Environmental Impact Assessment

660 MW Coal Fired Power Plant Construction Project

at Lakhra in

The Islamic Republic of Pakistan

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in association with
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Appendices (Volume 2 of 2)

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Appendix 1: SINDH ENVIRONMENTAL QUALITY STANDARDS

Following the promulgation of Sindh Environmental Protection Act 2014 (Sindh Act 2014), Sindh has notified its own ambient air quality standard. It is understood that the National Environmental Quality Standards (NEQS) issued prior to Sindh Act 2014 remain in force in Sindh unless they are expressly amended, as is the case with the ambient air quality standards. As the Sindh Act 2014, does not have the provision for a national standard and PEPA 1997 is no longer applicable in Sindh, the term 'Sindh Environmental Quality Standards' is understood to include the NEQS (except ambient air quality standards) issued under PEPA 1997. However, the term NEQS is still used in this document where reference is made to older standards.

Table 1-1: National Environmental Quality Standards for Municipal and Liquid Industrial Effluents (mg/l, unless otherwise defined)

No.	Parameter	Standards		
		Into Inland Waters	Into Sewage Treatment[1]	Into Sea[2)]
1.	Temperature increase[3]	=<3°C	=<3°C	=<3°C
2.	pH value	6 to 9	6 to 9	6 to 9
3.	Five-day bio-chemical oxygen demand $(BOD)_5$ at 20°C[4]	80	250	80[5]
4.	Chemical oxygen demand (COD)[1]	150	400	400
5.	Total suspended solids (TSS)	200	400	200
6.	Total dissolved solids (TDS)	3,500	3,500	3,500
7.	Grease and oil	10	10	10
8.	Phenolic compounds (as phenol)	0.1	0.3	0.3
9.	Chlorides (as Cl')	1,000	1,000	SC[6]
10.	Fluorides (as F')	10	10	10
11.	Cyanide total (as CN')	1.0	1.0	1.0
12.	Anionic detergents (as MBAS)[7]	20	20	20
13.	Sulfates (SO_4)	600	1,000	SC[6]
14.	Sulfides (s')	1.0	1.0	1.0
15.	Ammonia (NH_3)	40	40	40
16.	Pesticides[8]	0.15	0.15	0.15
17.	Cadmium[9]	0.1	0.1	0.1
18.	Chromium (trivalent and hexavalent)[9]	1.0	1.0	1.0
19.	Copper[9]	1.0	1.0	1.0
20.	Lead[9]	0.5	0.5	0.5
21.	Mercury[9]	0.01	0.01	0.01

No.	Parameter	Standards		
		Into Inland Waters	Into Sewage Treatment[1]	Into Sea[2)]
22.	Selenium[9]	0.5	0.5	0.5
23.	Nickel[9]	1.0	1.0	1.0
24.	Silver[9]	1.0	1.0	1.0
25.	Total toxic metals	2.0	2.0	2.0
26.	Zinc	5.0	5.0	5.0
27.	Arsenic[9]	1.0	1.0	1.0
28.	Barium[9]	1.5	1.5	1.5
29.	Iron	8.0	8.0	8.0
30.	Manganese	1.5	1.5	1.5
31.	Boron[9]	6.0	6.0	6.0
32.	Chlorine	1.0	1.0	1.0

Explanations:

1. Applicable only when and where sewage treatment is operational and BOD = 80 mg/l is achieved by the sewage treatment system.
2. Provided discharge is not at shore and not within 10 miles of mangrove or other important estuaries.
3. The effluent should not result in temperature increase of more than 3°C at the edge of the zone where initial mixing and dilution take place in the receiving body. In case zone is not define, use 100 m from the point of discharge
4. Assuming minimum dilution 1:10 discharge, lower ratio would attract progressively stringent standards to be determined by the Federal Environmental Protection Agency. By 1:10 dilution means, for example that for each one cubic meter of treated effluent, the recipient water body should have 10 cubic meter of water for dilution of this effluent.
5. The value for industry is 200 mg/l
6. Discharge concentration at or below sea concentration (SC)
7. Methylene Blue Active substances assuming surfactant as biodegradable
8. Pesticides include herbicides, fungicides, and insecticides
9. Subject to total toxic metals discharge should not exceed level given at S. No. 25

Notes:

1. Dilution of liquid effluents to bring them to the NEQS limiting values is not permissible through fresh water mixing with the effluent before discharging into the environment.
2. The concentration of pollutants in water being used will be subtracted from the effluent for calculating the NEQS limits.

Table 1-2: National Environmental Quality Standards for Gaseous Emissions (mg/Nm^3 unless otherwise stated)

No.	Parameter	Source of Emission	Standards
1.	Smoke	Smoke opacity not to exceed	40% or 2 on Ringlemann Scale or equivalent smoke number
2.	Particulate matter[1]	(a) Boilers and furnaces:	
		i) Oil-fired	300
		ii) Coal-fired	500
		iii) Cement kilns	300
		(b) Grinding, crushing, clinker coolers and related processes, metallurgical processes, converters, blast furnaces and cupolas	500
3.	Hydrogen chloride	Any	400
4.	Chlorine	Any	150
5.	Hydrogen fluoride	Any	150
6.	Hydrogen sulfide	Any	10
7.	Sulfur oxides[2, 3]	Sulfuric acid/sulfonic acid plants	5,000
		Other plants except power plants operating on oil and coal	1,700
8.	Carbon monoxide	Any	800
9.	Lead	Any	50
10.	Mercury	Any	10
11.	Cadmium	Any	20
12.	Arsenic	Any	20
13.	Copper	Any	50
14.	Antimony	Any	20
15.	Zinc	Any	200
16.	Oxides of nitrogen[3]	Nitric acid manufacturing unit	3,000
		Gas-fired	400
		Oil-fired	600
		Coal-fired	1,200

1. Based on the assumption that the size of the particulate is 10 micron or more.
2. Based on 1 per cent sulfur content in fuel oil. Higher content of sulfur will cause standards to be pro-rated.
3. In respect of emissions of sulfur dioxide and nitrogen oxides, the power plants operating on oil and coal as fuel shall in addition to National Environmental Quality Standards (NEQS) above, comply with the standards stated in **Table 1-3** and **Table 1-4**.

Table 1-3: Sulfur Dioxide Standards for Power Plants Operating on Oil and Coal

Sulfur Dioxide Background Levels ($\mu g/m^3$)			Standards	
			Criterion I	Criterion II
Background Air Quality (SO_2 basis)	**Annual Average**	**Maximum 24-Hour Interval**	**Max. SO_2 Emissions (TPD)**	**Max. Allowable 1-Year Average Ground Level Increment to Ambient ($\mu g/m^3$)**
Unpolluted	< 50	< 200	500	50
Moderately polluted[1]				
Low	50	200	500	50
High	100	400	100	10
Very polluted[2]	> 100	> 400	100	10

1. For intermediate values between 50 and 100 $\mu g/m^3$ linear interpretation should be used.
2. No project with sulfur dioxide emissions will be recommended.

Table 1-4: Nitrogen Oxides Standards for Power Plants Operating on Oil and Coal

Annual arithmetic mean of ambient air concentrations of nitrogen oxides (expressed as NO_2) should not exceed		100 $\mu g/m^3$ (0.05 ppm)
Maximum emission levels for stationary source discharges, before mixing with the atmosphere: For fuel fired steam generators		
	Liquid fossil fuel	130 ng/J of heat input
	Solid fossil fuel	300 ng/J of heat input
	Lignite fossil fuel	260 ng/J of heat input

Table 1-5: National Environmental Quality Standards for Motor Vehicle Exhaust and Noise

No.	Parameter	Standards (Maximum Permissible Limit)		Measuring Method
1.	Smoke	40% or 2 on the Ringelmann Scale during engine acceleration mode.		To compared with Ringlemann chart at a distance of 6 meters or more.
2.	Carbon Monoxide	Emission Standards:		
		New Vehicles	Used Vehicles	
		4.5%	6%	Under idling conditions: Nondispersive infrared detection through gas analyzer.
3.	Noise	85 db (A)		Sound-meter at 7.5 meters from the source.

Table 1-6: Sindh Environmental Quality Standards for Ambient Air

Pollutants	Time-weighted Average	Concentration in Ambient Air	Method of Measurement
Sulfur Dioxide (SO_2)	Annual Average*	80 µg/m^3	-Ultra Violet Fluorescence method
	24 hours**	120 µg/m^3	
Oxide of Nitrogen as (NO)	Annual Average*	40 µg/m^3	-Gas Phase Chemiluminescence
	24 hours**	40 µg/m^3	
Oxide of Nitrogen as (NO_2)	Annual Average*	40 µg/m^3	-Gas Phase Chemiluminescence
	24 hours**	80 µg/m^3	
O_3	1 hour	130 µg/m^3	-Non dispersive UV absorption method
Suspended Particulate Matter (SPM)	Annual Average*	360 µg/m^3	-High Volume Sampling, (Average flow rate not less than 1.1 m^3/min)
	24 hours**	500 µg/m^3	
Respirable particulate Matter. PM_{10}	Annual Average*	120 µg/m^3	-β Ray Absorption method
	24 hours**	150 µg/m^3	
Respirable Particulate Matter. $PM_{2.5}$	Annual Average*	40 µg/m^3 ***	-β Ray Absorption method
	24 hours**	75 µg/m^3	
Lead (Pb)	Annual Average*	1 µg/m^3	ASS Method after sampling using EPM 2000 or equivalent Filter paper
	24 hours**	1.5 µg/m^3	
Carbon Monoxide (CO)	8 hours**	5 mg/m^3	Non Dispersive Infra Red (NDIR) method
	1 hour	10 mg/m^3	

* Annual arithmetic mean of minimum 104 instruments in a year taken twice a week 24 hourly at uniform interval

** 24 hourly /8 hourly values should be met 98% of the in a year. 2% of the time, it may exceed but not on two consecutive days.

