change). These SOPs should include special considerations for Mazmats used in the process or operations (e.g. temperature control to prevent emissions of a volatile hazardous chemical; diversion of gaseous discharges of hazardous pollutants from the process to a temporary storage tank in case of emergency).

Other procedures to be developed include impacts of deviations, steps to avoid deviations, prevention of chemical exposure, exposure control measures, and equipment inspections.

Mechanical Integrity of process equipment, piping and instrumentation: Inspection and maintenance procedures should be developed and documented to ensure mechanical integrity of equipment, piping, and instrumentation and prevent uncontrolled releases of hazardous materials from the project. These procedures should be included as part of the project SOPs. The specific process components of major interest include pressure vessels and storage tanks, piping systems, relief and vent systems and devices, emergency shutdown systems, controls, and pumps. Recommended aspects of the inspection and maintenance program include:

- Developing inspection and maintenance procedures
- Establishing a quality assurance plan for equipment, maintenance materials, and spare parts
- Conducting employee training on the inspection and maintenance procedures
- Conducting equipment, piping, and instrumentation inspections and maintenance
- Identifying and correcting identified deficiencies

- Evaluating the inspection and maintenance results and, if necessary, updating the inspection and maintenance procedures
- Reporting the results to management.

Hot Work Permit: Hot work operations – such as brazing, torch-cutting, grinding, soldering, and welding – are associated with potential health, safety, and property hazards resulting from the fumes, gases, sparks, and hot metal and radiant energy produced during hot work. Hot work permit is required for any operation involving open flames or producing heat and/or sparks. The section of SOPs on hot work should include the responsibility for hot work permitting, personal protection equipment (PPE), hot work procedures, personnel training, and recordkeeping.

Pre-Start Review: Procedures should be prepared to carry out pre-start reviews when a modification is significant enough to require a change in safety information under the management of change procedure. The procedures should:

- Confirm that the new or modified construction and/or equipment meet design specifications
- Ensure that procedures for safety, operation, maintenance, and emergency are adequate
- Include a process hazard assessment, and resolve or implement recommendations for new process
- Ensure that training for all affected employees is being conducted

Emergency Preparedness and Response

When handling hazardous materials, procedures and practices should be developed allowing for quick and efficient responses to accidents that could result in human injury or damage to the environment. An Emergency Preparedness and Response Plan, incorporated into and consistent with, the facility's overall ES/OHS MS, should be prepared to cover the following:[49]

Planning Coordination: Procedures should be prepared for:

- Informing the public and emergency response agencies
- Documenting first aid and emergency medical treatment
- Taking emergency response actions
- Reviewing and updating the emergency response plan to reflect changes, and ensuring that employees are informed of such changes

Emergency Equipment: Procedures should be prepared for using, inspecting, testing, and maintaining the emergency response equipment.

Training: Employees and contractors should be trained on emergency response procedures.

Community Involvement and Awareness

When hazardous materials are in use above threshold quantities, the management plan should include a system for community awareness, notification and involvement that should be commensurate with the potential risks identified for the project during the hazard assessment studies. This should include mechanisms for sharing the results of hazard and risk assessment studies in a timely, understandable and culturally sensitive manner with potentially affected communities that provides a means for public feedback. Community involvement activities should include:

Availability of general information to the potentially affected community on the nature and extent of project operations, and the prevention and control measures in place to ensure no effects to human health

[49] For a comprehensive treatment of the development of emergency response plans in conjunction with communities refer to the Awareness and Preparedness for Emergencies at Local Level (APELL) Guidelines available at: http://www.uneptie.org/pc/apell/publications/handbooks.html

The potential for off-site effects to human health or the environment following an accident at planned or existing hazardous installations

Specific and timely information on appropriate behavior and safety measures to be adopted in the event of an accident including practice drills in locations with higher risks

Access to information necessary to understand the nature of the possible effect of an accident and an opportunity to contribute effectively, as appropriate, to decisions concerning hazardous installations and the development of community emergency preparedness plans.

1.6 Waste Management

Applicability and Approach

These guidelines apply to projects that generate, store, or handle any quantity of waste across a range of industry sectors. It is not intended to apply to projects or facilities where the primary business is the collection, transportation, treatment, or disposal of wastes. Specific guidance for these types of facilities is presented in the Environmental Health and Safety (EHS) Guidelines for Waste Management Facilities.

A *waste* is any solid, liquid, or contained gaseous material that is being discarded by disposal, recycling, burning or incineration. It can be byproduct of a manufacturing process or an obsolete commercial product that can no longer be used for intended purpose and requires disposal.

Solid (non-hazardous) wastes generally include any garbage, refuse. Examples of such waste include domestic trash and garbage; inert construction / demolition materials; refuse, such as metal scrap and empty containers (except those previously used to contain hazardous materials which should, in principle, be managed as a hazardous waste); and residual waste from industrial operations, such as boiler slag, clinker, and fly ash.

Hazardous waste shares the properties of a hazardous material (e.g. ignitability, corrosivity, reactivity, or toxicity), or other physical, chemical, or biological characteristics that may pose a potential risk to human health or the environment if improperly managed. Wastes may also be defined as "hazardous" by local regulations or international conventions, based on the origin of the waste and its inclusion on hazardous waste lists, or based on its characteristics.

Sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility, and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial operations needs to be evaluated on a case-by-case basis to establish whether it constitutes a hazardous or a non-hazardous waste.

Facilities that generate and store wastes should practice the following:

Establishing waste management priorities at the outset of activities based on an understanding of potential Environmental, Health, and Safety (EHS) risks and impacts and considering waste generation and its consequences

Establishing a waste management hierarchy that considers prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes.

Avoiding or minimizing the generation waste materials, as far as practicable

Where waste generation cannot be avoided but has been minimized, recovering and reusing waste

Where waste can not be recovered or reused, treating, destroying, and disposing of it in an environmentally sound manner

General Waste Management

The following guidance applies to the management of non-hazardous and hazardous waste. Additional guidance specifically applicable to hazardous wastes is presented below. Waste management should be addressed through a Waste management system that addresses issues linked to waste minimization, generation, transport, disposal, and monitoring.

Waste Management Planning

Facilities that generate waste should characterize their waste according to composition, source, types of wastes produced, generation rates, or according to local regulatory requirements. Effective planning and implementation of waste management strategies should include:

Review of new waste sources during planning, siting, and design activities, including during equipment modifications and process alterations, to identify expected waste generation, pollution prevention opportunities, and necessary treatment, storage, and disposal infrastructure

Collection of data and information about the process and waste streams in existing facilities, including characterization of waste streams by type, quantities, and potential use/disposition

Establishment of priorities based on a risk analysis that takes into account the potential EHS risks during the waste cycle and the availability of infrastructure to manage the waste in an environmentally sound manner

Definition of opportunities for source reduction, as well as reuse and recycling

Definition of procedures and operational controls for on-site storage

Definition of options / procedures / operational controls for treatment and final disposal

Waste Prevention

Processes should be designed and operated to prevent, or minimize, the quantities of wastes generated and hazards associated with the wastes generated in accordance with the following strategy:

Substituting raw materials or inputs with less hazardous or toxic materials, or with those where processing generates lower waste volumes

Applying manufacturing process that convert materials efficiently, providing higher product output yields, including modification of design of the production process, operating conditions, and process controls[50]

Instituting good housekeeping and operating practices, including inventory control to reduce the amount of waste resulting from materials that are out-of-date, off-specification, contaminated, damaged, or excess to plant needs

Instituting procurement measures that recognize opportunities to return usable materials such as containers and which prevents the over ordering of materials

Minimizing hazardous waste generation by implementing stringent waste segregation to prevent the commingling of non-hazardous and hazardous waste to be managed

[50] Examples of waste prevention strategies include the concept of Lean Manufacturing found at http://www.epa.gov/epaoswer/hazwaste/minimize/lean.htm

Recycling and Reuse

In addition to the implementation of waste prevention strategies, the total amount of waste may be significantly reduced through the implementation of recycling plans, which should consider the following elements:

- Evaluation of waste production processes and identification of potentially recyclable materials
- Identification and recycling of products that can be reintroduced into the manufacturing process or industry activity at the site
- Investigation of external markets for recycling by other industrial processing operations located in the neighborhood or region of the facility (e.g., waste exchange)
- Establishing recycling objectives and formal tracking of waste generation and recycling rates
- Providing training and incentives to employees in order to meet objectives

Treatment and Disposal

If waste materials are still generated after the implementation of feasible waste prevention, reduction, reuse, recovery and recycling measures, waste materials should be treated and disposed of and all measures should be taken to avoid potential impacts to human health and the environment. Selected management approaches should be consistent with the characteristics of the waste and local regulations, and may include one or more of the following:

- On-site or off-site biological, chemical, or physical treatment of the waste material to render it non-hazardous prior to final disposal
- Treatment or disposal at permitted facilities specially designed to receive the waste. Examples include: composting operations for organic non-hazardous wastes; properly designed, permitted and operated landfills or incinerators designed for the respective type of waste; or other methods known to be effective in the safe, final disposal of waste materials such as bioremediation.

Hazardous Waste Management

Hazardous wastes should always be segregated from non-hazardous wastes. If generation of hazardous waste can not be prevented through the implementation of the above general waste management practices, its management should focus on the prevention of harm to health, safety, and the environment, according to the following additional principles:

- Understanding potential impacts and risks associated with the management of any generated hazardous waste during its complete life cycle
- Ensuring that contractors handling, treating, and disposing of hazardous waste are reputable and legitimate enterprises, licensed by the relevant regulatory agencies and following good international industry practice for the waste being handled
- Ensuring compliance with applicable local and international regulations[51]

Waste Storage

Hazardous waste should be stored so as to prevent or control accidental releases to air, soil, and water resources in area location where:

[51] International requirements may include host-country commitments under the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their disposal (http://www.basel.int/) and Rotterdam Convention on the prior Inform Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (http://www.pic.int/)

Waste is stored in a manner that prevents the commingling or contact between incompatible wastes, and allows for inspection between containers to monitor leaks or spills. Examples include sufficient space between incompatibles or physical separation such as walls or containment curbs

Store in closed containers away from direct sunlight, wind and rain

Secondary containment systems should be constructed with materials appropriate for the wastes being contained and adequate to prevent loss to the environment

Secondary containment is included wherever liquid wastes are stored in volumes greater than 220 liters. The available volume of secondary containment should be at least 110 percent of the largest storage container, or 25 percent of the total storage capacity (whichever is greater), in that specific location

Provide adequate ventilation where volatile wastes are stored.

Hazardous waste storage activities should also be subject to special management actions, conducted by employees who have received specific training in handling and storage of hazardous wastes:

Provision of readily available information on chemical compatibility to employees, including labeling each container to identify its contents

Limiting access to hazardous waste storage areas to employees who have received proper training

Clearly identifying (label) and demarcating the area, including documentation of its location on a facility map or site plan

Conducting periodic inspections of waste storage areas and documenting the findings

Preparing and implementing spill response and emergency plans to address their accidental release (additional information on Emergency Plans in provided in Section 3 of this document)

Avoiding underground storage tanks and underground piping of hazardous waste

Transportation

On-site and Off-site transportation of waste should be conducted so as to prevent or minimize spills, releases, and exposures to employees and the public. All waste containers designated for off-site shipment should be secured and labeled with the contents and associated hazards, be properly loaded on the transport vehicles before leaving the site, and be accompanied by a shipping paper (i.e., manifest) that describes the load and its associated hazards, consistent with the guidance provided in Section 3.4 on the Transport of Hazardous Materials.

Treatment and Disposal

In addition to the recommendations for treatment and disposal applicable to general wastes, the following issues specific to hazardous wastes should be considered:

Commercial or Government Waste Contractors

In the absence of qualified commercial or government-owned waste vendors (taking into consideration proximity and transportation requirements), facilities generating waste should consider using:

Have the technical capability to manage the waste in a manner that reduces immediate and future impact to the environment

Have all required permits, certifications, and approvals, of applicable government authorities

Have been secured through the use of formal procurement agreements

In the absence of qualified commercial or government-owned waste disposal operators (taking into consideration proximity and transportation requirements), project sponsors should consider using:

Installing on-site waste treatment or recycling processes

As a final option, constructing facilities that will provide for the environmental sound long-term storage of wastes on-site (as described elsewhere in the General EHS Guidelines) or at an alternative appropriate location up until external commercial options become available

Small Quantities of Hazardous Waste

Hazardous waste materials are frequently generated in small quantities by many projects through a variety of activities such as equipment and building maintenance activities. Examples of these types of wastes include: spent solvents and oily rags, empty paint cans, chemical containers; used lubricating oil; used batteries (such as nickel-cadmium or lead acid); and lighting equipment, such as lamps or lamp ballasts. These wastes should be managed following the guidance provided in the above sections.

Monitoring

Monitoring activities associated with the management of hazardous and non-hazardous waste should include:

Regular visual inspection of all waste storage collection and storage areas for evidence of accidental releases and to verify that wastes are properly labeled and stored. When significant quantities of hazardous wastes are generated and stored on site, monitoring activities should include:

- Inspection of vessels for leaks, drips or other indications of loss
- Identification of cracks, corrosion, or damage to tanks, protective equipment, or floors
- Verification of locks, emergency valves, and other safety devices for easy operation (lubricating if required and employing the practice of keeping locks and safety equipment in standby position when the area is not occupied)
- Checking the operability of emergency systems
- Documenting results of testing for integrity, emissions, or monitoring stations (air, soil vapor, or groundwater)
- Documenting any changes to the storage facility, and any significant changes in the quantity of materials in storage

Regular audits of waste segregation and collection practices

Tracking of waste generation trends by type and amount of waste generated, preferably by facility departments

Characterizing waste at the beginning of generation of a new waste stream, and periodically documenting the characteristics and proper management of the waste, especially hazardous wastes

Keeping manifests or other records that document the amount of waste generated and its destination

Periodic auditing of third party treatment, and disposal services including re-use and recycling facilities when significant quantities of hazardous wastes are managed by third parties. Whenever possible, audits should include site visits to the treatment storage and disposal location

Regular monitoring of groundwater quality in cases of Hazardous Waste on site storage and/or pretreatment and disposal

Monitoring records for hazardous waste collected, stored, or shipped should include:

- Name and identification number of the material(s) composing the hazardous waste
- Physical state (i.e., solid, liquid, gaseous or a combination of one, or more, of these)
- Quantity (e.g., kilograms or liters, number of containers)
- Waste shipment tracking documentation to include, quantity and type, date dispatched, date transported and date received, record of the originator, the receiver and the transporter
- Method and date of storing, repacking, treating, or disposing at the facility, cross-referenced to specific manifest document numbers applicable to the hazardous waste
- Location of each hazardous waste within the facility, and the quantity at each location

1.7 Noise

Applicability

This section addresses impacts of noise beyond the property boundary of the facilities. Worker exposure to noise is covered in Section 2.0 on Occupational Health and Safety.