*** or 9 µg/m^3 plus baseline, whichever is low.

Table 1-7: National Environmental Quality Standards for Noise

No.	Category of Area/Zone	Effective from 1st July, 2010		Effective from 1st July, 2012	
		Limit in dB(A) Leq*			
		Day time	Night time	Day time	Night time
1.	Residential are (A)	65	50	55	45
2.	Commercial are (B)	70	60	65	55
3.	Industrial area (C)	80	75	75	65
4.	Silence zone (D)	55	45	50	45

Note:

1. Day time hours: 6 .00 am to 10.00 pm
2. Night Time hours: 10.00 pm to 6.00 am
3. Silence zone: Zones which are declared as such by the competent authority. An area comprising not less than 100 meters around hospitals, educational institutions and courts and courts.
4. Mixed categories of areas may be declared as one of the four above-mentioned categories by the competent authority.
5. dB(A) Leq: time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

Table 1-8: National Environmental Quality Standards for Drinking Water

Properties/ Parameters	Standard Values For Pakistan	Who Guidelines	Remarks
Bacterial			
All water intended for drinking (e.Coli or Thermo tolerant Coliform bacteria)	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample	Most Asian countries also follow WHO standards
Treated water entering the distribution system (E.Coli or thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample	Most Asian countries also follow WHO standards
Treated water in the distribution system (E.coli or thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml sample In case of large supplies, where sufficient samples are examined, must not be present in 95% of the samples taken throughout any 12-month period.	Must not be detectable in any 100 ml sample In case of large supplies, where sufficient samples are examined, must not be present in 95% of the samples taken throughout any 12-month period.	Most Asian countries also follow WHO standards
Physical			
Colour	≤15 TCU	≤15 TCU	
Taste	Non objectionable/Accept able	Non objectionable/Accept able	
Odor	Non objectionable/Accept able	Non objectionable/Accept able	
Turbidity	< 5 NTU	< 5 NTU	
Total hardness as CaCO3	< 500 mg/l	–	

Properties/ Parameters	Standard Values For Pakistan	Who Guidelines	Remarks
TDS	< 1000	< 1000	
pH	6.5 – 8.5	6.5 – 8.5	
Chemical			
Essential Inorganic	mg/Litre	mg/Litre	
Aluminium (Al) mg/1	<0.2	0.2	
Antimony (Sb)	<0.005 (P)	0.02	
Arsenic (As)	< 0.05 (P)	0.01	Standard for Pakistan similar to most Asian developing countries
Barium (Ba)	0.7	0.7	
Boron (B)	0.3	0.3	
Cadmium (Cd)	0.01	0.003	Standard for Pakistan similar to most Asian developing countries
Chloride (Cl)	<250	250	
Chromium (Cr)	<0.05	0.05	
Copper (Cu)	2	2	
Toxic Inorganic	mg/Litre	mg/Litre	
Cyanide (CN)	<0.05	0.07	Standard for Pakistan similar to Asian developing countries
Fluoride (F)*	<1.5	1.5	
Lead (Pb)	<0.05	0.01	Standard for Pakistan similar to most Asian developing countries
Manganese (Mn)	< 0.5	0.5	
Mercury (Hg)	<0.001	0.001	
Nickel (Ni)	<0.02	0.02	
Nitrate (NO3)*	<50	50	
Nitrite (NO2)*	<3 (P)	3	
Selenium (Se)	0.01(P)	0.01	
Residual chlorine	0.2-0.5 at consumer end 0.5-1.5 at source	–	
Zinc (Zn)	5.0	3	Standard for Pakistan similar to most Asian developing countries
* indicates priority health related inorganic constituents which need regular monitoring.			

Properties/ Parameters	Standard Values For Pakistan	Who Guidelines	Remarks
Organic			
Pesticides mg/L		PSQCA No. 4639-2004, Page No. 4 Table No. 3 Serial No. 20- 58 may be consulted.***	Annex II
Phenolic compounds (as Phenols) mg/L		< 0.002	
Polynuclear aromatic hydrocarbons (as PAH) g/L		0.01 (By GC/MS method)	
Radioactive			
Alpha Emitters bq/L or pCi	0.1	0.1	
Beta emitters	1	1	

*** PSQCA: Pakistan Standards Quality Control Authority.

Proviso:

1. The existing drinking water treatment infrastructure is not adequate to comply with WHO guidelines. The arsenic concentrations in South Punjab and in some parts of Sindh have been found high then Revised WHO guidelines. It will take some time to control arsenic through treatment process. Lead concentration in the proposed standards is higher than WHO Guidelines. As the piping system for supply of drinking water in urban centres are generally old and will take significant resources and time to get them replaced. In the recent past, lead was completely phased out from petroleum products to cut down lead entering into environment. These steps will enable to achieve WHO Guidelines for Arsenic, Lead, Cadmium and Zinc. However, for the bottled water, WHO limits for Arsenic, Lead, Cadmium and Zinc will be applicable and PSQCA Standards for all the remaining parameters.

Appendix 2: IFC ENVIRONMENTAL, HEALTH, AND SAFETY GUIDELINES

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)

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[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,

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[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.

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[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.

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[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

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[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

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[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).

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[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)).

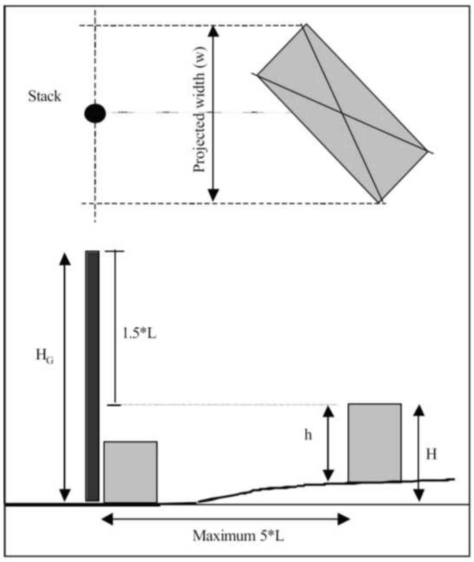
$H_G = H + 1.5L$; where

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.

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[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

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[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

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[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

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[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

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[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

Environmental, Health, and Safety Guidelines for Thermal Power Plants

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 industry sector EHS guidelines are designed to be used together with the **General EHS Guidelines** document, which provides guidance to users on common EHS issues potentially applicable to all 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/sustainability.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, based on environmental assessments and/or environmental audits as appropriate, 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 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.

Applicability

This document includes information relevant to combustion processes fueled by gaseous, liquid and solid fossil fuels and biomass and designed to deliver electrical or mechanical power, steam, heat, or any combination of these, regardless of the fuel type (except for solid waste which is covered under a separate Guideline for Waste Management Facilities), with a total rated heat input capacity above 50 Megawatt thermal input (MWth) on Higher Heating Value (HHV) basis.[2] It applies to boilers, reciprocating engines, and combustion turbines in new and existing facilities. Annex A contains a detailed description of industry activities for this sector, and Annex B contains guidance for Environmental Assessment (EA) of thermal power projects. Emissions guidelines applicable to facilities with a total heat input capacity of less than 50 MWth are presented in Section 1.1 of the **General EHS Guidelines.** Depending on the characteristics of the project and its associated activities (i.e., fuel sourcing and evacuation of generated electricity), readers should also consult

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[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] Total capacity applicable to a facility with multiple units.

the EHS Guidelines for Mining and the EHS Guidelines for Electric Power Transmission and Distribution.

Decisions to invest in this sector by one or more members of the World Bank Group are made within the context of the World Bank Group strategy on climate change.

This document is organized according to the following sections:

Section 1.0 – Industry Specific Impacts and Management
Section 2.0 – Performance Indicators and Monitoring
Section 3.0 – References and Additional Sources
Annex A – General Description of Industry Activities
Annex B – Environmental Assessment Guidance for Thermal Power Projects.

1.0 Industry-Specific Impacts and Management

The following section provides a summary of the most significant EHS issues associated with thermal power plants, which occur during the operational phase, along with recommendations for their management.

As described in the introduction to the **General EHS Guidelines**, the general approach to the management of EHS issues in industrial development activities, including power plants, should consider potential impacts as early as possible in the project cycle, including the incorporation of EHS considerations into the site selection and plant design processes in order to maximize the range of options available to prevent and control potential negative impacts.

Recommendations for the management of EHS issues common to most large industrial and infrastructure facilities during the construction and decommissioning phases are provided in the **General EHS Guidelines**.

1.1 Environment

Environmental issues in thermal power plant projects primarily include the following:

- Air emissions
- Energy efficiency and Greenhouse Gas emissions
- Water consumption and aquatic habitat alteration
- Effluents
- Solid wastes
- Hazardous materials and oil
- Noise

Air Emissions

The primary emissions to air from the combustion of fossil fuels or biomass are sulfur dioxide (SO_2), nitrogen oxides (NO_X), particulate matter (PM), carbon monoxide (CO), and greenhouse gases, such as carbon dioxide (CO_2). Depending on the fuel type and quality, mainly waste fuels or solid fuels, other substances such as heavy metals (i.e., mercury, arsenic, cadmium, vanadium, nickel, etc), halide compounds (including hydrogen fluoride), unburned hydrocarbons and other volatile organic compounds (VOCs) may be emitted in smaller quantities, but may have a significant influence on the environment due to their toxicity and/or persistence. Sulfur dioxide and nitrogen oxide are also implicated in long-range and trans-boundary acid deposition.

The amount and nature of air emissions depends on factors such as the fuel (e.g., coal, fuel oil, natural gas, or biomass), the type and design of the combustion unit (e.g., reciprocating engines, combustion turbines, or boilers), operating practices, emission control measures (e.g., primary combustion control, secondary flue gas treatment), and the overall system efficiency. For example, gas-fired plants generally produce negligible quantities of particulate matter and sulfur oxides, and levels of nitrogen oxides are about 60% of those from plants using coal (without emission reduction measures). Natural gas-fired plants also release lower quantities of carbon dioxide, a greenhouse gas.