Prevention and Control

Noise prevention and mitigation measures should be applied where predicted or measured noise impacts from a project facility or operations exceed the applicable noise level guideline at the most sensitive point of reception.[52] The preferred method for controlling noise from stationary sources is to implement noise control measures at source.[53] Methods for prevention and control of sources of noise emissions depend on the source and proximity of receptors. Noise reduction options that should be considered include:

- Selecting equipment with lower sound power levels
- Installing silencers for fans
- Installing suitable mufflers on engine exhausts and compressor components
- Installing acoustic enclosures for equipment casing radiating noise
- Improving the acoustic performance of constructed buildings, apply sound insulation
- Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m^2 in order to minimize the transmission of sound through the barrier. Barriers should be located as close to the source or to the receptor location to be effective
- Installing vibration isolation for mechanical equipment
- Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas
- Re-locating noise sources to less sensitive areas to take advantage of distance and shielding
- Siting permanent facilities away from community areas if possible
- Taking advantage of the natural topography as a noise buffer during facility design
- Reducing project traffic routing through community areas wherever possible
- Planning flight routes, timing and altitude for aircraft (airplane and helicopter) flying over community areas
- Developing a mechanism to record and respond to complaints

Noise Level Guidelines

Noise impacts should not exceed the levels presented in Table 1.7.1, or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

[52] A point of reception or receptor may be defined as any point on the premises occupied by persons where extraneous noise and/or vibration are received. Examples of receptor locations may include: permanent or seasonal residences; hotels / motels; schools and daycares; hospitals and nursing homes; places of worship; and parks and campgrounds.

[53] At the design stage of a project, equipment manufacturers should provide design or construction specifications in the form of *"Insertion Loss Performance"* for silencers and mufflers, and *"Transmission Loss Performance"* for acoustic enclosures and upgraded building construction.

Table 1.7.1- Noise Level Guidelines[54]		
	One Hour L_{Aeq} (dBA)	
Receptor	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional; educational[55]	55	45
Industrial; commercial	70	70

Highly intrusive noises, such as noise from aircraft flyovers and passing trains, should not be included when establishing background noise levels.

Monitoring

Noise monitoring[56] may be carried out for the purposes of establishing the existing ambient noise levels in the area of the proposed or existing facility, or for verifying operational phase noise levels.

Noise monitoring programs should be designed and conducted by trained specialists. Typical monitoring periods should be sufficient for statistical analysis and may last 48 hours with the use of noise monitors that should be capable of logging data continuously over this time period, or hourly, or more frequently, as appropriate (or else cover differing time periods within several days, including weekday and weekend workdays). The type of acoustic indices recorded depends on the type of noise being monitored, as established by a noise expert. Monitors should be located approximately 1.5 m above the ground and no closer than 3 m to any reflecting surface (e.g., wall). In general, the noise level limit is represented by the background or ambient noise levels that would be present in the absence of the facility or noise source(s) under investigation.

[54] Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999.

[55] For acceptable indoor noise levels for residential, institutional, and educational settings refer to WHO (1999).

[56] Noise monitoring should be carried out using a Type 1 or 2 sound level meter meeting all appropriate IEC standards.

1.8 Contaminated Land

Applicability and Approach

This section provides a summary of management approaches for land contamination due to anthropogenic releases of hazardous materials, wastes, or oil, including naturally occurring substances. Releases of these materials may be the result of historic or current site activities, including, but not limited to, accidents during their handling and storage, or due to their poor management or disposal.

Land is considered contaminated when it contains hazardous materials or oil concentrations above background or naturally occurring levels.

Contaminated lands may involve surficial soils or subsurface soils that, through leaching and transport, may affect groundwater, surface water, and adjacent sites. Where subsurface contaminant sources include volatile substances, soil vapor may also become a transport and exposure medium, and create potential for contaminant infiltration of indoor air spaces of buildings.

Contaminated land is a concern because of:

- The potential risks to human health and ecology (e.g. risk of cancer or other human health effects, loss of ecology);
- The liability that it may pose to the polluter/business owners (e.g., cost of remediation, damage of business reputation and/or business-community relations) or affected parties (e.g. workers at the site, nearby property owners).

Contamination of land should be avoided by preventing or controlling the release of hazardous materials, hazardous wastes, or oil to the environment. When contamination of land is suspected or confirmed during any project phase, the cause of the uncontrolled release should be identified and corrected to avoid further releases and associated adverse impacts.

Contaminated lands should be managed to avoid the risk to human health and ecological receptors. The preferred strategy for land decontamination is to reduce the level of contamination at the site while preventing the human exposure to contamination.

To determine whether risk management actions are warranted, the following assessment approach should be applied to establish whether the three risk factors of 'Contaminants', 'Receptors', and 'Exposure Pathways' co-exist, or are likely to co-exist, at the project site under current or possible future land use:

- *Contaminant(s)*: Presence of hazardous materials, waste, or oil in any environmental media at potentially hazardous concentrations
- *Receptor(s)*: Actual or likely contact of humans, wildlife, plants, and other living organisms with the contaminants of concern
- *Exposure pathway(s)*: A combination of the route of migration of the contaminant from its point of release (e.g., leaching into potable groundwater) and exposure routes

(e.g., ingestion, transdermal absorption), which would allow receptor(s) to come into actual contact with contaminants

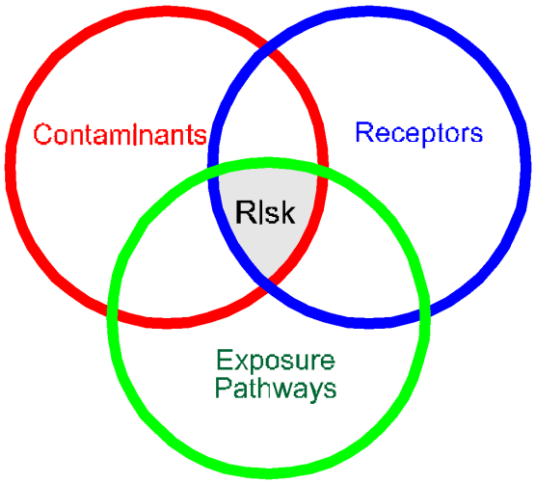


FIGURE 1.8.1: Inter-Relationship of Contaminant Risk Factors

When the three risk factors are considered to be present (in spite of limited data) under current or foreseeable future conditions, the following steps should be followed (as described in the remaining parts of this section):

1) Risk screening;
2) Interim risk management;
3) Detailed quantitative risk assessment; and
4) Permanent risk reduction measures.

Risk Screening

This step is also known as "problem formulation" for environmental risk assessment. Where there is potential evidence of contamination at a site, the following steps are recommended:

Identification of the location of suspected highest level of contamination through a combination of visual and historical operational information;

Sampling and testing of the contaminated media (soils or water) according to established technical methods applicable to suspected type of contaminant[57,58];

Evaluation of the analytical results against the local and national contaminated sites regulations. In the absence of such regulations or environmental standards, other sources of risk-based standards or guidelines should be consulted to obtain comprehensive criteria for screening soil concentrations of pollutants.[59]

Verification of the potential human and/or ecological receptors and exposure pathways relevant to the site in question

The outcome of risk-screening may reveal that there is no overlap between the three risk-factors as the contaminant levels identified are below those considered to pose a risk to human health or the environment. Alternatively, interim or permanent

[57] BC MOE. http://www.env.gov.bc.ca/epd/epdpa/contam_sites/guidance

[58] Massachusetts Department of Environment. http://www.mass.gov/dep/cleanup

[59] These may include the USEPA Region 3 Risk-Based Concentrations (RBCs). http://www.epa.gov/reg3hwmd/risk/human/index.htm. These RBCs are considered acceptable for specific land use and contaminant exposure scenarios as they have been developed by governments using risk assessment techniques for use as general targets in the site remediation. Separate PRGs have been developed or adopted for soil, sediment or groundwater, and often a distinction is made between land uses (as noted earlier) because of the need for more stringent guidelines for residential and agricultural versus commercial/industrial landuse. The RBC Tables contains Reference Doses (RfDs) and Cancer Slope Factors (CSFs) for about 400 chemicals. These toxicity factors have been combined with "standard" exposure scenarios to calculate RBCs--chemical concentrations corresponding to fixed levels of risk (i.e., a Hazard Quotient (HQ) of 1, or lifetime cancer risk of 1E-6, whichever occurs at a lower concentration) in water, air, fish tissue, and soil for individual chemical substances. The primary use of RBCs is for chemical screening during baseline risk assessment (see EPA Regional Guidance EPA/903/R-93-001, "Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening"). Additional useful soil quality guidelines can also be obtained from Lijzen et al. 2001.

risk reduction measures may need to be taken with, or without, more detailed risk assessment activities, as described below.

Interim Risk Management

Interim risk management actions should be implemented at any phase of the project life cycle if the presence of land contamination poses an "imminent hazard", i.e., representing an immediate risk to human health and the environment if contamination were allowed to continue, even a short period of time. Examples of situations considered to involve imminent hazards include, but are not restricted to:

- Presence of an explosive atmosphere caused by contaminated land
- Accessible and excessive contamination for which short-term exposure and potency of contaminants could result in acute toxicity, irreversible long term effects, sensitization, or accumulation of persistent biocumulative and toxic substances
- Concentrations of pollutants at concentrations above the Risk Based Concentrations (RBCs[60]) or drinking water standards in potable water at the point of abstraction

Appropriate risk reduction should be implemented as soon as practicable to remove the condition posing the imminent hazard.

Detailed Risk Assessment

As an alternative to complying with numerical standards or preliminary remediation goals, and depending on local regulatory requirements, a detailed site-specific, environmental risk assessment may be used to develop strategies that yield acceptable health risks, while achieving low level contamination on-site. An assessment of contaminant risks needs to be considered in the context of current and future land use, and development scenarios (e.g., residential, commercial, industrial, and urban parkland or wilderness use).

A detailed quantitative risk assessment builds on risk screening (problem formulation). It involves first, a detailed site investigation to identify the scope of contamination.[61] Site investigation programs should apply quality assurance/quality control (QA/QC) measures to ensure that data quality is adequate for the intended data use (e.g., method detection limits are below levels of concern). The site investigation in turn should be used to develop a *conceptual site model* of how and where contaminants exist, how they are transported, and where routes of exposure occur to organisms and humans. The risk factors and conceptual site model provide a framework for assessing contaminant risks.

Human or ecological risk assessments facilitate risk management decisions at contaminated sites. Specific risk assessment objectives include:

- Identifying relevant human and ecological receptors (e.g., children, adults, fish, wildlife)
- Determining if contaminants are present at levels that pose potential human health and/or ecological concerns (e.g., levels above applicable regulatory criteria based on health or environmental risk considerations)
- Determining how human or ecological receptors are exposed to the contaminants (e.g., ingestions of soil, dermal contact, inhalation of dust)

[60] For example, USEPA Region 3 Risk-Based Concentrations (RBCs). http://www.epa.gov/reg3hwmd/risk/human/index.htm.

[61] Examples include processes defined by the American Society of Testing and Materials (ASTM) Phase II ESA Process; the British Columbia Ministry of Environment Canada (BC MOE) http://www.env.gov.bc.ca/epd/epdpa/contam_sites/guidance); and the Massachusetts Department of Environment http://www.mass.gov/dep/cleanup.

Identifying the types of adverse effects that might result from exposure to the contaminants (e.g., effect on target organ, cancer, impaired growth or reproduction) in the absence of regulatory standards

Quantifying the magnitude of health risks to human and ecological receptors based on a quantitative analysis of contaminant exposure and toxicity (e.g. calculate lifetime cancer risk or ratios of estimated exposure rates compared to safe exposure rates)

Determining how current and proposed future land use influence the predicted risks (e.g. change of land use from industrial to residential with more sensitive receptors such as children)

Quantifying the potential environmental and/or human health risks from off-site contaminant migration (e.g., consider if leaching and groundwater transport, or surface water transport results in exposure at adjacent lands/receptors)

Determining if the risk is likely to remain stable, increase, or decrease with time in the absence of any remediation (e.g., consider if the contaminant is reasonably degradable and likely to remain in place, or be transported to other media)[62]

Addressing these objectives provides a basis to develop and implement risk reduction measures (e.g., clean-up, on-site controls) at the site. If such a need exists, the following additional objectives become relevant:

Determining where, and in what conceptual manner, risk reduction measures should be implemented

Identifying the preferred technologies (including engineering controls) needed to implement the conceptual risk reduction measures

Developing a monitoring plan to ascertain whether risk reduction measures are effective

Considering the need and appropriateness for institutional controls (e.g. deed restriction, land use restrictions) as part of a comprehensive approach

Permanent Risk Reduction Measures

The *risk factors* and *conceptual site model* within the contaminant risk approach described also provide a basis to manage and mitigate environmental contaminant health risks. The underlying principle is to reduce, eliminate, or control any or all of the three risk factors illustrated in Figure 1.8.1. A short list of examples of risk mitigation strategies is provided below, although actual strategies should be developed based on site- specific conditions, and the practicality of prevailing factors and site constraints. Regardless of the management options selected, the action plan should include, whenever possible, *contaminant source reduction* (i.e., net improvement of the site) as part of the overall strategy towards managing health risks at contaminated sites, as this alone provides for improved environmental quality.

Figure 1.8.2 presents a schematic of the inter-relationship of risk factors and example strategies to mitigate contaminant health risk by modifying the conditions of one or more risk factors to ultimately reduce contaminant exposure to the receptor. The selected approach should take into consideration the technical and financial feasibility (e.g. operability of a selected technology given the local availability of technical expertise and equipment and its associated costs).

Example risk mitigation strategies for contaminant source and exposure concentrations include:

[62] An example of a simplified quantitative risk assessment method is the ASTM E1739-95(2002) Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites and the ASTM E2081-00(2004)e1 Standard Guide for Risk-Based Corrective Action (at chemical release sites).

Soil, sediment, and sludge:

- In situ biological treatment (aerobic or anaerobic)
- In situ physical/chemical treatment (e.g., soil vapor extraction with off-gas treatment, chemical oxidation)
- In situ thermal treatment (e.g., steam injection, 6-phase heating)
- Ex situ biological treatment (e.g., excavation and composting)
- Ex situ physical/chemical treatment (e.g., excavation and stabilization)
- Ex situ thermal treatment (e.g., excavation and thermal desorption or incineration)
- Containment (e.g. landfill)
- Natural attenuation
- Other treatment processes

Groundwater, surface water, and leachate:

- In situ biological treatment (aerobic and/or aerobic)
- In situ physical/chemical treatment (e.g., air sparging, zero-valent iron permeable reactive barrier)
- Ex situ biological, physical, and or chemical treatment (i.e., groundwater extraction and treatment)
- Containment (e.g., slurry wall or sheet pile barrier)
- Natural attenuation
- Other treatment processes

Soil vapor intrusion:

- Soil vapor extraction to reduce VOC contaminant source in soil
- Installation of a sub-slab depressurization system to prevent migration of soil vapor into the building
- Creating a positive pressure condition in buildings
- Installation (during building construction) of an impermeable barrier below the building and/or an alternative flow pathway for soil vapor beneath building foundations (e.g., porous media and ventilation to shunt vapors away from building)

Example risk mitigation strategies for receptors include:

Limiting or preventing access to contaminant by receptors (actions targeted at the receptor may include signage with instructions, fencing, or site security)

Imposing health advisory or prohibiting certain practices leading to exposure such as fishing, crab trapping, shellfish collection

Educating receptors (people) to modify behavior in order to reduce exposure (e.g., improved work practices, and use of protective clothing and equipment)

Example risk mitigation strategies for exposure pathways include:

Providing an alternative water supply to replace, for example, a contaminated groundwater supply well

Capping contaminated soil with at least 1m of clean soil to prevent human contact, as well as plant root or small mammal penetration into contaminated soils

Paving over contaminated soil as an interim measure to negate the pathway of direct contact or dust generation and inhalation

Using an interception trench and pump, and treat technologies to prevent contaminated groundwater from discharging into fish streams

The above-reference containment measures should also be considered for immediate implementation in situations where source reduction measures are expected to take time.

Occupational Health and Safety Considerations

Investigation and remediation of contaminated lands requires that workers be mindful of the occupational exposures that could arise from working in close contact with contaminated soil or other environmental media (e.g., groundwater, wastewater, sediments, and soil vapor). Occupational health and safety precautions should be exercised to minimize exposure, as described in Section 2 on Occupational Health and Safety. In addition, workers on contaminated sites should receive special health and safety training specific to contaminated site investigation and remediation activities.[63]

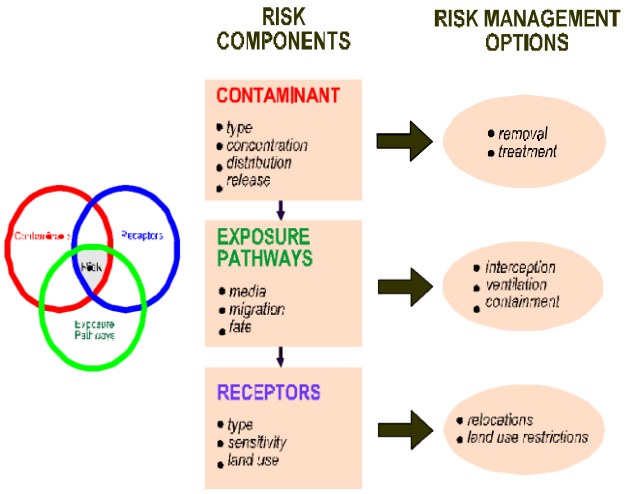


FIGURE 1.8.2: Inter-Relationship of Risk Factors and Management Options

[63] For example, US Occupational Safety and Health Agency (OSHA) regulations found at 40 CFR 1910.120. http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9765

2.0 Occupational Health and Safety

Applicability and Approach

Employers and supervisors are obliged to implement all reasonable precautions to protect the health and safety of workers. This section provides guidance and examples of reasonable precautions to implement in managing principal risks to occupational health and safety. Although the focus is placed on the operational phase of projects, much of the guidance also applies to construction and decommissioning activities. Companies should hire contractors that have the technical capability to manage the occupational health and safety issues of their employees, extending the application of the hazard management activities through formal procurement agreements.

Preventive and protective measures should be introduced according to the following order of priority:

Eliminating the hazard by removing the activity from the work process. Examples include substitution with less hazardous chemicals, using different manufacturing processes, etc;

Controlling the hazard at its source through use of engineering controls. Examples include local exhaust ventilation, isolation rooms, machine guarding, acoustic insulating, etc;

Minimizing the hazard through design of safe work systems and administrative or institutional control measures. Examples include job rotation, training safe work procedures, lock-out and tag-out, workplace monitoring, limiting exposure or work duration, etc.

Providing appropriate personal protective equipment (PPE) in conjunction with training, use, and maintenance of the PPE.

The application of prevention and control measures to occupational hazards should be based on comprehensive job

safety or job hazard analyses. The results of these analyses should be prioritized as part of an action plan based on the likelihood and severity of the consequence of exposure to the identified hazards. An example of a qualitative risk ranking or analysis matrix to help identify priorities is described in Table 2.1.1.

Table 2.1.1. Risk Ranking Table to Classify Worker Scenarios Based on Likelihood and Consequence

Likelihood	Consequences				
	Insignificant 1	Minor 2	Moderate 3	Major 4	Catas-trophic 5
A. Almost certain	L	M	E	E	E
B. Likely	L	M	H	E	E
C. Moderate	L	M	H	E	E
D. Unlikely	L	L	M	H	E
E. Rare	L	L	M	H	H

Legend
E: extreme risk; immediate action required
H: high risk; senior management attention needed
M: moderate risk; management responsibility should be specified
L: low risk; manage by routine procedures

2.1 General Facility Design and Operation

Integrity of Workplace Structures

Permanent and recurrent places of work should be designed and equipped to protect OHS:

Surfaces, structures and installations should be easy to clean and maintain, and not allow for accumulation of hazardous compounds.

Buildings should be structurally safe, provide appropriate protection against the climate, and have acceptable light and noise conditions.

Fire resistant, noise-absorbing materials should, to the extent feasible, be used for cladding on ceilings and walls.

Floors should be level, even, and non-skid.

Heavy oscillating, rotating or alternating equipment should be located in dedicated buildings or structurally isolated sections.

Severe Weather and Facility Shutdown

Work place structures should be designed and constructed to withstand the expected elements for the region and have an area designated for safe refuge, if appropriate.

Standard Operating Procedures (SOPs) should be developed for project or process shut-down, including an evacuation plan. Drills to practice the procedure and plan should also be undertaken annually.

Workspace and Exit

The space provided for each worker, and in total, should be adequate for safe execution of all activities, including transport and interim storage of materials and products. Passages to emergency exits should be unobstructed at all times. Exits should be clearly marked to be visible in total darkness. The number and capacity of emergency exits should be sufficient for safe and orderly evacuation of the greatest number of people present at any time, and there should be a minimum two exits from any work area.

Facilities also should be designed and built taking into account the needs of disabled persons.

Fire Precautions

The workplace should be designed to prevent the start of fires through the implementation of fire codes applicable to industrial settings. Other essential measures include:

Equipping facilities with fire detectors, alarm systems, and fire-fighting equipment. The equipment should be maintained in good working order and be readily accessible. It should be adequate for the dimensions and use of the premises, equipment installed, physical and chemical properties of substances present, and the maximum number of people present.

Provision of manual firefighting equipment that is easily accessible and simple to use

Fire and emergency alarm systems that are both audible and visible

The IFC Life and Fire Safety Guideline should apply to buildings accessible to the public (See Section 3.3).

Lavatories and Showers

Adequate lavatory facilities (toilets and washing areas) should be provided for the number of people expected to work in the facility and allowances made for segregated facilities, or for indicating whether the toilet facility is "In Use" or "Vacant". Toilet facilities should also be provided with adequate supplies of hot and cold running water, soap, and hand drying devices.

Where workers may be exposed to substances poisonous by ingestion and skin contamination may occur, facilities for showering and changing into and out of street and work clothes should be provided.

Potable Water Supply

Adequate supplies of potable drinking water should be provided from a fountain with an upward jet or with a sanitary means of collecting the water for the purposes of drinking Water supplied to areas of food preparation or for the purpose of personal hygiene (washing or bathing) should meet drinking water quality standards

Clean Eating Area

Where there is potential for exposure to substances poisonous by ingestion, suitable arrangements are to be made for provision of clean eating areas where workers are not exposed to the hazardous or noxious substances

Lighting

Workplaces should, to the degree feasible, receive natural light and be supplemented with sufficient artificial illumination to promote workers' safety and health, and enable safe equipment operation. Supplemental 'task lighting' may be required where specific visual acuity requirements should be met.

Emergency lighting of adequate intensity should be installed and automatically activated upon failure of the principal artificial light source to ensure safe shut-down, evacuation, etc.

Safe Access

Passageways for pedestrians and vehicles within and outside buildings should be segregated and provide for easy, safe, and appropriate access

Equipment and installations requiring servicing, inspection, and/or cleaning should have unobstructed, unrestricted, and ready access

Hand, knee and foot railings should be installed on stairs, fixed ladders, platforms, permanent and interim floor openings, loading bays, ramps, etc.

Openings should be sealed by gates or removable chains

Covers should, if feasible, be installed to protect against falling items

Measures to prevent unauthorized access to dangerous areas should be in place

First Aid

The employer should ensure that qualified first-aid can be provided at all times. Appropriately equipped first-aid stations should be easily accessible throughout the place of work

Eye-wash stations and/or emergency showers should be provided close to all workstations where immediate flushing with water is the recommended first-aid response

Where the scale of work or the type of activity being carried out so requires, dedicated and appropriately equipped first-aid room(s) should be provided. First aid stations and rooms should be equipped with gloves, gowns, and masks for protection against direct contact with blood and other body fluids

Remote sites should have written emergency procedures in place for dealing with cases of trauma or serious illness up to the point at which patient care can be transferred to an appropriate medical facility.

Air Supply

Sufficient fresh air should be supplied for indoor and confined work spaces. Factors to be considered in ventilation design include physical activity, substances in use, and process-related emissions. Air distribution systems should be designed so as not to expose workers to draughts

Mechanical ventilation systems should be maintained in good working order. Point-source exhaust systems required for maintaining a safe ambient environment should have local indicators of correct functioning.

Re-circulation of contaminated air is not acceptable. Air inlet filters should be kept clean and free of dust and microorganisms. Heating, ventilation and air conditioning (HVAC) and industrial evaporative cooling systems should be equipped, maintained and operated so as to prevent growth and spreading of disease agents (e.g. *Legionnella pneumophilia*) or breeding of vectors (e.g. mosquitoes and flies) of public health concern.

Work Environment Temperature

The temperature in work, rest room and other welfare facilities should, during service hours, be maintained at a level appropriate for the purpose of the facility.

2.2 Communication and Training

OHS Training

Provisions should be made to provide OHS orientation training to all new employees to ensure they are apprised of the basic site rules of work at / on the site and of personal protection and preventing injury to fellow employees.

Training should consist of basic hazard awareness, site-specific hazards, safe work practices, and emergency procedures for fire, evacuation, and natural disaster, as appropriate. Any site-specific hazard or color coding in use should be thoroughly reviewed as part of orientation training.

Visitor Orientation

If visitors to the site can gain access to areas where hazardous conditions or substances may be present, a visitor orientation and control program should be established to ensure visitors do not enter hazard areas unescorted.

New Task Employee and Contractor Training

The employer should ensure that workers and contractors, prior to commencement of new assignments, have received adequate training and information enabling them to

understand work hazards and to protect their health from hazardous ambient factors that may be present.

The training should adequately cover:

- Knowledge of materials, equipment, and tools
- Known hazards in the operations and how they are controlled
- Potential risks to health
- Precautions to prevent exposure
- Hygiene requirements
- Wearing and use of protective equipment and clothing
- Appropriate response to operation extremes, incidents and accidents

Basic OHS Training

A basic occupational training program and specialty courses should be provided, as needed, to ensure that workers are oriented to the specific hazards of individual work assignments. Training should generally be provided to management, supervisors, workers, and occasional visitors to areas of risks and hazards.

Workers with rescue and first-aid duties should receive dedicated training so as not to inadvertently aggravate exposures and health hazards to themselves or their co-workers. Training would include the risks of becoming infected with blood–borne pathogens through contact with bodily fluids and tissue.

Through appropriate contract specifications and monitoring, the employer should ensure that service providers, as well as contracted and subcontracted labor, are trained adequately before assignments begin.

Area Signage

Hazardous areas (electrical rooms, compressor rooms, etc), installations, materials, safety measures, and emergency exits, etc. should be marked appropriately.

Signage should be in accordance with international standards and be well known to, and easily understood by workers, visitors and the general public as appropriate.

Labeling of Equipment

All vessels that may contain substances that are hazardous as a result of chemical or toxicological properties, or temperature or pressure, should be labeled as to the contents and hazard, or appropriately color coded.

Similarly, piping systems that contain hazardous substances should be labeled with the direction of flow and contents of the pipe, or color coded whenever the pipe passing through a wall or floor is interrupted by a valve or junction device.

Communicate Hazard Codes

Copies of the hazard coding system should be posted outside the facility at emergency entrance doors and fire emergency connection systems where they are likely to come to the attention of emergency services personnel. Information regarding the types of hazardous materials stored, handled or used at the facility, including typical maximum inventories and storage locations, should be shared proactively with emergency services and security personnel to expedite emergency response when needed. Representatives of local emergency and security services should be invited to participate in periodic (annual) orientation tours and site inspections to ensure familiarity with potential hazards present.