Some measures, such as choice of fuel and use of measures to increase energy conversion efficiency, will reduce emissions of multiple air pollutants, including CO_2, per unit of energy generation. Optimizing energy utilization efficiency of the generation process depends on a variety of factors, including the nature and quality of fuel, the type of combustion system, the operating temperature of the combustion turbines, the operating pressure and temperature of steam turbines, the local climate conditions, the type of cooling system used, etc. Recommended measures to prevent, minimize, and control air emissions include:

- Use of the cleanest fuel economically available (natural gas is preferable to oil, which is preferable to coal) if that is consistent with the overall energy and environmental policy of the country or the region where the plant is proposed. For most large power plants, fuel choice is often part of the national energy policy, and fuels, combustion technology and pollution control technology, which are all interrelated, should be evaluated very carefully upstream of the project to optimize the project's environmental performance;
- When burning coal, giving preference to high-heat-content, low-ash, and low-sulfur coal;
- Considering beneficiation to reduce ash content, especially for high ash coal;[3]
- Selection of the best power generation technology for the fuel chosen to balance the environmental and economic benefits. The choice of technology and pollution control systems will be based on the site-specific environmental assessment (some examples include the use of higher energy-efficient systems, such as combined cycle gas turbine system for natural gas and oil-fired units, and supercritical, ultra-supercritical or integrated coal gasification combined cycle (IGCC) technology for coal-fired units);
- Designing stack heights according to Good International Industry Practice (GIIP) to avoid excessive ground level concentrations and minimize impacts, including acid deposition;[4]
- Considering use of combined heat and power (CHP, or co-generation) facilities. By making use of otherwise wasted heat, CHP facilities can achieve thermal efficiencies of 70 – 90 percent, compared with 32 – 45 percent for conventional thermal power plants.

- As stated in the General EHS Guidelines, emissions from a single project should not contribute more than 25% of the applicable ambient air quality standards to allow additional, future sustainable development in the same airshed.[5]

Pollutant-specific control recommendations are provided below.

Sulfur Dioxide

The range of options for the control of sulfur oxides varies substantially because of large differences in the sulfur content of different fuels and in control costs as described in Table 1. The choice of technology depends on a benefit-cost analysis of the environmental performance of different fuels, the cost of controls, and the existence of a market for sulfur control by-products[6]. Recommended measures to prevent, minimize, and control SO_2 emissions include:

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[3] If sulfur is inorganically bound to the ash, this will also reduce sulfur content.

[4] For specific guidance on calculating stack height see Annex 1.1.3 of the General EHS Guidelines. Raising stack height should not be used to allow more emissions. However, if the proposed emission rates result in significant incremental ambient air quality impacts to the attainment of the relevant ambient air quality standards, options to raise stack height and/or to further reduce emissions should be considered in the EA. Typical examples of GIIP stack heights are up to around 200m for large coal-fired power plants, up to around 80m for HFO-fueled diesel engine power plants, and up to 100m for gas-fired combined cycle gas turbine power plants. Final selection of the stack height will depend on the terrain of the surrounding areas, nearby buildings, meteorological conditions, predicted incremental impacts and the location of existing and future receptors.

[5] For example, the US EPA Prevention of Significant Deterioration Increments Limits applicable to non-degraded airsheds provide the following: SO_2 (91 $\mu g/m^3$ for 2nd highest 24-hour, 20 $\mu g/m^3$ for annual average), NO_2 (20 $\mu g/m^3$ for annual average), and PM_{10} (30 $\mu g/m^3$ for 2nd highest 24-hour, and 17 $\mu g/m^3$ for annual average).

- Use of fuels with a lower content of sulfur where economically feasible;
- Use of lime (CaO) or limestone ($CaCO_3$) in coal-fired fluidized bed combustion boilers to have integrated desulfurization which can achieve a removal efficiency of up to 80-90 % through use of Fluidized Bed Combustion[7, 8];
- Depending on the plant size, fuel quality, and potential for significant emissions of SO_2 , use of flue gas desulfurization (FGD) for large boilers using coal or oil and for large reciprocating engines . The optimal type of FGD system (e.g., wet FGD using limestone with 85 to 98% removal efficiency, dry FGD using lime with 70 to 94% removal efficiency, seawater FGD with up to 90% removal efficiency) depends on the capacity of the plant, fuel properties, site conditions, and the cost and availability of reagent as well as by-product disposal and utilization.[9]

Table 1 - Performance / Characteristics of FGDs

Type of FGD	Characteristics	Plant Capital Cost Increase
Wet FGD	• Flue gas is saturated with water • Limestone ($CaCO_3$) as reagent • Removal efficiency up to 98% • Use 1-1.5% of electricity generated • Most widely used • Distance to limestone source and the limestone reactivity to be considered • High water consumption • Need to treat wastewater • Gypsum as a saleable by-product or waste	11-14%
Semi-Dry FGD	• Also called "Dry Scrubbing" – under controlled humidification. • Lime (CaO) as reagent • Removal efficiency up to 94% • Can remove SO_3 as well at higher removal rate than Wet FGD • Use 0.5-1.0% of electricity generated, less than Wet FGD • Lime is more expensive than limestone • No wastewater • Waste – mixture of fly ash, unreacted additive and $CaSO_3$	9-12%
Seawater FGD	• Removal efficiency up to 90% • Not practical for high S coal (>1%S) • Impacts on marine environment need to be carefully examined (e.g., reduction of pH, inputs of remaining heavy metals, fly ash, temperature, sulfate, dissolved oxygen, and chemical oxygen demand) • Use 0.8-1.6% of electricity generated • Simple process, no wastewater or solid waste,	7-10%

Sources: EC (2006) and World Bank Group.

Nitrogen Oxides

Formation of nitrogen oxides can be controlled by modifying operational and design parameters of the combustion process (primary measures). Additional treatment of NO_X from the flue gas (secondary measures; see Table 2) may be required in some cases depending on the ambient air quality objectives. Recommended measures to prevent, minimize, and control NO_X emissions include:

- Use of low NO_X burners with other combustion modifications, such as low excess air (LEA) firing, for boiler plants. Installation of additional NO_X controls for boilers may be necessary to meet emissions limits; a selective catalytic reduction (SCR) system can be used for pulverized coal-fired, oil-fired, and gas-fired boilers or a selective non-catalytic reduction (SNCR) system for a fluidized-bed boiler;
- Use of dry low-NO_X combustors for combustion turbines burning natural gas;
- Use of water injection or SCR for combustion turbines and

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[6] Regenerative Flue Gas Desulfurization (FGD) options (either wet or semi-dray) may be considered under these conditions.

[7] EC (2006).

[8] The SO2 removal efficiency of FBC technologies depends on the sulfur and lime content of fuel, sorbent quantity, ratio, and quality.

[9] The use of wet scrubbers, in addition to dust control equipment (e.g. ESP or Fabric Filter), has the advantage of also reducing emissions of HCl, HF, heavy metals, and further dust remaining after ESP or Fabric Filter. Because of higher costs, the wet scrubbing process is generally not used at plants with a capacity of less than 100 MWth (EC 2006).

reciprocating engines burning liquid fuels;[10]

- Optimization of operational parameters for existing reciprocating engines burning natural gas to reduce NOx emissions;
- Use of lean-burn concept or SCR for new gas engines.

Table 2 - Performance / Characteristics of Secondary NOx Reduction Systems

Type	Characteristics	Plant Capital Cost Increase
SCR	• NOx emission reduction rate of 80 – 95% • Use 0.5% of electricity generated • Use ammonia or urea as reagent. • Ammonia slip increases with increasing NH_3/NOx ratio may cause a problem (e.g., too high ammonia in the fly ash). Larger catalyst volume / improving the mixing of NH_3 and NOx in the flue gas may be needed to avoid this problem. • Catalysts may contain heavy metals. Proper handling and disposal / recycle of spent catalysts is needed. • Life of catalysts has been 6-10 years (coal-fired), 8-12 years (oil-fired) and more than 10 years (gas-fired).	4-9% (coal-fired boiler) 1-2% (gas-fired combined cycle gas turbine) 20-30% (reciprocating engines)
SNCR	• NOx emission reduction rate of 30 – 50% • Use 0.1-0.3% of electricity generated • Use ammonia or urea as reagent. • Cannot be used on gas turbines or gas engines. • Operates without using catalysts.	1-2%

Source: EC (2006), World Bank Group

Particulate Matter

Particulate matter[11] is emitted from the combustion process, especially from the use of heavy fuel oil, coal, and solid biomass. The proven technologies for particulate removal in power plants are fabric filters and electrostatic precipitators (ESPs), shown in Table 3. The choice between a fabric filter and an ESP depends on the fuel properties, type of FGD system if used for SO_2 control, and ambient air quality objectives. Particulate matter can also be released during transfer and storage of coal and additives, such as lime. Recommendations to prevent, minimize, and control particulate matter emissions include:

- Installation of dust controls capable of over 99% removal efficiency, such as ESPs or Fabric Filters (baghouses), for coal-fired power plants. The advanced control for particulates is a wet ESP, which further increases the removal efficiency and also collects condensables (e.g., sulfuric acid mist) that are not effectively captured by an ESP or a fabric filter;[12]
- Use of loading and unloading equipment that minimizes the height of fuel drop to the stockpile to reduce the generation of fugitive dust and installing of cyclone dust collectors;
- Use of water spray systems to reduce the formation of fugitive dust from solid fuel storage in arid environments;
- Use of enclosed conveyors with well designed, extraction and filtration equipment on conveyor transfer points to prevent the emission of dust;
- For solid fuels of which fine fugitive dust could contain vanadium, nickel and Polycyclic Aromatic Hydrocarbons (PAHs) (e.g., in coal and petroleum coke), use of full enclosure during transportation and covering stockpiles where necessary;
- Design and operate transport systems to minimize the generation and transport of dust on site;
- Storage of lime or limestone in silos with well designed, extraction and filtration equipment;
- Use of wind fences in open storage of coal or use of enclosed storage structures to minimize fugitive dust

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[10] Water injection may not be practical for industrial combustion turbines in all cases. Even if water is available, the facilities for water treatment and the operating and maintenance costs of water injection may be costly and may complicate the operation of a small combustion turbine.