2.3 Physical Hazards

Physical hazards represent potential for accident or injury or illness due to repetitive exposure to mechanical action or work activity. Single exposure to physical hazards may result in a wide range of injuries, from minor and medical aid only, to disabling, catastrophic, and/or fatal. Multiple exposures over prolonged

periods can result in disabling injuries of comparable significance and consequence.

Rotating and Moving Equipment

Injury or death can occur from being trapped, entangled, or struck by machinery parts due to unexpected starting of equipment or unobvious movement during operations. Recommended protective measures include:

- Designing machines to eliminate trap hazards and ensuring that extremities are kept out of harm's way under normal operating conditions. Examples of proper design considerations include two-hand operated machines to prevent amputations or the availability of emergency stops dedicated to the machine and placed in strategic locations.
- Where a machine or equipment has an exposed moving part or exposed pinch point that may endanger the safety of any worker, the machine or equipment should be equipped with, and protected by, a guard or other device that prevents access to the moving part or pinch point. Guards should be designed and installed in conformance with appropriate machine safety standards.[64]
- Turning off, disconnecting, isolating, and de-energizing (Locked Out and Tagged Out) machinery with exposed or guarded moving parts, or in which energy can be stored (e.g. compressed air, electrical components) during servicing or maintenance, in conformance with a standard such as CSA Z460 Lockout or equivalent ISO or ANSI standard
- Designing and installing equipment, where feasible, to enable routine service, such as lubrication, without removal of the guarding devices or mechanisms

[64] For example: CSA Z432.04 Safe Guarding of Machinery, CSA Z434 Robot Safety, ISO 11161 Safety of Machinery – Integrated Manufacturing Systems or ISO 14121 Safety of Machinery – Principals of Risk Management or equivalent ANSI standard.

Noise

Noise limits for different working environments are provided in Table 2.3.1.

- No employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection. In addition, no unprotected ear should be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C).
- The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB(A), the peak sound levels reach 140 dB(C), or the average maximum sound level reaches 110dB(A). Hearing protective devices provided should be capable of reducing sound levels at the ear to at least 85 dB(A).
- Although hearing protection is preferred for any period of noise exposure in excess of 85 dB(A), an equivalent level of protection can be obtained, but less easily managed, by limiting the duration of noise exposure. For every 3 dB(A) increase in sound levels, the 'allowed' exposure period or duration should be reduced by 50 percent.[65]
- Prior to the issuance of hearing protective devices as the final control mechanism, use of acoustic insulating materials, isolation of the noise source, and other engineering controls should be investigated and implemented, where feasible
- Periodic medical hearing checks should be performed on workers exposed to high noise levels

Vibration

Exposure to hand-arm vibration from equipment such as hand and power tools, or whole-body vibrations from surfaces on which the worker stands or sits, should be controlled through choice of equipment, installation of vibration dampening pads or devices, and limiting the duration of exposure. Limits for vibration and

[65] The American Conference of Governmental Industrial Hygienists (ACGIH), 2006

action values, (i.e. the level of exposure at which remediation should be initiated) are provided by the ACGIH[66]. Exposure levels should be checked on the basis of daily exposure time and data provided by equipment manufacturers.

Electrical

Exposed or faulty electrical devices, such as circuit breakers, panels, cables, cords and hand tools, can pose a serious risk to workers. Overhead wires can be struck by metal devices, such as poles or ladders, and by vehicles with metal booms. Vehicles or grounded metal objects brought into close proximity with overhead wires can result in arcing between the wires and the object, without actual contact. Recommended actions include:

Table 2.3.1. Noise Limits for Various Working Environments

Location /activity	Equivalent level LA_{eq},8h	Maximum LA_{max},fast
Heavy Industry (no demand for oral communication)	85 dB(A)	110 dB(A)
Light industry (decreasing demand for oral communication)	50-65 dB(A)	110 dB(A)
Open offices, control rooms, service counters or similar	45-50 dB(A)	-
Individual offices (no disturbing noise)	40-45 dB(A)	-
Classrooms, lecture halls	35-40 dB(A)	-
Hospitals	30-35 dB(A)	40 dB(A)

Marking all energized electrical devices and lines with warning signs

Locking out (de-charging and leaving open with a controlled locking device) and tagging-out (warning sign placed on the lock) devices during service or maintenance

Checking all electrical cords, cables, and hand power tools for frayed or exposed cords and following manufacturer recommendations for maximum permitted operating voltage of the portable hand tools

Double insulating / grounding all electrical equipment used in environments that are, or may become, wet; using equipment with ground fault interrupter (GFI) protected circuits

Protecting power cords and extension cords against damage from traffic by shielding or suspending above traffic areas

Appropriate labeling of service rooms housing high voltage equipment ('electrical hazard') and where entry is controlled or prohibited (see also Section 3 on Planning, Siting, and Design);

Establishing "No Approach" zones around or under high voltage power lines in conformance with Table 2.3.2

Rubber tired construction or other vehicles that come into direct contact with, or arcing between, high voltage wires may need to be taken out of service for periods of 48 hours and have the tires replaced to prevent catastrophic tire and wheel assembly failure, potentially causing serious injury or death;

Conducting detailed identification and marking of all buried electrical wiring prior to any excavation work

[66] ACGIH, 2005

Table 2.3.2. No Approach Zones for High Voltage Power Lines

Nominal phase-to-phase voltage rating	Minimum distance
750 or more volts, but no more than 150,000 volts	3 meters
More than 150,000 volts, but no more than 250,000 volts	4.5 meters
More than 250,000 volts	6 meters

Eye Hazards

Solid particles from a wide variety of industrial operations, and / or a liquid chemical spray may strike a worker in the eye causing an eye injury or permanent blindness. Recommended measures include:

Use of machine guards or splash shields and/or face and eye protection devices, such as safety glasses with side shields, goggles, and/or a full face shield. Specific Safe Operating Procedures (SOPs) may be required for use of sanding and grinding tools and/or when working around liquid chemicals. Frequent checks of these types of equipment prior to use to ensure mechanical integrity is also good practice. Machine and equipment guarding should conform to standards published by organizations such as CSA, ANSI and ISO (see also Section 2.3 on Rotating and Moving Equipment and 2.7 on Personal Protective Equipment).

Moving areas where the discharge of solid fragments, liquid, or gaseous emissions can reasonably be predicted (e.g. discharge of sparks from a metal cutting station, pressure relief valve discharge) away from places expected to be occupied or transited by workers or visitors. Where machine or work fragments could present a hazard to transient workers or passers-by, extra area guarding or proximity restricting systems should be implemented, or PPE required for transients and visitors.

Provisions should be made for persons who have to wear prescription glasses either through the use overglasses or prescription hardened glasses.

Welding / Hot Work

Welding creates an extremely bright and intense light that may seriously injur a worker's eyesight. In extreme cases, blindness may result. Additionally, welding may produce noxious fumes to which prolonged exposure can cause serious chronic diseases. Recommended measures include:

Provision of proper eye protection such as welder goggles and/or a full-face eye shield for all personnel involved in, or assisting, welding operations. Additional methods may include the use of welding barrier screens around the specific work station (a solid piece of light metal, canvas, or plywood designed to block welding light from others). Devices to extract and remove noxious fumes at the source may also be required.

Special hot work and fire prevention precautions and Standard Operating Procedures (SOPs) should be implemented if welding or hot cutting is undertaken outside established welding work stations, including 'Hot Work Permits, stand-by fire extinguishers, stand-by fire watch, and maintaining the fire watch for up to one hour after welding or hot cutting has terminated. Special procedures are required for hotwork on tanks or vessels that have contained flammable materials.

Industrial Vehicle Driving and Site Traffic

Poorly trained or inexperienced industrial vehicle drivers have increased risk of accident with other vehicles, pedestrians, and equipment. Industrial vehicles and delivery vehicles, as well as private vehicles on-site, also represent potential collision scenarios. Industrial vehicle driving and site traffic safety practices include:

Training and licensing industrial vehicle operators in the safe operation of specialized vehicles such as forklifts, including safe loading/unloading, load limits

Ensuring drivers undergo medical surveillance

Ensuring moving equipment with restricted rear visibility is outfitted with audible back-up alarms

Establishing rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures (e.g. prohibiting operation of forklifts with forks in down position), and control of traffic patterns or direction

Restricting the circulation of delivery and private vehicles to defined routes and areas, giving preference to 'one-way' circulation, where appropriate

Working Environment Temperature

Exposure to hot or cold working conditions in indoor or outdoor environments can result temperature stress-related injury or death. Use of personal protective equipment (PPE) to protect against other occupational hazards can accentuate and aggravate heat-related illnesses. Extreme temperatures in permanent work environments should be avoided through implementation of engineering controls and ventilation. Where this is not possible, such as during short-term outdoor work, temperature-related stress management procedures should be implemented which include:

Monitoring weather forecasts for outdoor work to provide advance warning of extreme weather and scheduling work accordingly

Adjustment of work and rest periods according to temperature stress management procedures provided by ACGIH[67], depending on the temperature and workloads

Providing temporary shelters to protect against the elements during working activities or for use as rest areas

Use of protective clothing

Providing easy access to adequate hydration such as drinking water or electrolyte drinks, and avoiding consumption of alcoholic beverages

Ergonomics, Repetitive Motion, Manual Handling

Injuries due to ergonomic factors, such as repetitive motion, over-exertion, and manual handling, take prolonged and repeated exposures to develop, and typically require periods of weeks to months for recovery. These OHS problems should be minimized or eliminated to maintain a productive workplace. Controls may include:

Facility and workstation design with 5th to 95th percentile operational and maintenance workers in mind

Use of mechanical assists to eliminate or reduce exertions required to lift materials, hold tools and work objects, and requiring multi-person lifts if weights exceed thresholds

Selecting and designing tools that reduce force requirements and holding times, and improve postures

Providing user adjustable work stations

Incorporating rest and stretch breaks into work processes, and conducting job rotation

Implementing quality control and maintenance programs that reduce unnecessary forces and exertions

Taking into consideration additional special conditions such as left handed persons

Working at Heights

Fall prevention and protection measures should be implemented whenever a worker is exposed to the hazard of falling more than two meters; into operating machinery; into water or other liquid; into hazardous substances; or through an opening in a work surface. Fall prevention / protection measures may also be warranted on a case-specific basis when there are risks of falling from lesser heights. Fall prevention may include:

[67] ACGIH, 2005

Installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area

Proper use of ladders and scaffolds by trained employees Use of fall prevention devices, including safety belt and lanyard travel limiting devices to prevent access to fall hazard area, or fall protection devices such as full body harnesses used in conjunction with shock absorbing lanyards or self- retracting inertial fall arrest devices attached to fixed anchor point or horizontal life-lines

Appropriate training in use, serviceability, and integrity of the necessary PPE

Inclusion of rescue and/or recovery plans, and equipment to respond to workers after an arrested fall

Illumination

Work area light intensity should be adequate for the general purpose of the location and type of activity, and should be supplemented with dedicated work station illumination, as needed. The minimum limits for illumination intensity for a range of locations/activities appear in Table 2.3.3.

Table 2.3.3. Minimum Limits For Workplace Illumination Intensity

Location / Activity	Light Intensity
Emergency light	10 lux
Outdoor non working areas	20 lux
Simple orientation and temporary visits (machine storage, garage, warehouse)	50 lux
Workspace with occasional visual tasks only (corridors, stairways, lobby, elevator, auditorium, etc.)	100 lux
Medium precision work (simple assembly, rough machine works, welding, packing, etc.)	200 lux
Precision work (reading, moderately difficult assembly, sorting, checking, medium bench and machine works, etc.), offices.	500 lux
High precision work (difficult assembly, sewing, color inspection, fine sorting etc.)	1,000 – 3,000 lux

Controls should include:

Use of energy efficient light sources with minimum heat emission

Undertaking measures to eliminate glare / reflections and flickering of lights

Taking precautions to minimize and control optical radiation including direct sunlight. Exposure to high intensity UV and IR radiation and high intensity visible light should also be controlled

Controlling laser hazards in accordance with equipment specifications, certifications, and recognized safety standards. The lowest feasible class Laser should be applied to minimize risks.

2.4 Chemical Hazards

Chemical hazards represent potential for illness or injury due to single acute exposure or chronic repetitive exposure to toxic, corrosive, sensitizing or oxidative substances. They also represent a risk of uncontrolled reaction, including the risk of fire and explosion, if incompatible chemicals are inadvertently mixed. Chemical hazards can most effectively be prevented through a hierarchical approach that includes:

Replacement of the hazardous substance with a less hazardous substitute

Implementation of engineering and administrative control measures to avoid or minimize the release of hazardous substances into the work environment keeping the level of exposure below internationally established or recognized limits

Keeping the number of employees exposed, or likely to become exposed, to a minimum

Communicating chemical hazards to workers through labeling and marking according to national and internationally recognized requirements and standards, including the International Chemical Safety Cards (ICSC), Materials Safety Data Sheets (MSDS), or equivalent. Any means of written communication should be in an easily understood language and be readily available to exposed workers and first-aid personnel

Training workers in the use of the available information (such as MSDSs), safe work practices, and appropriate use of PPE

Air Quality

Poor air quality due to the release of contaminants into the work place can result in possible respiratory irritation, discomfort, or illness to workers. Employers should take appropriate measures to maintain air quality in the work area. These include:

Maintaining levels of contaminant dusts, vapors and gases in the work environment at concentrations below those recommended by the ACGIH[68] as TWA-TLV's (threshold limit value)—concentrations to which most workers can be exposed repeatedly (8 hours/day, 40 hrs/week, week-after-week), without sustaining adverse health effects.

Developing and implementing work practices to minimize release of contaminants into the work environment including:

- Direct piping of liquid and gaseous materials
- Minimized handling of dry powdered materials;
- Enclosed operations
- Local exhaust ventilation at emission / release points
- Vacuum transfer of dry material rather than mechanical or pneumatic conveyance
- Indoor secure storage, and sealed containers rather than loose storage

Where ambient air contains several materials that have similar effects on the same body organs (additive effects), taking into account combined exposures using calculations recommended by the ACGIH[69]

Where work shifts extend beyond eight (8) hours, calculating adjusted workplace exposure criteria recommended by the ACGIH[70]

Fire and Explosions

Fires and or explosions resulting from ignition of flammable materials or gases can lead to loss of property as well as possible injury or fatalities to project workers. Prevention and control strategies include:

Storing flammables away from ignition sources and oxidizing materials. Further, flammables storage area should be:

- Remote from entry and exit points into buildings
- Away from facility ventilation intakes or vents
- Have natural or passive floor and ceiling level ventilation and explosion venting
- Use spark-proof fixtures
- Be equipped with fire extinguishing devices and self-closing doors, and constructed of materials made to withstand flame impingement for a moderate period of time

Providing bonding and grounding of, and between, containers and additional mechanical floor level ventilation if materials are being, or could be, dispensed in the storage area

Where the flammable material is mainly comprised of dust, providing electrical grounding, spark detection, and, if needed, quenching systems

[68] ACGIH, 2005

[69] ACGIH, 2005.

[70] ACGIH, 2005.

Defining and labeling fire hazards areas to warn of special rules (e.g. prohibition in use of smoking materials, cellular phones, or other potential spark generating equipment)
Providing specific worker training in handling of flammable materials, and in fire prevention or suppression

Corrosive, oxidizing, and reactive chemicals

Corrosive, oxidizing, and reactive chemicals present similar hazards and require similar control measures as flammable materials. However, the added hazard of these chemicals is that inadvertent mixing or intermixing may cause serious adverse reactions. This can lead to the release of flammable or toxic materials and gases, and may lead directly to fires and explosions. These types of substances have the additional hazard of causing significant personal injury upon direct contact, regardless of any intermixing issues. The following controls should be observed in the work environment when handling such chemicals:

Corrosive, oxidizing and reactive chemicals should be segregated from flammable materials and from other chemicals of incompatible class (acids vs. bases, oxidizers vs. reducers, water sensitive vs. water based, etc.), stored in ventilated areas and in containers with appropriate secondary containment to minimize intermixing during spills
Workers who are required to handle corrosive, oxidizing, or reactive chemicals should be provided with specialized training and provided with, and wear, appropriate PPE (gloves, apron, splash suits, face shield or goggles, etc). Where corrosive, oxidizing, or reactive chemicals are used, handled, or stored, qualified first-aid should be ensured at all times. Appropriately equipped first-aid stations should be easily accessible throughout the place of work, and eye-wash stations and/or emergency showers should be provided close to all workstations where the recommended first-aid response is immediate flushing with water

Asbestos Containing Materials (ACM)

The use of asbestos containing materials (ACM) should be avoided in new buildings or as a new material in remodeling or renovation activities. Existing facilities with ACM should develop an asbestos management plan which clearly identifies the locations where the ACM is present, its condition (e.g. whether it is in friable form with the potential to release fibers), procedures for monitoring its condition, procedures to access the locations where ACM is present to avoid damage, and training of staff who can potentially come into contact with the material to avoid damage and prevent exposure. The plan should be made available to all persons involved in operations and maintenance activities. Repair or removal and disposal of existing ACM in buildings should only be performed by specially trained personnel[71] following host country requirements, or in their absence, internationally recognized procedures.[72]

2.5 Biological Hazards

Biological agents represent potential for illness or injury due to single acute exposure or chronic repetitive exposure. Biological hazards can be prevented most effectively by implementing the following measures:

If the nature of the activity permits, use of any harmful biological agents should be avoided and replaced with an agent that, under normal conditions of use, is not dangerous or less dangerous to workers. If use of harmful agents can not be avoided, precautions should be taken to keep the risk of exposure as low as possible and maintained below internationally established and recognized exposure limits.

[71] Training of specialized personnel and the maintenance and removal methods applied should be equivalent to those required under applicable regulations in the United States and Europe (examples of North American training standards are available at: http://www.osha.gov/SLTC/asbestos/training.html)
[72] Examples include the American Society for Testing and Materials (ASTM) E 1368 - Standard Practice for Visual Inspection of Asbestos Abatement Projects; E 2356 - Standard Practice for Comprehensive Building Asbestos Surveys; and E 2394 - Standard Practice for Maintenance, Renovation and Repair of Installed Asbestos Cement Products.

Work processes, engineering, and administrative controls should be designed, maintained, and operated to avoid or minimize release of biological agents into the working environment. The number of employees exposed or likely to become exposed should be kept at a minimum.

The employer should review and assess known and suspected presence of biological agents at the place of work and implement appropriate safety measures, monitoring, training, and training verification programs.

Measures to eliminate and control hazards from known and suspected biological agents at the place of work should be designed, implemented and maintained in close co-operation with the local health authorities and according to recognized international standards.

Biological agents should be classified into four groups[73]:

Group 1: Biological agents unlikely to cause human disease, and consequently only require controls similar to those required for hazardous or reactive chemical substances;

Group 2: Biological agents that can cause human disease and are thereby likely to require additional controls, but are unlikely to spread to the community;

Group 3: Biological agents that can cause severe human disease, present a serious hazard to workers, and may present a risk of spreading to the community, for which there usually is effective prophylaxis or treatment available and are thereby likely to require extensive additional controls;

Group 4: Biological agents that can cause severe human disease, are a serious hazard to workers, and present a high risk of spreading to the community, for which there is usually no effective prophylaxis or treatment available and are thereby likely to require very extensive additional controls.

The employer should at all times encourage and enforce the highest level of hygiene and personal protection, especially for activities employing biological agents of Groups 3 and 4 above. Work involving agents in Groups 3 and 4 should be restricted only to those persons who have received specific verifiable training in working with and controlling such materials.

Areas used for the handling of Groups 3 and 4 biological agents should be designed to enable their full segregation and isolation in emergency circumstances, include independent ventilation systems, and be subject to SOPs requiring routine disinfection and sterilization of the work surfaces.

HVAC systems serving areas handling Groups 3 and 4 biological agents should be equipped with High Efficiency Particulate Air (HEPA) filtration systems. Equipment should readily enable their disinfection and sterilization, and maintained and operated so as to prevent growth and spreading of disease agents, amplification of the biological agents, or breeding of vectors e.g. mosquitoes and flies of public health concern.

[73] World Health Organization (WHO) Classification of Infective Microorganisms by Risk Group (2004).

2.6 Radiological Hazards

Radiation exposure can lead to potential discomfort, injury or serious illness to workers. Prevention and control strategies include:

Places of work involving occupational and/or natural exposure to ionizing radiation should be established and operated in accordance with recognized international safety standards and guidelines.[74] The acceptable effective dose limits appear Table 2.6.1.

Exposure to non-ionizing radiation (including static magnetic fields; sub-radio frequency magnetic fields; static electric fields; radio frequency and microwave radiation; light and near-infrared radiation; and ultraviolet radiation) should be controlled to internationally recommended limits[75].

Table 2.6.1. Acceptable Effective Dose Limits for Workplace Radiological Hazards

Exposure	Workers (min.19 years of age)	Apprentices and students (16-18 years of age)
Five consecutive year average – effective dose	20 mSv/year	
Single year exposure – effective dose	50 mSv/year	6 mSv/year
Equivalent dose to the lens of the eye	150 mSv/year	50 mSv/year
Equivalent dose to the extremities (hands, feet) or the skin	500 mSv/year	150 mSv/year

In the case of both ionizing and non-ionizing radiation, the preferred method for controlling exposure is shielding and limiting the radiation source. Personal protective equipment is supplemental only or for emergency use. Personal protective equipment for near-infrared, visible and ultraviolet range radiation can include appropriate sun block creams, with or without appropriate screening clothing.

2.7 Personal Protective Equipment (PPE)

Personal Protective Equipment (PPE) provides additional protection to workers exposed to workplace hazards in conjunction with other facility controls and safety systems.

PPE is considered to be a last resort that is above and beyond the other facility controls and provides the worker with an extra level of personal protection. Table 2.7.1 presents general examples of occupational hazards and types of PPE available for different purposes. Recommended measures for use of PPE in the workplace include:

Active use of PPE if alternative technologies, work plans or procedures cannot eliminate, or sufficiently reduce, a hazard or exposure

Identification and provision of appropriate PPE that offers adequate protection to the worker, co-workers, and occasional visitors, without incurring unnecessary inconvenience to the individual

Proper maintenance of PPE, including cleaning when dirty and replacement when damaged or worn out. Proper use of PPE should be part of the recurrent training programs for employees

[74] International Basic Safety Standard for protection against Ionizing Radiation and for the Safety of Radiation Sources and its three interrelated Safety Guides.

IAEA. http://www-ns.iaea.org/standards/documents/default.asp?sub=160

[75] For example ACGIH (2005) and International Commission for Non-Ionizing Radiation (ICNIRP).

Selection of PPE should be based on the hazard and risk ranking described earlier in this section, and selected according to criteria on performance and testing established by recognized organizations[76].

Table 2.7.1. Summary of Recommended Personal Protective Equipment According to Hazard

Objective	Workplace Hazards	Suggested PPE
Eye and face protection	Flying particles, molten metal, liquid chemicals, gases or vapors, light radiation.	Safety Glasses with side-shields, protective shades, etc.
Head protection	Falling objects, inadequate height clearance, and overhead power cords.	Plastic Helmets with top and side impact protection.
Hearing protection	Noise, ultra-sound.	Hearing protectors (ear plugs or ear muffs).
Foot protection	Falling or rolling objects, pointed objects. Corrosive or hot liquids.	Safety shoes and boots for protection against moving & falling objects, liquids and chemicals.
Hand protection	Hazardous materials, cuts or lacerations, vibrations, extreme temperatures.	Gloves made of rubber or synthetic materials (Neoprene), leather, steel, insulating materials, etc.
Respiratory protection	Dust, fogs, fumes, mists, gases, smokes, vapors.	Facemasks with appropriate filters for dust removal and air purification (chemicals, mists, vapors and gases). Single or multi-gas personal monitors, if available.
	Oxygen deficiency	Portable or supplied air (fixed lines). On-site rescue equipment.
Body/leg protection	Extreme temperatures, hazardous materials, biological agents, cutting and laceration.	Insulating clothing, body suits, aprons etc. of appropriate materials.

2.8 Special Hazard Environments

Special hazard environments are work situations where all of the previously described hazards may exist under unique or especially hazardous circumstances. Accordingly, extra precautions or rigor in application of precautions is required.

Confined Space

A confined space is defined as a wholly or partially enclosed space not designed or intended for human occupancy and in which a hazardous atmosphere could develop as a result of the contents, location or construction of the confined space or due to work done in or around the confined space. A "permit-required" confined space is one that also contains physical or atmospheric hazards that could trap or engulf the person.[77]

Confined spaces can occur in enclosed or open structures or locations. Serious injury or fatality can result from inadequate preparation to enter a confined space or in attempting a rescue from a confined space. Recommended management approaches include:

Engineering measures should be implemented to eliminate, to the degree feasible, the existence and adverse character of confined spaces.

Permit-required confined spaces should be provided with permanent safety measures for venting, monitoring, and rescue operations, to the extent possible. The area adjoining an access to a confined space should provide ample room for emergency and rescue operations.

[76] Examples include the American National Standards Institute (ANSI), http://www.ansi.org/; National Institute for Occupational Safety and Health[76] (NIOSH), http://www.cdc.gov/niosh/homepage.html; Canadian Standards Association[76] (CSA), http://www.csa.ca/Default.asp?language=english; Mine Safety and Health Administration[76] (MSHA), http://www.msha.gov.

[77] US OSHA CFR 1910.146

Access hatches should accommodate 90% of the worker population with adjustments for tools and protective clothing. The most current ISO and EN standards should be consulted for design specifications;

Prior to entry into a permit-required confined space:

- Process or feed lines into the space should be disconnected or drained, and blanked and locked-out.
- Mechanical equipment in the space should be disconnected, de-energized, locked-out, and braced, as appropriate.
- The atmosphere within the confined space should be tested to assure the oxygen content is between 19.5 percent and 23 percent, and that the presence of any flammable gas or vapor does not exceed 25 percent of its respective Lower Explosive Limit (LEL).
- If the atmospheric conditions are not met, the confined space should be ventilated until the target safe atmosphere is achieved, or entry is only to be undertaken with appropriate and additional PPE.

Safety precautions should include Self Contained Breathing Apparatus (SCBA), life lines, and safety watch workers stationed outside the confined space, with rescue and first aid equipment readily available.

Before workers are required to enter a permit-required confined space, adequate and appropriate training in confined space hazard control, atmospheric testing, use of the necessary PPE, as well as the serviceability and integrity of the PPE should be verified. Further, adequate and appropriate rescue and / or recovery plans and equipment should be in place before the worker enters the confined space.

Lone and Isolated Workers

A lone and isolated worker is a worker out of verbal and line of sight communication with a supervisor, other workers, or other persons capable of providing aid and assistance, for continuous periods exceeding one hour. The worker is therefore at increased risk should an accident or injury occur.

Where workers may be required to perform work under lone or isolated circumstances, Standard Operating Procedures (SOPs) should be developed and implemented to ensure all PPE and safety measures are in place before the worker starts work. SOPs should establish, at a minimum, verbal contact with the worker at least once every hour, and ensure the worker has a capability for summoning emergency aid.

If the worker is potentially exposed to highly toxic or corrosive chemicals, emergency eye-wash and shower facilities should be equipped with audible and visible alarms to summon aid whenever the eye-wash or shower is activated by the worker and without intervention by the worker.

2.9 Monitoring

Occupational health and safety monitoring programs should verify the effectiveness of prevention and control strategies. The selected indicators should be representative of the most significant occupational, health, and safety hazards, and the implementation of prevention and control strategies. The occupational health and safety monitoring program should include:

Safety inspection, testing and calibration: This should include regular inspection and testing of all safety features and hazard control measures focusing on engineering and personal protective features, work procedures, places of work, installations, equipment, and tools used. The inspection should verify that issued PPE continues to provide adequate protection and is being worn as required. All instruments installed or used for monitoring and recording of working environment parameters should be regularly tested and calibrated, and the respective records maintained.