[11] Including all particle sizes (e.g. TSP, PM_{10}, and $PM_{2.5}$)

[12] Flue gas conditioning (FGC) is a recommended approach to address the issue of low gas conductivity and lower ESP collection performance which occurs when ESPs are used to collect dust from very low sulfur fuels. One particular FGC design involves introduction of sulfur trioxide (SO_3) gas into the flue gas upstream of the ESP, to increase the conductivity of the flue gas dramatically improve the ESP collection efficiency. There is typically no risk of increased SOx emissions as the SO_3 is highly reactive and adheres to the dust.

emissions where necessary, applying special ventilation systems in enclosed storage to avoid dust explosions (e.g., use of cyclone separators at coal transfer points).

See Annex 1.1.2 of the **General EHS Guidelines** for an additional illustrative presentation of point source emissions prevention and control technologies.

Table 3 – Performance / Characteristics of Dust Removal Systems

Type	Performance / Characteristics
ESP	• Removal efficiency of >96.5% (<1 µm), >99.95% (>10 µm) • 0.1-1.8% of electricity generated is used • It might not work on particulates with very high electrical resistivity. In these cases, flue gas conditioning (FGC) may improve ESP performance. • Can handle very large gas volume with low pressure drops
Fabric Filter	• Removal efficiency of >99.6% (<1 µm), >99.95% (>10 µm). Removes smaller particles than ESPs. • 0.2-3% of electricity generated is used • Filter life decreases as coal S content increases • Operating costs go up considerably as the fabric filter becomes dense to remove more particles • If ash is particularly reactive, it can weaken the fabric and eventually it disintegrates.
Wet Scrubber	• Removal efficiency of >98.5% (<1 µm), >99.9% (>10 µm) • Up to 3% of electricity generated is used. • As a secondary effect, can remove and absorb gaseous heavy metals • Wastewater needs to be treated

Sources: EC (2006) and World Bank Group.

Other Pollutants

Depending on the fuel type and quality, other air pollutants may be present in environmentally significant quantities requiring proper consideration in the evaluation of potential impacts to ambient air quality and in the design and implementation of management actions and environmental controls. Examples of additional pollutants include mercury in coal, vanadium in heavy fuel oil, and other heavy metals present in waste fuels such as petroleum coke (petcoke) and used lubricating oils[13]. Recommendations to prevent, minimize, and control emissions of other air pollutants such as mercury in particular from thermal power plants include the use of conventional secondary controls such as fabric filters or ESPs operated in combination with FGD techniques, such as limestone FGD, Dry Lime FGD, or sorbent injection.[14] Additional removal of metals such as mercury can be achieved in a high dust SCR system along with powered activated carbon, bromine-enhanced Powdered Activated Carbon (PAC) or other sorbents. Since mercury emissions from thermal power plants pose potentially significant local and transboundary impacts to ecosystems and public health and safety through bioaccumulation, particular consideration should be given to their minimization in the environmental assessment and accordingly in plant design.[15]

Emissions Offsets

Facilities in degraded airsheds should minimize incremental impacts by achieving emissions values outlined in Table 6. Where these emissions values result nonetheless in excessive ambient impacts relative to local regulatory standards (or in their absence, other international recognized standards or guidelines, including World Health Organization guidelines), the project should explore and implement site-specific offsets that result in no net increase in the total emissions of those pollutants (e.g., particulate matter, sulfur dioxide, or nitrogen dioxide) that are responsible for the degradation of the airshed. Offset provisions should be implemented before the power plant comes fully on stream. Suitable offset measures could include reductions in emissions of particulate matter, sulfur dioxide, or nitrogen dioxide, as necessary through (a) the installation of new or more effective controls at other units within the same power plant or at other power plants in

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[13] In these cases, the EA should address potential impacts to ambient air quality for such heavy metals as mercury, nickel, vanadium, cadmium, lead, etc.

[14] For Fabric Filters or Electrostatic Precipitators operated in combination with FGD techniques, an average removal rate of 75% or 90 % in the additional presence of SCR can be obtained (EC, 2006).

[15] Although no major industrial country has formally adopted regulatory limits for mercury emissions from thermal power plants, such limitations where under consideration in the United States and European Union as of 2008. Future updates of these EHS Guidelines will reflect changes in the international state of

the same airshed, (b) the installation of new or more effective controls at other large sources, such as district heating plants or industrial plants, in the same airshed, or (c) investments in gas distribution or district heating systems designed to substitute for the use of coal for residential heating and other small boilers. Wherever possible, the offset provisions should be implemented within the framework of an overall air quality management strategy designed to ensure that air quality in the airshed is brought into compliance with ambient standards. The monitoring and enforcement of ambient air quality in the airshed to ensure that offset provisions are complied with would be the responsibility of the local or national agency responsible for granting and supervising environmental permits. Project sponsors who cannot engage in the negotiations necessary to put together an offset agreement (for example, due to the lack of the local or national air quality management framework) should consider the option of relying on an appropriate combination of using cleaner fuels, more effective pollution controls, or reconsidering the selection of the proposed project site. The overall objective is that the new thermal power plants should not contribute to deterioration of the already degraded airshed.

Energy Efficiency and GHG Emissions

Carbon dioxide, one of the major greenhouse gases (GHGs) under the UN Framework Convention on Climate Change, is emitted from the combustion of fossil fuels. Recommendations to avoid, minimize, and offset emissions of carbon dioxide from new and existing thermal power plants include, among others:

- Use of less carbon intensive fossil fuels (i.e., less carbon containing fuel per unit of calorific value -- gas is less than oil and oil is less than coal) or co-firing with carbon neutral fuels (i.e., biomass);
- Use of combined heat and power plants (CHP) where feasible;
- Use of higher energy conversion efficiency technology of the same fuel type / power plant size than that of the country/region average. New facilities should be aimed to be in top quartile of the country/region average of the same fuel type and power plant size. Rehabilitation of existing facilities must achieve significant improvements in efficiency. Typical CO_2 emissions performance of different fuels / technologies are presented below in Table 4;
- Consider efficiency-relevant trade-offs between capital and operating costs involved in the use of different technologies. For example, supercritical plants may have a higher capital cost than subcritical plants for the same capacity, but lower operating costs. On the other hand, characteristics of existing and future size of the grid may impose limitations in plant size and hence technological choice. These tradeoffs need to be fully examined in the EA;
- Use of high performance monitoring and process control techniques, good design and maintenance of the combustion system so that initially designed efficiency performance can be maintained;
- Where feasible, arrangement of emissions offsets (including the Kyoto Protocol's flexible mechanisms and the voluntary carbon market), including reforestation, afforestation, or capture and storage of CO_2 or other currently experimental options[16];
- Where feasible, include transmission and distribution loss reduction and demand side measures. For example, an investment in peak load management could reduce cycling requirements of the generation facility thereby improving its operating efficiency. The feasibility of these types of off-set options may vary depending on whether the facility is part of a vertically integrated utility or an independent power producer;
- Consider fuel cycle emissions and off-site factors (e.g., fuel

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practice regarding mercury emissions prevention and control.

[16] The application of carbon capture and storage (CCS) from thermal power projects is still in experimental stages worldwide although consideration has started to be given to CCS-ready design. Several options are currently under evaluation including CO_2 storage in coal seams or deep aquifers and oil reservoir injection for enhanced oil recovery.

supply, proximity to load centers, potential for off-site use of waste heat, or use of nearby waste gases (blast furnace gases or coal bed methane) as fuel. etc).

Table 4 - Typical CO_2 Emissions Performance of New Thermal Power Plants

Fuel	Efficiency	CO_2 (gCO_2 / kWh – Gross)
Efficiency (% Net, HHV)		
Coal (*1, *2)	Ultra-Supercritical (*1):	
	37.6 – 42.7	676-795
	Supercritical:	
	35.9-38.3 (*1)	756-836
	39.1 (w/o CCS) (*2)	763
	24.9 (with CCS) (*2)	95
	Subcritical:	
	33.1-35.9 (*1)	807-907
	36.8 (w/o CCS) (*2)	808
	24.9 (with CCS) (*2)	102
	IGCC:	
	39.2-41.8 (*1)	654-719
	38.2–41.1 (w/o CCS) (*2)	640 – 662
	31.7–32.5 (with CCS) (*2)	68 – 86
Gas (*2)	Advanced CCGT (*2):	
	50.8 (w/o CCS)	355
	43.7 (with CCS)	39
Efficiency (% Net, LHV)		
Coal (*3)	42 (Ultra-Supercritical)	811
	40 (Supercritical)	851
	30 – 38 (Subcritical)	896-1,050
	46 (IGCC)	760
	38 (IGCC+CCS)	134
Coal and Lignite (*4, *7)	(*4) 43-47 (Coal-PC)	(*6) 725-792 (Net)
	>41(Coal-FBC)	<831 (Net)
	42-45 (Lignite-PC)	808-866 (Net)
	>40 (Lignite-FBC)	<909 (Net)
Gas (*4, *7)	(*4) 36–40 (Simple Cycle GT)	(*6) 505-561 (Net)
	38-45 (Gas Engine)	531-449 (Net)
	40-42 (Boiler)	481-505 (Net)
	54-58 (CCGT)	348-374 (Net)
Oil (*4, *7)	(*4) 40 – 45 (HFO/LFO Reciprocating Engine)	(*6) 449-505 (Net)
Efficiency (% Gross, LHV)		
Coal (*5, *7)	(*5) 47 (Ultra-supercritical)	(*6) 725
	44 (Supercritical)	774
	41-42 (Subcritical)	811-831
	47-48 (IGCC)	710-725
Oil (*5, *7)	(*5) 43 (Reciprocating Engine)	(*6) 648
	41 (Boiler)	680
Gas (*5)	(*5) 34 (Simple Cycle GT)	(*6) 594
	51 (CCGT)	396

Source: (*1) US EPA 2006, (*2) US DOE/NETL 2007, (*3) World Bank, April 2006, (*4) European Commission 2006, (*5) World Bank Group, Sep 2006, (*6) World Bank Group estimates

Water Consumption and Aquatic Habitat Alteration

Steam turbines used with boilers and heat recovery steam generators(HRSG) used in combined cycle gas turbine units require a cooling system to condense steam used to generate electricity. Typical cooling systems used in thermal power plants include: (i) once-through cooling system where sufficient cooling water and receiving surface water are available; (ii) closed circuit wet cooling system; and (iii) closed circuit dry cooling system (e.g., air cooled condensers).