Surveillance of the working environment: Employers should document compliance using an appropriate combination of

portable and stationary sampling and monitoring instruments. Monitoring and analyses should be conducted according to internationally recognized methods and standards. Monitoring methodology, locations, frequencies, and parameters should be established individually for each project following a review of the hazards. Generally, monitoring should be performed during commissioning of facilities or equipment and at the end of the defect and liability period, and otherwise repeated according to the monitoring plan.

Surveillance of workers health: When extraordinary protective measures are required (for example, against biological agents Groups 3 and 4, and/or hazardous compounds), workers should be provided appropriate and relevant health surveillance prior to first exposure, and at regular intervals thereafter. The surveillance should, if deemed necessary, be continued after termination of the employment.

Training: Training activities for employees and visitors should be adequately monitored and documented (curriculum, duration, and participants). Emergency exercises, including fire drills, should be documented adequately. Service providers and contractors should be contractually required to submit to the employer adequate training documentation before start of their assignment.

Accidents and Diseases monitoring

The employer should establish procedures and systems for reporting and recording:

- Occupational accidents and diseases
- Dangerous occurrences and incidents

These systems should enable workers to report immediately to their immediate supervisor any situation they believe presents a serious danger to life or health.

The systems and the employer should further enable and encourage workers to report to management all:

- Occupational injuries and near misses
- Suspected cases of occupational disease
- Dangerous occurrences and incidents

All reported occupational accidents, occupational diseases, dangerous occurrences, and incidents together with near misses should be investigated with the assistance of a person knowledgeable/competent in occupational safety. The investigation should:

- Establish what happened
- Determine the cause of what happened
- Identify measures necessary to prevent a recurrence

Occupational accidents and diseases should, at a minimum, be classified according to Table 2.10.1. Distinction is made between fatal and non-fatal injuries. The two main categories are divided into three sub-categories according to time of death or duration of the incapacity to work. The total work hours during the specified reporting period should be reported to the appropriate regulatory agency.

Table 2.9.1. Occupational Accident Reporting

a. Fatalities (number)	**b. Non-fatal injuries** (number) [78]	**c. Total time lost** non-fatal injuries (days)
a.1 Immediate	**b.1** Less than one day	
a.2 Within a month	**b.2** Up to 3 days	**c.1** Category b.2
a.3 Within a year	**b.3** More than 3 days	**c.2** Category b.3

[78] The day on which an incident occurs is not included in b.2 and b.3.

3.0 Community Health and Safety

This section complements the guidance provided in the preceding environmental and occupational health and safety sections, specifically addressing some aspects of project activities taking place outside of the traditional project boundaries, but nonetheless related to the project operations, as may be applicable on a project basis. These issues may arise at any stage of a project life cycle and can have an impact beyond the life of the project.

3.1 Water Quality and Availability

Groundwater and surface water represent essential sources of drinking and irrigation water in developing countries, particularly in rural areas where piped water supply may be limited or unavailable and where available resources are collected by the consumer with little or no treatment. Project activities involving wastewater discharges, water extraction, diversion or impoundment should prevent adverse impacts to the quality and availability of groundwater and surface water resources.

Water Quality

Drinking water sources, whether public or private, should at all times be protected so that they meet or exceed applicable national acceptability standards or in their absence the current edition of WHO Guidelines for Drinking-Water Quality. Air emissions, wastewater effluents, oil and hazardous materials, and wastes should be managed according to the guidance provided in the respective sections of the General EHS Guidelines with the objective of protecting soil and water resources.

Where the project includes the delivery of water to the community or to users of facility infrastructure (such as hotel hosts and hospital patients), where water may be used for drinking, cooking, washing, and bathing, water quality should comply with national acceptability standards or in their absence the current edition of with WHO Drinking Water Guidelines. Water quality for more sensitive well-being-related demands such as water used in health care facilities or food production may require more stringent, industry-specific guidelines or standards, as applicable. Any dependency factors associated with the deliver of water to the local community should be planned for and managed to ensure the sustainability of the water supply by involving the community in its management to minimize the dependency in the long-term.

Water Availability

The potential effect of groundwater or surface water abstraction for project activities should be properly assessed through a combination of field testing and modeling techniques, accounting for seasonal variability and projected changes in demand in the project area.

Project activities should not compromise the availability of water for personal hygiene needs and should take account of potential future increases in demand. The overall target should be the availability of 100 liters per person per day although lower levels may be used to meet basic health requirements.[79] Water volume requirements for well-being-related demands such as water use in health care facilities may need to be higher.

3.2 Structural Safety of Project Infrastructure

Hazards posed to the public while accessing project facilities may include:

- Physical trauma associated with failure of building structures
- Burns and smoke inhalation from fires
- Injuries suffered as a consequence of falls or contact with heavy equipment
- Respiratory distress from dust, fumes, or noxious odors
- Exposure to hazardous materials

Reduction of potential hazards is best accomplished during the design phase when the structural design, layout and site modifications can be adapted more easily. The following issues should be considered and incorporated as appropriate into the planning, siting, and design phases of a project:

- Inclusion of buffer strips or other methods of physical separation around project sites to protect the public from major hazards associated with hazardous materials incidents or process failure, as well as nuisance issues related to noise, odors, or other emissions
- Incorporation of siting and safety engineering criteria to prevent failures due to natural risks posed by earthquakes, tsunamis, wind, flooding, landslides and fire. To this end, all project structures should be designed in accordance with engineering and design criteria mandated by site-specific risks, including but not limited to seismic activity, slope stability, wind loading, and other dynamic loads
- Application of locally regulated or internationally recognized building codes[80] to ensure structures are designed and constructed in accordance with sound architectural and engineering practice, including aspects of fire prevention and response
- Engineers and architects responsible for designing and constructing facilities, building, plants and other structures should certify the applicability and appropriateness of the structural criteria employed.

International codes, such as those compiled by the International Code Council (ICC)[81], are intended to regulate the design, construction, and maintenance of a built environment and contain detailed guidance on all aspects of building safety, encompassing methodology, best practices, and documenting compliance. Depending on the nature of a project, guidance provided in the ICC or comparable codes should be followed, as appropriate, with respect to:

- Existing structures
- Soils and foundations
- Site grading
- Structural design
- Specific requirements based on intended use and occupancy
- Accessibility and means of egress
- Types of construction
- Roof design and construction
- Fire-resistant construction
- Flood-resistant construction

[79] World Health Organization (WHO) defines 100 liters/capita/day as the amount required to meet all consumption and hygiene needs. Additional information on lower service levels and potential impacts on health are described in "Domestic Water Quantity, Service Level and Health" 2003. http://www.who.int/water_sanitation_health/diseases/wsh0302/en/index.html

[80] ILO-OSH, 2001. http://www.ilo.org/public/english/protection/safework/cops/english/download/e000013.pdf

[81] ICC, 2006.

Construction materials
Interior environment
Mechanical, plumbing and electrical systems
Elevators and conveying systems
Fire safety systems
Safeguards during construction
Encroachments into public right-of-way

Although major design changes may not be feasible during the operation phase of a project, hazard analysis can be undertaken to identify opportunities to reduce the consequences of a failure or accident. Illustrative management actions, applicable to hazardous materials storage and use, include:

Reducing inventories of hazardous materials through inventory management and process changes to greatly reduce or eliminate the potential off-site consequences of a release
Modifying process or storage conditions to reduce the potential consequences of an accidental off-site release
Improving shut-down and secondary containment to reduce the amount of material escaping from containment and to reduce the release duration
Reducing the probability that releases will occur through improved site operations and control, and through improvements in maintenance and inspection
Reducing off-site impacts of releases through measures intended to contain explosions and fires, alert the public, provide for evacuation of surrounding areas, establish safety zones around a site, and ensure the provision of emergency medical services to the public

3.3 Life and Fire Safety (L&FS)

Applicability and Approach

All new buildings accessible to the public should be designed, constructed, and operated in full compliance with local building codes, local fire department regulations, local legal/insurance requirements, and in accordance with an internationally accepted life and fire safety (L&FS) standard. The Life Safety Code[82], which provides extensive documentation on life and fire safety provisions, is one example of an internationally accepted standard and may be used to document compliance with the Life and Fire Safety objectives outlined in these guidelines. With regard to these objectives:

Project sponsors' architects and professional consulting engineers should demonstrate that affected buildings meet these life and fire safety objectives.

Life and fire safety systems and equipment should be designed and installed using appropriate prescriptive standards and/or performance based design, and sound engineering practices.

Life and fire safety design criteria for all existing buildings should incorporate all local building codes and fire department regulations.

These guidelines apply to buildings that are accessible to the public. Examples of such buildings include:

Health and education facilities
Hotels, convention centers, and leisure facilities
Retail and commercial facilities
Airports, other public transport terminals, transfer facilities

Specific Requirements for New Buildings

The nature and extent of life and fire safety systems required will depend on the building type, structure, construction, occupancy, and exposures. Sponsors should prepare a Life and Fire Safety Master Plan identifying major fire risks, applicable codes, standards and regulations, and mitigation measures. The Master

[82] US NFPA. http://www.nfpa.org/catalog/product.asp?category%5Fname=&pid=10106&target%5Fpid=10106&src%5Fpid=&link%5Ftype=search

Plan should be prepared by a suitably qualified professional, and adequately cover, but not be limited to, the issues addressed briefly in the following points. The suitably qualified professional selected to prepare the Master Plan is responsible for a detailed treatment of the following illustrative, and all other required, issues.

Fire Prevention

Fire prevention addresses the identification of fire risks and ignition sources, and measures needed to limit fast fire and smoke development. These issues include:

- Fuel load and control of combustibles
- Ignition sources
- Interior finish flame spread characteristics Interior finish smoke production characteristics Human acts, and housekeeping and maintenance

Means of Egress

Means of Egress includes all design measures that facilitate a safe evacuation by residents and/or occupants in case of fire or other emergency, such as:

- Clear, unimpeded escape routes
- Accessibility to the impaired/handicapped
- Marking and signing
- Emergency lighting

Detection and Alarm Systems

These systems encompass all measures, including communication and public address systems needed to detect a fire and alert:

- Building staff
- Emergency response teams
- Occupants
- Civil defense

Compartmentation

Compartmentation involves all measures to prevent or slow the spread of fire and smoke, including:

- Separations
- Fire walls
- Floors
- Doors
- Dampers
- Smoke control systems

Fire Suppression and Control

Fire suppression and control includes all automatic and manual fire protection installations, such as:

- Automatic sprinkler systems
- Manual portable extinguishers
- Fire hose reels

Emergency Response Plan

An Emergency Response Plan is a set of scenario–based procedures to assist staff and emergency response teams during real life emergency and training exercises. This chapter of the Fire and Life Safety Master Plan should include an assessment of local fire prevention and suppression capabilities.

Operation and Maintenance

Operation and Maintenance involves preparing schedules for mandatory regular maintenance and testing of life and fire safety features to ensure that mechanical, electrical, and civil structures and systems are at all times in conformance with life and fire safety design criteria and required operational readiness.

L&FS Master Plan Review and Approval

A suitably qualified professional prepares and submits a Life and Fire Safety (L&FS) Master Plan, including preliminary drawings and specifications, and certifies that the design

meets the requirements of these L&FS guidelines. The findings and recommendations of the review are then used to establish the conditions of a Corrective Action Plan and a time frame for implementing the changes.

The suitably qualified professional conducts a review as part of the project completion test at the time of life and fire safety systems testing and commissioning, and certifies that construction of these systems has been carried out in accordance with the accepted design. The findings and recommendations of the review are used as the basis for establishing project completion or to establish the conditions of a Pre-Completion Corrective Action Plan and a time frame for implementing the changes.

Specific Requirements for Existing Buildings

All life and fire safety guideline requirements for new buildings apply to existing buildings programmed for renovation. A suitably qualified professional conducts a complete life and fire safety review of existing buildings slated for renovation. The findings and recommendations of the review are used as the basis to establish the scope of work of a Corrective Action Plan and a time frame for implementing the changes.

If it becomes apparent that life and fire safety conditions are deficient in an existing building that is not part of the project or that has not been programmed for renovation, a life and fire safety review of the building may be conducted by a suitably qualified professional. The findings and recommendations of the review are used as the basis to establish the scope of work of a Corrective Action Plan and a time frame for implementing the changes.

Other Hazards

Facilities, buildings, plants, and structures should be situated to minimize potential risks from forces of nature (e.g. earthquakes, tsunamis, floods, windstorms, and fires from surrounding areas).

All such structures should be designed in accordance with the criteria mandated by situation-, climatic-, and geology-specific location risks (e.g. seismic activity, wind loading, and other dynamic loads).

Structural engineers and architects responsible for facilities, buildings, plants and structures should certify the applicability and appropriateness of the design criteria employed.

National or regional building regulations typically contain fire safety codes and standards[83] or these standards are found in separate Fire Codes.[84,85] Generally, such codes and regulations incorporate further compliance requirements with respect to methodology, practice, testing, and other codes and standards[86]. Such nationally referenced material constitutes the acceptable fire life safety code.

3.4 Traffic Safety

Traffic accidents have become one of the most significant causes of injuries and fatalities among members of the public worldwide. Traffic safety should be promoted by all project personnel during displacement to and from the workplace, and during operation of project equipment on private or public roads. Prevention and control of traffic related injuries and fatalities should include the adoption of safety measures that are protective of project workers and of road users, including those who are most vulnerable to road traffic accidents[87]. Road safety initiatives proportional to the scope and nature of project activities should include:

[83] For example, Australia, Canada, South Africa, United Kingdom

[84] Réglementation Incendie [des ERP]

[85] USA NFPA, 2006.

[86] Prepared by National Institutes and Authorities such as American Society for Testing and Materials (ASTM), British Standards (BS), German Institute of Standardization (DIN), and French Standards (NF)

[87] Additional information on vulnerable users of public roads in developing countries is provided by Peden et al., 2004.

Adoption of best transport safety practices across all aspects of project operations with the goal of preventing traffic accidents and minimizing injuries suffered by project personnel and the public. Measures should include:

- Emphasizing safety aspects among drivers
- Improving driving skills and requiring licensing of drivers
- Adopting limits for trip duration and arranging driver rosters to avoid overtiredness
- Avoiding dangerous routes and times of day to reduce the risk of accidents
- Use of speed control devices (governors) on trucks, and remote monitoring of driver actions

Regular maintenance of vehicles and use of manufacturer approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure.

Where the project may contribute to a significant increase in traffic along existing roads, or where road transport is a significant component of a project, recommended measures include:

Minimizing pedestrian interaction with construction vehicles Collaboration with local communities and responsible authorities to improve signage, visibility and overall safety of roads, particularly along stretches located near schools or other locations where children may be present. Collaborating with local communities on education about traffic and pedestrian safety (e.g. school education campaigns)[88] Coordination with emergency responders to ensure that appropriate first aid is provided in the event of accidents Using locally sourced materials, whenever possible, to minimize transport distances. Locating associated facilities such as worker camps close to project sites and arranging worker bus transport to minimizing external traffic

Employing safe traffic control measures, including road signs and flag persons to warn of dangerous conditions

3.5 Transport of Hazardous Materials

General Hazardous Materials Transport

Projects should have procedures in place that ensure compliance with local laws and international requirements applicable to the transport of hazardous materials, including:

- IATA requirements[89] for air transport
- IMDG Code[90] sea transport
- UN Model Regulations[91] of other international standards as well as local requirements for land transport
- Host-country commitments under the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their disposal and Rotterdam Convention on the prior Inform Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, if applicable to the project activities

The procedures for transportation of hazardous materials (Hazmats) should include:

- Proper labeling of containers, including the identify and quantity of the contents, hazards, and shipper contact information
- Providing a shipping document (e.g. shipping manifest) that describes the contents of the load and its associated hazards in addition to the labeling of the containers. The shipping document should establish a chain-of-custody using multiple signed copies to show that the waste was properly shipped, transported and received by the recycling or treatment/disposal facility

[88] Additional sources of information for implementation of road safety measures is available at WHO, 1989, Ross et al., 1991, Tsunokawa and Hoban, 1997, and OECD, 1999

[89] IATA, 2005. www.iata.org

[90] IMO. www.imo.org/safety

[91] United Nations. Transport of Dangerous Goods - Model Regulations. 14th Revised Edition. Geneva 2005. http://www.unece.org/trans/danger/publi/unrec/rev14/14files_e.html

- Ensuring that the volume, nature, integrity and protection of packaging and containers used for transport are appropriate for the type and quantity of hazardous material and modes of transport involved
- Ensuring adequate transport vehicle specifications
- Training employees involved in the transportation of hazardous materials regarding proper shipping procedures and emergency procedures
- Using labeling and placarding (external signs on transport vehicles), as required
- Providing the necessary means for emergency response on call 24 hours/day

Major Transportation Hazards

Guidance related to major transportation hazards should be implemented in addition to measures presented in the preceding section for preventing or minimizing the consequences of catastrophic releases of hazardous materials, which may result in toxic, fire, explosion, or other hazards during transportation.

In addition to these aforementioned procedures, projects which transport hazardous materials *at or above the threshold quantities*[92] should prepare a Hazardous Materials Transportation Plan containing all of the elements presented below[93].

Hazard Assessment

The hazard assessment should identify the potential hazard involved in the transportation of hazardous materials by reviewing:

The hazard characteristics of the substances identified during the screening stage

The history of accidents, both by the company and its contractors, involving hazardous materials transportation

The existing criteria for the safe transportation of hazardous materials, including environmental management systems used by the company and its contractors

This review should cover the management actions, preventive measures and emergency response procedures described below. The hazard assessment helps to determine what additional measures may be required to complete the plan.

Management Actions

Management of Change: These procedures should address:

- The technical basis for changes in hazardous materials offered for transportation, routes and/or procedures
- The potential impact of changes on health and safety
- Modification required to operating procedures
- Authorization requirements
- Employees affected
- Training needs

Compliance Audit: A compliance audit evaluates compliance with prevention requirements for each transportation route or for each hazardous material, as appropriate. A compliance audit covering each element of the prevention measures (see below) should be conducted at least every three years. The audit program should include:

- Preparation of a report of the findings
- Determination and documentation of the appropriate response to each finding
- Documentation that any deficiency has been corrected.

Incident Investigation: Incidents can provide valuable information about transportation hazards and the steps needed to prevent accidental releases. The implementation of incident investigation procedures should ensure that:

- Investigations are initiated promptly
- Summaries of investigations are included in a report
- Report findings and recommendations are addressed

[92] Threshold quantities for the transport of hazardous materials are found in the UN – Transport of Dangerous Goods – Model Regulations cited above.

[93] For further information and guidance, please refer to International Finance Corporation (IFC) Hazardous Materials Transportation Manual. Washington, D.C. December 2000.

- Reports are reviewed with staff and contractors

Employee Participation: There should be a written plan of action regarding the implementation of active employee participation in the prevention of accidents.

Contractors: The plan should include procedures to ensure that:

- The contractor is provided with safety performance procedures and safety and hazard information
- Contractors observe safety practices
- Verify that the contractor acts responsibly

The plan should also include additional procedures to ensure the contractors will:

- Ensure appropriate training for their employees
- Ensure their employees know process hazards and applicable emergency actions
- Prepare and submit training records
- Inform employees about the hazards presented by their work

Training: Good training programs on operating procedures will provide the employees with the necessary information to understand how to operate safely and why safe operations are needed. The training program should include:

- The list of employees to be trained
- Specific training objectives
- Mechanisms to achieve objectives (i.e. hands-on workshops, videos, etc.)
- Means to determine the effectiveness of the training program
- Training procedures for new hires and refresher programs

Preventive Measures

The plan should include procedures to implement preventive measures specific to each hazardous material offered for transportation, including:

Classification and segregation of hazardous materials in warehouses and transport units

Packaging and packaging testing

Marking and labeling of packages containing hazardous materials

Handling and securing packages containing hazardous materials in transport units

Marking and placarding of transport units

Documentation (e.g. bills of lading)

Application of special provisions, as appropriate

Emergency Preparedness and Response

It is important to develop procedures and practices for the handling of hazardous materials that allow for quick and efficient responses to accidents that may result in injury or environmental damage. The sponsor should prepare an Emergency Preparedness and Response Plan that should cover:

Planning Coordination: This should include procedures for:

- Informing the public and emergency response agencies
- Documenting first aid and emergency medical treatment
- Taking emergency response actions
- Reviewing and updating the emergency response plan to reflect changes and ensuring that the employees are informed of such changes

Emergency Equipment: The plan should include procedures for using, inspecting, testing, and maintaining emergency response equipment.

Training: Employees should be trained in any relevant procedures

3.6 Disease Prevention

Communicable Diseases

Communicable diseases pose a significant public health threat worldwide. Health hazards typically associated with large development projects are those relating to poor sanitation and living conditions, sexual transmission and vector-borne infections. Communicable diseases of most concern during the construction phase due to labor mobility are sexually-transmitted diseases (STDs), such as HIV/AIDS. Recognizing that no single measure is likely to be effective in the long term, successful initiatives typically involve a combination of behavioral and environmental modifications.

Recommended interventions at the project level include[94]:

Providing surveillance and active screening and treatment of workers

Preventing illness among workers in local communities by:

- Undertaking health awareness and education initiatives, for example, by implementing an information strategy to reinforce person-to-person counseling addressing systemic factors that can influence individual behavior as well as promoting individual protection, and protecting others from infection, by encouraging condom use
- Training health workers in disease treatment
- Conducting immunization programs for workers in local communities to improve health and guard against infection
- Providing health services

Providing treatment through standard case management in on-site or community health care facilities. Ensuring ready access to medical treatment, confidentiality and appropriate care, particularly with respect to migrant workers

Promoting collaboration with local authorities to enhance access of workers families and the community to public health services and promote immunization

Vector-Borne Diseases

Reducing the impact of vector-borne disease on the long-term health of workers is best accomplished through implementation of diverse interventions aimed at eliminating the factors that lead to disease. Project sponsors, in close collaboration with community health authorities, can implement an integrated control strategy for mosquito and other arthropod-borne diseases that might involve:

Prevention of larval and adult propagation through sanitary improvements and elimination of breeding habitats close to human settlements

Elimination of unusable impounded water

Increase in water velocity in natural and artificial channels

Considering the application of residual insecticide to dormitory walls

Implementation of integrated vector control programs

Promoting use of repellents, clothing, netting, and other barriers to prevent insect bites

Use of chemoprophylaxis drugs by non-immune workers and collaborating with public health officials to help eradicate disease reservoirs

Monitoring and treatment of circulating and migrating populations to prevent disease reservoir spread

Collaboration and exchange of in-kind services with other control programs in the project area to maximize beneficial effects

Educating project personnel and area residents on risks, prevention, and available treatment

Monitoring communities during high-risk seasons to detect and treat cases

[94] Additional sources of information on disease prevention include IFC, 2006; UNDP, 2000, 2003; Walley et al., 2000; Kindhauser, 2003; Heymann, 2004.

Distributing appropriate education materials

Following safety guidelines for the storage, transport, and distribution of pesticides to minimize the potential for misuse, spills, and accidental human exposure

3.7 Emergency Preparedness and Response

An emergency is an unplanned event when a project operation loses control, or could lose control, of a situation that may result in risks to human health, property, or the environment, either within the facility or in the local community. Emergencies do not normally include safe work practices for frequent upsets or events that are covered by occupational health and safety.

All projects should have an Emergency Preparedness and Response Plan that is commensurate with the risks of the facility and that includes the following basic elements:

Administration (policy, purpose, distribution, definitions, etc)

Organization of emergency areas (command centers, medical stations, etc)

Roles and responsibilities

Communication systems

Emergency response procedures

Emergency resources

Training and updating

Checklists (role and action list and equipment checklist)

Business Continuity and Contingency

Additional information is provided for key components of the emergency plan, as follows below.

Communication Systems

Worker notification and communication

Alarm bells, visual alarms, or other forms of communication should be used to reliably alert workers to an emergency. Related measures include:

Testing warning systems at least annually (fire alarms monthly), and more frequently if required by local regulations, equipment, or other considerations

Installing a back-up system for communications on-site with off-site resources, such as fire departments, in the event that normal communication methods may be inoperable during an emergency

Community Notification

If a local community may be at risk from a potential emergency arising at the facility, the company should implement communication measures to alert the community, such as:

Audible alarms, such as fire bells or sirens

Fan out telephone call lists

Vehicle mounted speakers

Communicating details of the nature of the emergency

Communicating protection options (evacuation, quarantine)

Providing advise on selecting an appropriate protection option

Media and Agency Relations

Emergency information should be communicated to the media through:

A trained, local spokesperson able to interact with relevant stakeholders, and offer guidance to the company for speaking to the media, government, and other agencies

Written press releases with accurate information, appropriate level of detail for the emergency, and for which accuracy can be guaranteed

Emergency Resources

Finance and Emergency Funds

A mechanism should be provided for funding emergency activities.

Fire Services

The company should consider the level of local fire fighting capacity and whether equipment is available for use at the facility in the event of a major emergency or natural disaster. If insufficient capacity is available, fire fighting capacity should be acquired that may include pumps, water supplies, trucks, and training for personnel.

Medical Services

The company should provide first aid attendants for the facility as well as medical equipment suitable for the personnel, type of operation, and the degree of treatment likely to be required prior to transportation to hospital.

Availability of Resources

Appropriate measures for managing the availability of resources in case of an emergency include:

Maintaining a list of external equipment, personnel, facilities, funding, expert knowledge, and materials that may be required to respond to emergencies. The list should include personnel with specialized expertise for spill clean-up, flood control, engineering, water treatment, environmental science, etc., or any of the functions required to adequately respond to the identified emergency

Providing personnel who can readily call up resources, as required

Tracking and managing the costs associated with emergency resources

Considering the quantity, response time, capability, limitations, and cost of these resources, for both site-specific emergencies, and community or regional emergencies

Considering if external resources are unable to provide sufficient capacity during a regional emergency and whether additional resources may need to be maintained on-site

Mutual Aid

Mutual aid agreements decrease administrative confusion and provide a clear basis for response by mutual aid providers.

Where appropriate, mutual aid agreements should be maintained with other organizations to allow for sharing of personnel and specialized equipment.

Contact List

The company should develop a list of contact information for all internal and external resources and personnel. The list should include the name, description, location, and contact details (telephone, email) for each of the resources, and be maintained annually.

Training and Updating

The emergency preparedness facilities and emergency response plans require maintenance, review, and updating to account for changes in equipment, personnel, and facilities. Training programs and practice exercises provide for testing systems to ensure an adequate level of emergency preparedness. Programs should:

Identify training needs based on the roles and responsibilities, capabilities and requirements of personnel in an emergency

Develop a training plan to address needs, particularly for fire fighting, spill response, and evacuation

Conduct annual training, at least, and perhaps more frequent training when the response includes specialized equipment, procedures, or hazards, or when otherwise mandated

Provide training exercises to allow personnel the opportunity to test emergency preparedness, including:

- Desk top exercises with only a few personnel, where the contact lists are tested and the facilities and communication assessed
- Response exercises, typically involving drills that allow for testing of equipment and logistics

- Debrief upon completion of a training exercise to assess what worked well and what aspects require improvement
- Update the plan, as required, after each exercise. Elements of the plan subject to significant change (such as contact lists) should be replaced
- Record training activities and the outcomes of the training

Business Continuity and Contingency

Measures to address business continuity and contingency include:

Identifying replacement supplies or facilities to allow business continuity following an emergency. For example, alternate sources of water, electricity, and fuel are commonly sought.

Using redundant or duplicate supply systems as part of facility operations to increase the likelihood of business continuity.

Maintaining back-ups of critical information in a secure location to expedite the return to normal operations following an emergency.

4.0 Construction and Decommissioning

Applicability and Approach

This section provides additional, specific guidance on prevention and control of community health and safety impacts that may occur during new project development, at the end of the project life-cycle, or due to expansion or modification of existing project facilities. Cross referencing is made to various other sections of the General EHS Guidelines.