Combustion facilities using once-through cooling systems require large quantities of water which are discharged back to receiving surface water with elevated temperature. Water is also required for boiler makeup, auxiliary station equipment, ash handling, and FGD systems.[17] The withdrawal of such large quantities of water has the potential to compete with other important water uses such as agricultural irrigation or drinking water sources. Withdrawal and discharge with elevated temperature and chemical contaminants such as biocides or other additives, if used, may affect aquatic organisms, including phytoplankton, zooplankton, fish, crustaceans, shellfish, and many other forms of aquatic life. Aquatic organisms drawn into cooling water intake structures are either impinged on components of the cooling water intake structure or entrained in the cooling water system itself. In the case of either impingement or entrainment, aquatic organisms may be killed or subjected to significant harm. In some cases (e.g., sea turtles), organisms are entrapped in the intake canals. There may be special concerns about the potential impacts of cooling water intake structures located in or near habitat areas that support threatened, endangered, or other protected species or where local fishery is active.

Conventional intake structures include traveling screens with relative high through-screen velocities and no fish handling or

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[17] The availability of water and impact of water use may affect the choice of FGD

return system.[18] Measures to prevent, minimize, and control environmental impacts associated with water withdrawal should be established based on the results of a project EA, considering the availability and use of water resources locally and the ecological characteristics of the project affected area. Recommended management measures to prevent or control impacts to water resources and aquatic habitats include[19]:

- Conserving water resources, particularly in areas with limited water resources, by:
    - Use of a closed-cycle, recirculating cooling water system (e.g., natural or forced draft cooling tower), or closed circuit dry cooling system (e.g., air cooled condensers) if necessary to prevent unacceptable adverse impacts. Cooling ponds or cooling towers are the primary technologies for a recirculating cooling water system. Once-through cooling water systems may be acceptable if compatible with the hydrology and ecology of the water source and the receiving water and may be the preferred or feasible alternative for certain pollution control technologies such as seawater scrubbers
    - Use of dry scrubbers in situations where these controls are also required or recycling of wastewater in coal-fired plants for use as FGD makeup
    - Use of air-cooled systems
- Reduction of maximum through-screen design intake velocity to 0.5 ft/s;
- Reduction of intake flow to the following levels:
    - For freshwater rivers or streams to a flow sufficient to maintain resource use (i.e., irrigation and fisheries) as well as biodiversity during annual mean low flow conditions[20]
    - For lakes or reservoirs, intake flow must not disrupt the thermal stratification or turnover pattern of the source water
    - For estuaries or tidal rivers, reduction of intake flow to 1% of the tidal excursion volume
- If there are threatened, endangered, or other protected species or if there are fisheries within the hydraulic zone of influence of the intake, reduction of impingement and entrainment of fish and shellfish by the installation of technologies such as barrier nets (seasonal or year-round), fish handling and return systems, fine mesh screens, wedgewire screens, and aquatic filter barrier systems. Examples of operational measures to reduce impingement and entrainment include seasonal shutdowns, if necessary, or reductions in flow or continuous use of screens. Designing the location of the intake structure in a different direction or further out into the water body may also reduce impingement and entrainment.

Effluents

Effluents from thermal power plants include thermal discharges, wastewater effluents, and sanitary wastewater.

Thermal Discharges

As noted above, thermal power plants with steam-powered generators and once-through cooling systems use significant volume of water to cool and condense the steam for return to the boiler. The heated water is normally discharged back to the source water (i.e., river, lake, estuary, or the ocean) or the nearest surface water body. In general, thermal discharge should be designed to ensure that discharge water temperature does not result in exceeding relevant ambient water quality temperature standards outside a scientifically established mixing zone. The mixing zone is typically defined as the zone where initial dilution of a discharge takes place within which relevant water quality

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system used (i.e., wet vs. semi-dry).

[18] The velocity generally considered suitable for the management of debris is 1 fps [0.30 m/s] with wide mesh screens; a standard mesh for power plants of 3/8 in (9.5 mm).

[19] For additional information refer to Schimmoller (2004) and USEPA (2001).

[20] Stream flow requirements may be based on mean annual flow or mean low flow. Regulatory requirements may be 5% or higher for mean annual flows and 10% to 25% for mean low flows. Their applicability should be verified on a site-specific

temperature standards are allowed to exceed and takes into account cumulative impact of seasonal variations, ambient water quality, receiving water use, potential receptors and assimilative capacity among other considerations. Establishment of such a mixing zone is project specific and may be established by local regulatory agencies and confirmed or updated through the project's environmental assessment process. Where no regulatory standard exists, the acceptable ambient water temperature change will be established through the environmental assessment process. Thermal discharges should be designed to prevent negative impacts to the receiving water taking into account the following criteria:

- The elevated temperature areas because of thermal discharge from the project should not impair the integrity of the water body as a whole or endanger sensitive areas (such as recreational areas, breeding grounds, or areas with sensitive biota);
- There should be no lethality or significant impact to breeding and feeding habits of organisms passing through the elevated temperature areas;
- There should be no significant risk to human health or the environment due to the elevated temperature or residual levels of water treatment chemicals.

If a once-through cooling system is used for large projects (i.e., a plant with > 1,200MWth steam generating capacity), impacts of thermal discharges should be evaluated in the EA with a mathematical or physical hydrodynamic plume model, which can be a relatively effective method for evaluating a thermal discharge to find the maximum discharge temperatures and flow rates that would meet the environmental objectives of the receiving water.[21]

Recommendations to prevent, minimize, and control thermal discharges include:

- Use of multi-port diffusers;
- Adjustment of the discharge temperature, flow, outfall location, and outfall design to minimize impacts to acceptable level (i.e., extend length of discharge channel before reaching the surface water body for pre-cooling or change location of discharge point to minimize the elevated temperature areas);
- Use of a closed-cycle, recirculating cooling water system as described above (e.g., natural or forced draft cooling tower), or closed circuit dry cooling system (e.g., air cooled condensers) if necessary to prevent unacceptable adverse impacts. Cooling ponds or cooling towers are the primary technologies for a recirculating cooling water system.

Liquid Waste

The wastewater streams in a thermal power plant include cooling tower blowdown; ash handling wastewater; wet FGD system discharges; material storage runoff; metal cleaning wastewater; and low-volume wastewater, such as air heater and precipitator wash water, boiler blowdown, boiler chemical cleaning waste, floor and yard drains and sumps, laboratory wastes, and backflush from ion exchange boiler water purification units. All of these wastewaters are usually present in plants burning coal or biomass; some of these streams (e.g., ash handling wastewater) may be present in reduced quantities or may not be present at all in oil-fired or gas-fired power plants. The characteristics of the wastewaters generated depend on the ways in which the water has been used. Contamination arises from demineralizers; lubricating and auxiliary fuel oils; trace contaminants in the fuel (introduced through the ash-handling wastewater and wet FGD system discharges); and chlorine, biocides, and other chemicals used to manage the quality of water in cooling systems. Cooling tower blowdown tends to be very high in total dissolved solids but is generally classified as non-contact cooling water and, as such,

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basis taking into consideration resource use and biodiversity requirements.

[21] An example model is CORMIX (Cornell Mixing Zone Expert System) hydrodynamic mixing zone computer simulation, which has been developed by the U.S. Environmental Protection Agency. This model emphasizes predicting the site- and discharge-specific geometry and dilution characteristics to assess the environmental effects of a proposed discharge.

is typically subject to limits for pH, residual chlorine, and toxic chemicals that may be present in cooling tower additives (including corrosion inhibiting chemicals containing chromium and zinc whose use should be eliminated).

Recommended water treatment and wastewater conservation methods are discussed in Sections 1.3 and 1.4, respectively, of the **General EHS Guidelines**. In addition, recommended measures to prevent, minimize, and control wastewater effluents from thermal power plants include:

- Recycling of wastewater in coal-fired plants for use as FGD makeup. This practice conserves water and reduces the number of wastewater streams requiring treatment and discharge[22];
- In coal-fired power plants without FGD systems, treatment of process wastewater in conventional physical-chemical treatment systems for pH adjustment and removal of total suspended solids (TSS), and oil / grease, at a minimum. Depending on local regulations, these treatment systems can also be used to remove most heavy metals to part-per-billion (ppb) levels by chemical precipitation as either metal hydroxide or metal organosulfide compounds;
- Collection of fly ash in dry form and bottom ash in drag chain conveyor systems in new coal-fired power plants;
- Consider use of soot blowers or other dry methods to remove fireside wastes from heat transfer surfaces so as to minimize the frequency and amount of water used in fireside washes;
- Use of infiltration and runoff control measures such as compacted soils, protective liners, and sedimentation controls for runoff from coal piles;
- Spraying of coal piles with anionic detergents to inhibit bacterial growth and minimize acidity of leachate;[23]
- Use of SO_X removal systems that generate less wastewater, if feasible; however, the environmental and cost characteristics of both inputs and wastes should be assessed on a case-by-case basis;
- Treatment of low-volume wastewater streams that are typically collected in the boiler and turbine room sumps in conventional oil-water separators before discharge;
- Treatment of acidic low-volume wastewater streams, such as those associated with the regeneration of makeup demineralizer and deep-bed condensate polishing systems, by chemical neutralization in-situ before discharge;
- Pretreatment of cooling tower makeup water, installation of automated bleed/feed controllers, and use of inert construction materials to reduce chemical treatment requirements for cooling towers;
- Elimination of metals such as chromium and zinc from chemical additives used to control scaling and corrosion in cooling towers;
- Use the minimum required quantities of chlorinated biocides in place of brominated biocides or alternatively apply intermittent shock dosing of chlorine as opposed to continuous low level feed.