4.1 Environment{ TC "4.1 Environment" \f C \l "2" }

Noise and Vibration

During construction and decommissioning activities, noise and vibration may be caused by the operation of pile drivers, earth moving and excavation equipment, concrete mixers, cranes and the transportation of equipment, materials and people. Some recommended noise reduction and control strategies to consider in areas close to community areas include:

Planning activities in consultation with local communities so that activities with the greatest potential to generate noise are planned during periods of the day that will result in least disturbance

Using noise control devices, such as temporary noise barriers and deflectors for impact and blasting activities, and exhaust muffling devices for combustion engines.

Avoiding or minimizing project transportation through community areas

Soil Erosion

Soil erosion may be caused by exposure of soil surfaces to rain and wind during site clearing, earth moving, and excavation activities. The mobilization and transport of soil particles may, in turn, result in sedimentation of surface drainage networks, which may result in impacts to the quality of natural water systems and ultimately the biological systems that use these waters. Recommended soil erosion and water system management approaches include:

Sediment mobilization and transport

Reducing or preventing erosion by:

- Scheduling to avoid heavy rainfall periods (i.e., during the dry season) to the extent practical
- Contouring and minimizing length and steepness of slopes
- Mulching to stabilize exposed areas
- Re-vegetating areas promptly
- Designing channels and ditches for post-construction flows
- Lining steep channel and slopes (e.g. use jute matting)

Reducing or preventing off-site sediment transport through use of settlement ponds, silt fences, and water treatment, and modifying or suspending activities during extreme rainfall and high winds to the extent practical.

Clean runoff management

Segregating or diverting clean water runoff to prevent it mixing with water containing a high solids content, to minimize the volume of water to be treated prior to release

Road design

Limiting access road gradients to reduce runoff-induced erosion

Providing adequate road drainage based on road width, surface material, compaction, and maintenance

Disturbance to water bodies

Depending on the potential for adverse impacts, installing free-spanning structures (e.g., single span bridges) for road watercourse crossings

Restricting the duration and timing of in-stream activities to lower low periods, and avoiding periods critical to biological cycles of valued flora and fauna (e.g., migration, spawning, etc.)

For in-stream works, using isolation techniques such as berming or diversion during construction to limit the exposure of disturbed sediments to moving water

Consider using trenchless technology for pipeline crossings (e.g., suspended crossings) or installation by directional drilling

Structural (slope) stability

Providing effective short term measures for slope stabilization, sediment control and subsidence control until long term measures for the operational phase can be implemented

Providing adequate drainage systems to minimize and control infiltration

Air Quality

Construction and decommissioning activities may generate emission of fugitive dust caused by a combination of on-site excavation and movement of earth materials, contact of construction machinery with bare soil, and exposure of bare soil and soil piles to wind. A secondary source of emissions may include exhaust from diesel engines of earth moving equipment, as well as from open burning of solid waste on-site. Techniques to consider for the reduction and control of air emissions from construction and decommissioning sites include:

Minimizing dust from material handling sources, such as conveyors and bins, by using covers and/or control equipment (water suppression, bag house, or cyclone)

Minimizing dust from open area sources, including storage piles, by using control measures such as installing enclosures and covers, and increasing the moisture content

Dust suppression techniques should be implemented, such as applying water or non-toxic chemicals to minimize dust from vehicle movements

Selectively removing potential hazardous air pollutants, such as asbestos, from existing infrastructure prior to demolition

Managing emissions from mobile sources according to Section 1.1

Avoiding open burning of solid (refer to solid waste management guidance in Section 1.6)

Solid Waste

Non-hazardous solid waste generated at construction and decommissioning sites includes excess fill materials from grading and excavation activities, scrap wood and metals, and small concrete spills. Other non-hazardous solid wastes include office, kitchen, and dormitory wastes when these types of operations are part of construction project activities. *Hazardous solid waste* includes contaminated soils, which could potentially be encountered on-site due to previous land use activities, or small

amounts of machinery maintenance materials, such as oily rags, used oil filters, and used oil, as well as spill cleanup materials from oil and fuel spills. Techniques for preventing and controlling non-hazardous and hazardous construction site solid waste include those already discussed in Section 1.6.

Hazardous Materials

Construction and decommissioning activities may pose the potential for release of petroleum based products, such as lubricants, hydraulic fluids, or fuels during their storage, transfer, or use in equipment. These materials may also be encountered during decommissioning activities in building components or industrial process equipment. Techniques for prevention, minimization, and control of these impacts include:

- Providing adequate secondary containment for fuel storage tanks and for the temporary storage of other fluids such as lubricating oils and hydraulic fluids,
- Using impervious surfaces for refueling areas and other fluid transfer areas
- Training workers on the correct transfer and handling of fuels and chemicals and the response to spills
- Providing portable spill containment and cleanup equipment on site and training in the equipment deployment
- Assessing the contents of hazardous materials and petroleum-based products in building systems (e.g. PCB containing electrical equipment, asbestos-containing building materials) and process equipment and removing them prior to initiation of decommissioning activities, and managing their treatment and disposal according to Sections 1.5 and 1.6 on Hazardous Materials and Hazardous Waste Management, respectively
- Assessing the presence of hazardous substances in or on building materials (e.g., polychlorinated biphenyls, asbestos-containing flooring or insulation) and decontaminating or properly managing contaminated building materials

Wastewater Discharges

Construction and decommissioning activities may include the generation of sanitary wastewater discharges in varying quantities depending on the number of workers involved. Adequate portable or permanent sanitation facilities serving all workers should be provided at all construction sites. Sanitary wastewater in construction and other sites should be managed as described in Section 1.3.

Contaminated Land

Land contamination may be encountered in sites under construction or decommissioning due to known or unknown historical releases of hazardous materials or oil, or due to the presence of abandoned infrastructure formerly used to store or handle these materials, including underground storage tanks. Actions necessary to manage the risk from contaminated land will depend on factors such as the level and location of contamination, the type and risks of the contaminated media, and the intended land use. However, a basic management strategy should include:

- Managing contaminated media with the objective of protecting the safety and health of occupants of the site, the surrounding community, and the environment post construction or post decommissioning
- Understanding the historical use of the land with regard to the potential presence of hazardous materials or oil prior to initiation of construction or decommissioning activities
- Preparing plans and procedures to respond to the discovery of contaminated media to minimize or reduce the risk to health, safety, and the environment consistent with the approach for Contaminated Land in Section 1.6
- Preparation of a management plan to manage obsolete, abandoned, hazardous materials or oil consistent with the approach to hazardous waste management described in Section 1.6.

Successful implementation of any management strategy may require identification and cooperation with whoever is responsible and liable for the contamination.

4.2 Occupational Health and Safety{ TC "4.2 Occupational Health and Safety" \f C \l "2" }

Over-exertion

Over-exertion, and ergonomic injuries and illnesses, such as repetitive motion, over-exertion, and manual handling, are among the most common causes of injuries in construction and decommissioning sites. Recommendations for their prevention and control include:

- Training of workers in lifting and materials handling techniques in construction and decommissioning projects, including the placement of weight limits above which mechanical assists or two-person lifts are necessary
- Planning work site layout to minimize the need for manual transfer of heavy loads
- Selecting tools and designing work stations that reduce force requirements and holding times, and which promote improved postures, including, where applicable, user adjustable work stations
- Implementing administrative controls into work processes, such as job rotations and rest or stretch breaks

Slips and Falls

Slips and falls on the same elevation associated with poor housekeeping, such as excessive waste debris, loose construction materials, liquid spills, and uncontrolled use of electrical cords and ropes on the ground, are also among the most frequent cause of lost time accidents at construction and decommissioning sites. Recommended methods for the prevention of slips and falls from, or on, the same elevation include:

- Implementing good house-keeping practices, such as the sorting and placing loose construction materials or demolition debris in established areas away from foot paths
- Cleaning up excessive waste debris and liquid spills regularly
- Locating electrical cords and ropes in common areas and marked corridors
- Use of slip retardant footwear

Work in Heights

Falls from elevation associated with working with ladders, scaffolding, and partially built or demolished structures are among the most common cause of fatal or permanent disabling injury at construction or decommissioning sites. If fall hazards exist, a fall protection plan should be in place which includes one or more of the following aspects, depending on the nature of the fall hazard[95]:

- Training and use of temporary fall prevention devices, such as rails or other barriers able to support a weight of 200 pounds, when working at heights equal or greater than two meters or at any height if the risk includes falling into operating machinery, into water or other liquid, into hazardous substances, or through an opening in a work surface
- Training and use of personal fall arrest systems, such as full body harnesses and energy absorbing lanyards able to support 5000 pounds (also described in this section in Working at Heights above), as well as fall rescue procedures to deal with workers whose fall has been successfully arrested. The tie in point of the fall arresting system should also be able to support 5000 pounds
- Use of control zones and safety monitoring systems to warn workers of their proximity to fall hazard zones, as well as

[95] Additional information on identification of fall hazards and design of protection systems can be found in the United States Occupational Health and Safety Administration's (US OSHA) web site: http://www.osha.gov/SLTC/fallprotection/index.html

securing, marking, and labeling covers for openings in floors, roofs, or walking surfaces

Struck By Objects

Construction and demolition activities may pose significant hazards related to the potential fall of materials or tools, as well as ejection of solid particles from abrasive or other types of power tools which can result in injury to the head, eyes, and extremities. Techniques for the prevention and control of these hazards include:

- Using a designated and restricted waste drop or discharge zones, and/or a chute for safe movement of wastes from upper to lower levels
- Conducting sawing, cutting, grinding, sanding, chipping or chiseling with proper guards and anchoring as applicable
- Maintaining clear traffic ways to avoid driving of heavy equipment over loose scrap
- Use of temporary fall protection measures in scaffolds and out edges of elevated work surfaces, such as hand rails and toe boards to prevent materials from being dislodged Evacuating work areas during blasting operations, and using blast mats or other means of deflection to minimize fly rock or ejection of demolition debris if work is conducted in proximity to people or structures
- Wearing appropriate PPE, such as safety glasses with side shields, face shields, hard hats, and safety shoes

Moving Machinery

Vehicle traffic and use of lifting equipment in the movement of machinery and materials on a construction site may pose temporary hazards, such as physical contact, spills, dust, emissions, and noise. Heavy equipment operators have limited fields of view close to their equipment and may not see pedestrians close to the vehicle. Center-articulated vehicles create a significant impact or crush hazard zone on the outboard side of a turn while moving. Techniques for the prevention and control of these impacts include:

- Planning and segregating the location of vehicle traffic, machine operation, and walking areas, and controlling vehicle traffic through the use of one-way traffic routes, establishment of speed limits, and on-site trained flag-people wearing high-visibility vests or outer clothing covering to direct traffic
- Ensuring the visibility of personnel through their use of high visibility vests when working in or walking through heavy equipment operating areas, and training of workers to verify eye contact with equipment operators before approaching the operating vehicle
- Ensuring moving equipment is outfitted with audible back-up alarms
- Using inspected and well-maintained lifting devices that are appropriate for the load, such as cranes, and securing loads when lifting them to higher job-site elevations.

Dust

- Dust suppression techniques should be implemented, such as applying water or non-toxic chemicals to minimize dust from vehicle movements
- PPE, such as dusk masks, should be used where dust levels are excessive

Confined Spaces and Excavations

Examples of confined spaces that may be present in construction or demolition sites include: silos, vats, hoppers, utility vaults, tanks, sewers, pipes, and access shafts. Ditches and trenches may also be considered a confined space when access or egress is limited. In addition to the guidance provided in Section 2.8 the occupational hazards associated with confined spaces and excavations in construction and decommissioning sites should be prevented according to the following recommendations:

Controlling site-specific factors which may contribute to excavation slope instability including, for example, the use of excavation dewatering, side-walls support, and slope gradient adjustments that eliminate or minimize the risk of collapse, entrapment, or drowning

Providing safe means of access and egress from excavations, such as graded slopes, graded access route, or stairs and ladders

Avoiding the operation of combustion equipment for prolonged periods inside excavations areas where other workers are required to enter unless the area is actively ventilated

Other Site Hazards

Construction and decommissioning sites may pose a risk of exposure to dust, chemicals, hazardous or flammable materials, and wastes in a combination of liquid, solid, or gaseous forms, which should be prevented through the implementation of project-specific plans and other applicable management practices, including:

Use of specially trained personnel to identify and remove waste materials from tanks, vessels, processing equipment or contaminated land as a first step in decommissioning activities to allow for safe excavation, construction, dismantling or demolition

Use of specially trained personnel to identify and selectively remove potentially hazardous materials in building elements prior to dismantling or demolition including, for example, insulation or structural elements containing asbestos and Polychlorinated Biphenyls (PCBs), electrical components containing mercury[96]

Use of waste-specific PPE based on the results of an occupational health and safety assessment, including respirators, clothing/protective suits, gloves and eye protection

4.3 Community Health and Safety{ TC "4.3 Community Health and Safety" \f C \l "2" }

General Site Hazards

Projects should implement risk management strategies to protect the community from physical, chemical, or other hazards associated with sites under construction and decommissioning. Risks may arise from inadvertent or intentional trespassing, including potential contact with hazardous materials, contaminated soils and other environmental media, buildings that are vacant or under construction, or excavations and structures which may pose falling and entrapment hazards. Risk management strategies may include:

Restricting access to the site, through a combination of institutional and administrative controls, with a focus on high risk structures or areas depending on site-specific situations, including fencing, signage, and communication of risks to the local community

Removing hazardous conditions on construction sites that cannot be controlled affectively with site access restrictions, such as covering openings to small confined spaces, ensuring means of escape for larger openings such as trenches or excavations, or locked storage of hazardous materials

Disease Prevention

Increased incidence of communicable and vector-borne diseases attributable to construction activities represents a potentially serious health threat to project personnel and residents of local communities. Recommendations for the prevention and control of communicable and vector-borne diseases also applicable to

[96] Additional information on the management and removal of asbestos containing building materials can be found in ASTM Standard E2356 and E1368

construction phase activities are provided in Section 3.6 (Disease Prevention).

Traffic Safety

Construction activities may result in a significant increase in movement of heavy vehicles for the transport of construction materials and equipment increasing the risk of traffic-related accidents and injuries to workers and local communities. The incidence of road accidents involving project vehicles during construction should be minimized through a combination of education and awareness-raising, and the adoption of procedures described in Section 3.4 (Traffic Safety).

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