Sanitary Wastewater

Sewage and other wastewater generated from washrooms, etc. are similar to domestic wastewater. Impacts and management of sanitary wastewater is addressed in Section 1.3 of the **General EHS Guidelines.**

Solid Wastes

Coal-fired and biomass-fired thermal power plants generate the greatest amount of solid wastes due to the relatively high percentage of ash in the fuel.[24] The large-volume coal

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[22] Suitable wastewater streams for reuse include gypsum wash water, which is a different wastewater stream than the FGD wastewater. In plants that produce marketable gypsum, the gypsum is rinsed to remove chloride and other undesirable trace elements.

[23] If coal pile runoff will be used as makeup to the FGD system, anionic detergents may increase or create foaming within the scrubber system. Therefore, use of anionic surfactants on coal piles should be evaluated on a case-by-case basis.

[24] For example, a 500 MWe plant using coal with 2.5% sulfur (S), 16% ash, and 30,000 kilojoules per kilogram (kJ/kg) heat content will generate about 500 tons of

combustion wastes (CCW) are fly ash, bottom ash, boiler slag, and FGD sludge. Biomass contains less sulfur; therefore FGD may not be necessary. Fluidized-bed combustion (FBC) boilers generate fly ash and bottom ash, which is called bed ash. Fly ash removed from exhaust gases makes up 60–85% of the coal ash residue in pulverized-coal boilers and 20% in stoker boilers. Bottom ash includes slag and particles that are coarser and heavier than fly ash. Due to the presence of sorbent material, FBC wastes have a higher content of calcium and sulfate and a lower content of silica and alumina than conventional coal combustion wastes. Low-volume solid wastes from coal-fired thermal power plants and other plants include coal mill rejects/pyrites, cooling tower sludge, wastewater treatment sludge, and water treatment sludge.

Oil combustion wastes include fly ash and bottom ash and are normally only generated in significant quantities when residual fuel oil is burned in oil-fired steam electric boilers. Other technologies (e.g., combustion turbines and diesel engines) and fuels (e.g., distillate oil) generate little or no solid wastes. Overall, oil combustion wastes are generated in much smaller quantities than the large-volume CCW discussed above. Gas-fired thermal power plants generate essentially no solid waste because of the negligible ash content, regardless of the combustion technology.

Metals are constituents of concern in both CCW and low-volume solid wastes. For example, ash residues and the dust removed from exhaust gases may contain significant levels of heavy metals and some organic compounds, in addition to inert materials.

Ash residues are not typically classified as a hazardous waste due to their inert nature.[25] However, where ash residues are expected to contain potentially significant levels of heavy metals, radioactivity, or other potentially hazardous materials, they should be tested at the start of plant operations to verify their classification as hazardous or non-hazardous according to local regulations or internationally recognized standards. Additional information about the classification and management of hazardous and non-hazardous wastes is presented in Section 1.6 of the **General EHS Guidelines.**

The high-volume CCWs wastes are typically managed in landfills or surface impoundments or, increasingly, may be applied to a variety of beneficial uses. Low-volume wastes are also managed in landfills or surface impoundments, but are more frequently managed in surface impoundments. Many coal-fired plants co-manage large-volume and low-volume wastes.

Recommended measures to prevent, minimize, and control the volume of solid wastes from thermal power plants include:

- Dry handling of the coal combustion wastes, in particular fly ash. Dry handling methods do not involve surface impoundments and, therefore, do not present the ecological risks identified for impoundments (e.g., metal uptake by wildlife);
- Recycling of CCWs in uses such as cement and other concrete products, construction fills (including structural fill, flowable fill, and road base), agricultural uses such as calcium fertilizers (provided trace metals or other potentially hazardous materials levels are within accepted thresholds), waste management applications, mining applications, construction materials (e.g., synthetic gypsum for plasterboard), and incorporation into other products provided the residues (such as trace metals and radioactivity) are not considered hazardous. Ensuring consistent quality of fuels and additives helps to ensure the CCWs can be recycled. If beneficial reuse is not feasible, disposal of CCW in permitted landfills with environmental controls such as run-on/run-off controls, liners, leachate collection systems, ground-water monitoring, closure controls, daily (or other operational) cover, and fugitive dust controls is recommended;

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solid waste per day.

[25] Some countries may categorize fly ash as hazardous due to the presence of arsenic or radioactivity, precluding its use as a construction material.

- Dry collection of bottom ash and fly ash from power plants combusting heavy fuel oil if containing high levels of economically valuable metals such as vanadium and recycle for vanadium recovery (where economically viable) or disposal in a permitted landfill with environmental controls;
- Management of ash disposal and reclamation so as to minimize environmental impacts – especially the migration of toxic metals, if present, to nearby surface and groundwater bodies, in addition to the transport of suspended solids in surface runoff due to seasonal precipitation and flooding. In particular, construction, operation, and maintenance of surface impoundments should be conducted in accordance with internationally recognized standards.[26, 27]
- Reuse of sludge from treatment of waste waters from FGD plants. This sludge may be re-used in the FGD plant due to the calcium components. It can also be used as an additive in coal-fired plant combustion to improve the ash melting behavior

Hazardous Materials and Oil

Hazardous materials stored and used at combustion facilities include solid, liquid, and gaseous waste-based fuels; air, water, and wastewater treatment chemicals; and equipment and facility maintenance chemicals (e.g., paint certain types of lubricants, and cleaners). Spill prevention and response guidance is addressed in Sections 1.5 and 3.7 of the **General EHS Guidelines**.

In addition, recommended measures to prevent, minimize, and control hazards associated with hazardous materials storage and handling at thermal power plants include the use of double-walled, underground pressurized tanks for storage of pure liquefied ammonia (e.g., for use as reagent for SCR) in quantities over 100 m^3; tanks of lesser capacity should be manufactured using annealing processes (EC 2006).

Noise

Principal sources of noise in thermal power plants include the turbine generators and auxiliaries; boilers and auxiliaries, such as coal pulverizers; reciprocating engines; fans and ductwork; pumps; compressors; condensers; precipitators, including rappers and plate vibrators; piping and valves; motors; transformers; circuit breakers; and cooling towers. Thermal power plants used for base load operation may operate continually while smaller plants may operate less frequently but still pose a significant source of noise if located in urban areas.

Noise impacts, control measures, and recommended ambient noise levels are presented in Section 1.7 of the **General EHS Guidelines**. Additional recommended measures to prevent, minimize, and control noise from thermal power plants include:

- Siting new facilities with consideration of distances from the noise sources to the receptors (e.g., residential receptors, schools, hospitals, religious places) to the extent possible. If the local land use is not controlled through zoning or is not effectively enforced, examine whether residential receptors could come outside the acquired plant boundary. In some cases, it could be more cost effective to acquire additional land as buffer zone than relying on technical noise control measures, where possible;
- Use of noise control techniques such as: using acoustic machine enclosures; selecting structures according to their noise isolation effect to envelop the building; using mufflers or silencers in intake and exhaust channels; using sound-absorptive materials in walls and ceilings; using vibration isolators and flexible connections (e.g., helical steel springs and rubber elements); applying a carefully detailed design to prevent possible noise leakage through openings or to minimize pressure variations in piping;

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[26] See, for example, U.S. Department of Labor, Mine Safety and Health Administration regulations at 30 CFR §§ 77.214 - 77.216.

[27] Additional detailed guidance applicable to the prevention and control of impacts to soil and water resources from non-hazardous and hazardous solid waste disposal is presented in the World Bank Group EHS Guidelines for Waste Management Facilities.

- Modification of the plant configuration or use of noise barriers such as berms and vegetation to limit ambient noise at plant property lines, especially where sensitive noise receptors may be present.

Noise propagation models may be effective tools to help evaluate noise management options such as alternative plant locations, general arrangement of the plant and auxiliary equipment, building enclosure design, and, together with the results of a baseline noise assessment, expected compliance with the applicable community noise requirements.

1.2 Occupational Health and Safety

Occupational health and safety risks and mitigation measures during construction, operation, and decommissioning of thermal power plants are similar to those at other large industrial facilities, and are addressed in Section 2.0 of the **General EHS Guidelines**. In addition, the following health and safety impacts are of particular concern during operation of thermal power plants:

- Non-ionizing radiation
- Heat
- Noise
- Confined spaces
- Electrical hazards
- Fire and explosion hazards
- Chemical hazards
- Dust

Non-ionizing radiation

Combustion facility workers may have a higher exposure to electric and magnetic fields (EMF) than the general public due to working in proximity to electric power generators, equipment, and connecting high-voltage transmission lines. Occupational EMF exposure should be prevented or minimized through the preparation and implementation of an EMF safety program including the following components:

- Identification of potential exposure levels in the workplace, including surveys of exposure levels in new projects and the use of personal monitors during working activities;
- Training of workers in the identification of occupational EMF levels and hazards;
- Establishment and identification of safety zones to differentiate between work areas with expected elevated EMF levels compared to those acceptable for public exposure, limiting access to properly trained workers;
- Implementation of action plans to address potential or confirmed exposure levels that exceed reference occupational exposure levels developed by international organizations such as the International Commission on Non-Ionizing Radiation Protection (ICNIRP), the Institute of Electrical and Electronics Engineers (IEEE).[28] Personal exposure monitoring equipment should be set to warn of exposure levels that are below occupational exposure reference levels (e.g., 50 percent). Action plans to address occupational exposure may include limiting exposure time through work rotation, increasing the distance between the source and the worker, when feasible, or the use of shielding materials.

Heat

Occupational exposure to heat occurs during operation and maintenance of combustion units, pipes, and related hot equipment. Recommended prevention and control measures to address heat exposure at thermal power plants include:

- Regular inspection and maintenance of pressure vessels and piping;
- Provision of adequate ventilation in work areas to reduce heat and humidity;

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[28] The ICNIRP exposure guidelines for Occupational Exposure are listed in Section 2.2 of this Guideline.

- Reducing the time required for work in elevated temperature environments and ensuring access to drinking water;
- Shielding surfaces where workers come in close contact with hot equipment, including generating equipment, pipes etc;
- Use of warning signs near high temperature surfaces and personal protective equipment (PPE) as appropriate, including insulated gloves and shoes.

Noise

Noise sources in combustion facilities include the turbine generators and auxiliaries; boilers and auxiliaries, such as pulverizers; diesel engines; fans and ductwork; pumps; compressors; condensers; precipitators, including rappers and plate vibrators; piping and valves; motors; transformers; circuit breakers; and cooling towers. Recommendations for reducing noise and vibration are discussed in Section 1.1, above. In addition, recommendations to prevent, minimize, and control occupational noise exposures in thermal power plants include:

- Provision of sound-insulated control rooms with noise levels below 60 dBA[29];
- Design of generators to meet applicable occupational noise levels;
- Identify and mark high noise areas and require that personal noise protecting gear is used all the time when working in such high noise areas (typically areas with noise levels >85 dBA).

Confined Spaces

Specific areas for confined space entry may include coal ash containers, turbines, condensers, and cooling water towers (during maintenance activities). Recommend confined space entry procedures are discussed in Section 2.8 of the **General EHS Guidelines**.

Electrical Hazards

Energized equipment and power lines can pose electrical hazards for workers at thermal power plants. Recommended measures to prevent, minimize, and control electrical hazards at thermal power plants include:

- Consider installation of hazard warning lights inside electrical equipment enclosures to warn of inadvertent energization;
- Use of voltage sensors prior to and during workers' entrance into enclosures containing electrical components;
- Deactivation and proper grounding of live power equipment and distribution lines according to applicable legislation and guidelines whenever possible before work is performed on or proximal to them;
- Provision of specialized electrical safety training to those workers working with or around exposed components of electric circuits. This training should include, but not be limited to, training in basic electrical theory, proper safe work procedures, hazard awareness and identification, proper use of PPE, proper lockout/tagout procedures, first aid including CPR, and proper rescue procedures. Provisions should be made for periodic retraining as necessary.

Fire and Explosion Hazards

Thermal power plants store, transfer, and use large quantities of fuels; therefore, careful handling is necessary to mitigate fire and explosion risks. In particular, fire and explosion hazards increase as the particle size of coal is reduced. Particle sizes of coal that can fuel a propagating explosion occur within thermal dryers, cyclones, baghouses, pulverized-fuel systems, grinding mills, and other process or conveyance equipment. Fire and explosion prevention management guidance is provided in Section 2.1 and

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[29] Depending on the type and size of the thermal power plants, distance between control room and the noise emitting sources differs. CSA Z107.58 provides design guidelines for control rooms as 60 dBA. Large thermal power plants using steam boilers or combustion turbines tend to be quieter than 60 dBA. Reciprocating engine manufacturers recommend 65 to 70 dBA instead of 60 dBA (Euromot Position as of 9 May 2008). This guideline recommends 60 dBA as GIIP, with an understanding that up to 65 dBA can be accepted for reciprocating engine power plants if 60 dBA is economically difficult to achieve.

2.4 of the **General EHS Guidelines**. Recommended measures to prevent, minimize, and control physical hazards at thermal power plants include:

- Use of automated combustion and safety controls;
- Proper maintenance of boiler safety controls;
- Implementation of startup and shutdown procedures to minimize the risk of suspending hot coal particles (e.g., in the pulverizer, mill, and cyclone) during startup;
- Regular cleaning of the facility to prevent accumulation of coal dust (e.g., on floors, ledges, beams, and equipment);
- Removal of hot spots from the coal stockpile (caused by spontaneous combustion) and spread until cooled, never loading hot coal into the pulverized fuel system;
- Use of automated systems such as temperature gauges or carbon monoxide sensors to survey solid fuel storage areas to detect fires caused by self-ignition and to identify risk points.

Chemical Hazards

Thermal power plants utilize hazardous materials, including ammonia for NO_X control systems, and chlorine gas for treatment of cooling tower and boiler water. Guidance on chemical hazards management is provided in Section 2.4 of the **General EHS Guidelines.** Additional, recommended measures to prevent, minimize, and control physical hazards at thermal power plants include:

- Consider generation of ammonia on site from urea or use of aqueous ammonia in place of pure liquefied ammonia;
- Consider use of sodium hypochlorite in place of gaseous chlorine.

Dust

Dust is generated in handing solid fuels, additives, and solid wastes (e.g., ash). Dust may contain silica (associated with silicosis), arsenic (skin and lung cancer), coal dust (black lung), and other potentially harmful substances. Dust management guidance is provided in the Section 2.1 and 2.4 of the **General EHS Guidelines.** Recommended measures to prevent, minimize, and control occupational exposure to dust in thermal power plants include:

- Use of dust controls (e.g., exhaust ventilation) to keep dust below applicable guidelines (see Section 2) or wherever free silica levels in airborne dust exceed 1 percent;
- Regular inspection and maintenance of asbestos containing materials (e.g., insulation in older plants may contain asbestos) to prevent airborne asbestos particles.

1.3 Community Health and Safety

Many community health and safety impacts during the construction, operation, and decommissioning of thermal power plant projects are common to those of most infrastructure and industrial facilities and are discussed in Section 3.0 the **General EHS Guidelines**. In addition to these and other aspects covered in Section 1.1, the following community health and safety impacts may be of particular concern for thermal power plant projects:

- Water Consumption;
- Traffic Safety.

Water Consumption

Boiler units require large amounts of cooling water for steam condensation and efficient thermal operation. The cooling water flow rate through the condenser is by far the largest process water flow, normally equating to about 98 percent of the total process water flow for the entire unit. In a once-through cooling water system, water is usually taken into the plant from surface waters, but sometimes ground waters or municipal supplies are used. The potential effects of water use should be assessed, as discussed in Section 3.1 of the **General EHS Guidelines**, to ensure that the project does not compromise the availability of water for personal hygiene, agriculture, recreation, and other community needs.

Traffic Safety

Operation of a thermal power plant will increase traffic volume, in particular for facilities with fuels transported via land and sea, including heavy trucks carrying fuel, additives, etc. The increased traffic can be especially significant in sparsely populate areas where some thermal power plants are located. Prevention and control of traffic-related injuries are discussed in Section 3.4 of the **General EHS Guidelines**. Water transport safety is covered in the **EHS Guidelines for Shipping**.

2.0 Performance Indicators and Monitoring

2.1 Environment

Emissions and Effluent Guidelines

Effluent guidelines are described in Table 5. Emissions guidelines are described in Table 6. Effluent guidelines are applicable for direct discharges of treated effluents to surface waters for general use. Site-specific discharge levels may be established based on the availability and conditions in the use of publicly operated sewage collection and treatment systems or, if discharged directly to surface waters, on the receiving water use classification as described in the **General EHS Guideline.** Guideline values for process emissions and effluents in this sector are indicative of good international industry practice as reflected in standards of countries with recognized regulatory frameworks. These levels should be achieved, without dilution, at least 95 percent of the time that the plant or unit is operating, to be calculated as a proportion of annual operating hours. Deviation from these levels due to specific local project conditions should be justified in the environmental assessment.

Table 5 - Effluent Guidelines
(To be applicable at relevant wastewater stream: e.g., from FGD system, wet ash transport, washing boiler / air preheater and precipitator, boiler acid washing, regeneration of demineralizers and condensate polishers, oil-separated water, site drainage, coal pile runoff, and cooling water)

Parameter	mg/L, except pH and temp
pH	6 – 9
TSS	50
Oil and grease	10
Total residual chlorine	0.2
Chromium - Total (Cr)	0.5
Copper (Cu)	0.5
Iron (Fe)	1.0
Zinc (Zn)	1.0
Lead (Pb)	0.5
Cadmium (Cd)	0.1
Mercury (Hg)	0.005
Arsenic (As)	0.5
Temperature increase by thermal discharge from cooling system	• Site specific requirement to be established by the EA. • Elevated temperature areas due to discharge of once-through cooling water (e.g., 1 Celsius above, 2 Celsius above, 3 Celsius above ambient water temperature) should be minimized by adjusting intake and outfall design through the project specific EA depending on the sensitive aquatic ecosystems around the discharge point.

Note: Applicability of heavy metals should be determined in the EA. Guideline limits in the Table are from various references of effluent performance by thermal power plants.

Emissions levels for the design and operation of each project should be established through the EA process on the basis of country legislation and the recommendations provided in this guidance document, as applied to local conditions. The emissions levels selected should be justified in the EA.[30] The maximum emissions levels given here can be consistently achieved by well-designed, well-operated, and well-maintained pollution control systems. In contrast, poor operating or maintenance procedures affect actual pollutant removal efficiency and may reduce it to well

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[30] For example, in cases where potential for acid deposition has been identified as a significant issue in the EA, plant design and operation should ensure that emissions mass loadings are effectively reduced to prevent or minimize such impacts.

below the design specification. Dilution of air emissions to achieve these guidelines is unacceptable. Compliance with ambient air quality guidelines should be assessed on the basis of good international industry practice (GIIP) recommendations.

As described in the General EHS Guidelines, emissions should not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards[31] by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines[32], or other internationally recognized sources[33]. Also, emissions from a single project should not contribute more than 25% of the applicable ambient air quality standards to allow additional, future sustainable development in the same airshed. [34]

As described in the General EHS Guidelines, facilities or projects located within poor quality airsheds[35], 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.

Environmental Monitoring

Environmental monitoring programs for this sector are presented in Table 7. Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Examples of emissions, stack testing, ambient air quality, and noise monitoring recommendations applicable to power plants are provided in Table 7. Additional guidance on applicable sampling and analytical methods for emissions and effluents is provided in the **General EHS Guidelines**.

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[31] 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).

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

[33] 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).

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

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

Table 6 (A) - Emissions Guidelines (in mg/Nm³ or as indicated) for Reciprocating Engine

Note:

- **Guidelines are applicable for new facilities.**
- **EA may justify more stringent or less stringent limits due to ambient environment, technical and economic considerations provided there is compliance with applicable ambient air quality standards and incremental impacts are minimized.**
- **For projects to rehabilitate existing facilities, case-by-case emission requirements should be established by the EA considering (i) the existing emission levels and impacts on the environment and community health, and (ii) cost and technical feasibility of bringing the existing emission levels to meet these new facilities limits.**
- **EA should demonstrate that emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards, and more stringent limits may be required.**

Combustion Technology / Fuel	Particulate Matter (PM)		Sulfur Dioxide (SO_2)		Nitrogen Oxides (NOx)		Dry Gas, Excess O_2 Content (%)
Reciprocating Engine	NDA	DA	NDA	DA	NDA	DA	
Natural Gas	N/A	N/A	N/A	N/A	200 (Spark Ignition) 400 (Dual Fuel) (a)	200(SI) 400 (Dual Fuel / CI)	15%
Liquid Fuels (Plant >50 MWth to <300 MWth)	50	30	1,170 or use of 2% or less S fuel	0.5% S	1,460 (Compression Ignition, bore size diameter [mm] < 400) 1,850 (Compression Ignition, bore size diameter [mm] ≥ 400) 2,000 (Dual Fuel)	400	15%
Liquid Fuels (Plant >/=300 MWth)	50	30	585 or use of 1% or less S fuel	0.2% S	740 (contingent upon water availability for injection)	400	15%
Biofuels / Gaseous Fuels other than Natural Gas	50	30	N/A	N/A	30% higher limits than those provided above for Natural Gas and Liquid Fuels.	200 (SI, Natural Gas), 400 (other)	15%

General notes:

- MWth = Megawatt thermal input on HHV basis; N/A = not applicable; NDA = Non-degraded airshed; DA = Degraded airshed (poor air quality); Airshed should be considered as being degraded if nationally legislated air quality standards are exceeded or, in their absence, if WHO Air Quality Guidelines are exceeded significantly; S = sulfur content (expressed as a percent by mass); Nm³ is at one atmospheric pressure, 0 degree Celsius; MWth category is to apply to the entire facility consisting of multiple units that are reasonably considered to be emitted from a common stack. Guideline limits apply to facilities operating more than 500 hours per year. Emission levels should be evaluated on a one hour average basis and be achieved 95% of annual operating hours.
- (a) Compression Ignition (CI) engines may require different emissions values which should be evaluated on a case-by-case basis through the EA process.

Comparison of the Guideline limits with standards of selected countries / region (as of August 2008):

- Natural Gas-fired Reciprocating Engine – NOx
  - Guideline limits: 200 (SI), 400 (DF)
  - UK: 100 (CI) , US: Reduce by 90% or more, or alternatively 1.6 g/kWh
- Liquid Fuels-fired Reciprocating Engine – NOx (Plant >50 MWth to <300 MWth)
  - Guideline limits: 1,460 (CI, bore size diameter < 400 mm), 1,850 (CI, bore size diameter ≥ 400 mm), 2,000 (DF)
  - UK: 300 (> 25 MWth), India: 1,460 (Urban area & ≤ 75 MWe (≈ 190 MWth), Rural area & ≤ 150 MWe (≈ 380 MWth))
- Liquid Fuels-fired Reciprocating Engine – NOx (Plant ≥300 MWth)
  - Guideline limits: 740 (contingent upon water availability for injection)
  - UK: 300 (> 25 MWth), India: 740 (Urban area & > 75MWe (≈ 190 MWth), Rural area & > 150 MWe (≈ 380 MWth))
- Liquid Fuels-fired Reciprocating Engine – SO2
  - Guideline limits: 1,170 or use of ≤ 2% S (Plant >50 MWth to <300 MWth), 585 or use of ≤ 1% S (Plant ≥300 MWth)
  - EU: Use of low S fuel oil or the secondary FGD (IPCC LCP BREF), HFO S content ≤ 1% (Liquid Fuel Quality Directive), US: Use of diesel fuel with max S of 500 ppm (0.05%); EU: Marine HFO S content ≤ 1.5% (Liquid Fuel Quality Directive) used in SOx Emission Control Areas; India: Urban (< 2% S), Rural (< 4%S), Only diesel fuels (HSD, LDO) should be used in Urban

Source: UK (S2 1.03 Combustion Processes: Compression Ignition Engines, 50 MWth and over), India (SOx/NOx Emission Standards for Diesel Engines ≥ 0.8 MW), EU (IPCC LCP BREF July 2006), EU (Liquid Fuel Quality Directive 1999/32/EC amended by 2005/33/EC), US (NSPS for Stationary Compression Ignition Internal Combustion Engine – Final Rule – July 11, 2006)

Table 6 (B) - Emissions Guidelines (in mg/Nm³ or as indicated) for Combustion Turbine

Note:

- **Guidelines are applicable for new facilities.**
- **EA may justify more stringent or less stringent limits due to ambient environment, technical and economic considerations provided there is compliance with applicable ambient air quality standards and incremental impacts are minimized.**
- **For projects to rehabilitate existing facilities, case-by-case emission requirements should be established by the EA considering (i) the existing emission levels and impacts on the environment and community health, and (ii) cost and technical feasibility of bringing the existing emission levels to meet these new facilities limits.**
- **EA should demonstrate that emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards, and more stringent limits may be required.**

Combustion Technology / Fuel	Particulate Matter (PM)		Sulfur Dioxide (SO_2)		Nitrogen Oxides (NOx)	Dry Gas, Excess O_2 Content (%)
Combustion Turbine			NDA/DA		NDA/DA	
Natural Gas (all turbine types of Unit > 50MWth)	N/A	N/A	N/A	N/A	51 (25 ppm)	15%
Fuels other than Natural Gas (Unit > > 50MWth)	50	30	Use of 1% or less S fuel	Use of 0.5% or less S fuel	152 (74 ppm)[a]	15%

General notes:

- MWth = Megawatt thermal input on HHV basis; N/A = not applicable; NDA = Non-degraded airshed; DA = Degraded airshed (poor air quality); Airshed should be considered as being degraded if nationally legislated air quality standards are exceeded or, in their absence, if WHO Air Quality Guidelines are exceeded significantly; S = sulfur content (expressed as a percent by mass); Nm³ is at one atmospheric pressure, 0 degree Celsius; MWth category is to apply to single units; Guideline limits apply to facilities operating more than 500 hours per year. Emission levels should be evaluated on a one hour average basis and be achieved 95% of annual operating hours.
- If supplemental firing is used in a combined cycle gas turbine mode, the relevant guideline limits for combustion turbines should be achieved including emissions from those supplemental firing units (e.g., duct burners).
- (a) Technological differences (for example the use of Aeroderivatives) may require different emissions values which should be evaluated on a cases-by-case basis through the EA process but which should not exceed 200 mg/Nm3.

Comparison of the Guideline limits with standards of selected countries / region (as of August 2008):

- Natural Gas-fired Combustion Turbine – NOx
  - Guideline limits: 51 (25 ppm)
  - EU: 50 (24 ppm), 75 (37 ppm) (if combined cycle efficiency > 55%), 50*η / 35 (where η = simple cycle efficiency)
  - US: 25 ppm (> 50 MMBtu/h (≈ 14.6 MWth) and ≤ 850 MMBtu/h (≈ 249MWth)), 15 ppm (> 850 MMBtu/h (≈ 249 MWth))
  - (Note: further reduced NOx ppm in the range of 2 to 9 ppm is typically required through air permit)
- Liquid Fuel-fired Combustion Turbine – NOx
  - Guideline limits: 152 (74 ppm) – Heavy Duty Frame Turbines & LFO/HFO, 300 (146 ppm) – Aeroderivatives & HFO, 200 (97 ppm) – Aeroderivatives & LFO
  - EU: 120 (58 ppm), US: 74 ppm (> 50 MMBtu/h (≈ 14.6 MWth) and ≤ 850 MMBtu/h (≈ 249MWth)), 42 ppm (> 850 MMBtu/h (≈ 249 MWth))
- Liquid Fuel-fired Combustion Turbine – SOx
  - Guideline limits: Use of 1% or less S fuel
  - EU: S content of light fuel oil used in gas turbines below 0.1% / US: S content of about 0.05% (continental area) and 0.4% (non-continental area)

Source: EU (LCP Directive 2001/80/EC October 23 2001), EU (Liquid Fuel Quality Directive 1999/32/EC, 2005/33/EC), US (NSPS for Stationary Combustion Turbines, Final Rule – July 6, 2006)

Table 6 (C) - Emissions Guidelines (in mg/Nm^3 or as indicated) for Boiler

Note:

- **Guidelines are applicable for new facilities.**
- **EA may justify more stringent or less stringent limits due to ambient environment, technical and economic considerations provided there is compliance with applicable ambient air quality standards and incremental impacts are minimized.**
- **For projects to rehabilitate existing facilities, case-by-case emission requirements should be established by the EA considering (i) the existing emission levels and impacts on the environment and community health, and (ii) cost and technical feasibility of bringing the existing emission levels to meet these new facilities limits.**
- **EA should demonstrate that emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards, and more stringent limits may be required.**

Combustion Technology / Fuel	Particulate Matter (PM)		Sulfur Dioxide (SO_2)		Nitrogen Oxides (NOx)		Dry Gas, Excess O_2 Content (%)
Boiler	NDA	DA	NDA	DA	NDA	DA	
Natural Gas	N/A	N/A	N/A	N/A	240	240	3%
Other Gaseous Fuels	50	30	400	400	240	240	3%
Liquid Fuels (Plant >50 MWth to <600 MWth)	50	30	900 – 1,500[a]	400	400	200	3%
Liquid Fuels (Plant >/=600 MWth)	50	30	200 – 850[b]	200	400	200	3%
Solid Fuels (Plant >50 MWth to <600 MWth)	50	30	900 – 1,500[a]	400	510[c] Or up to 1,100 if volatile matter of fuel < 10%	200	6%
Solid Fuels (Plant >/=600 MWth)	50	30	200 – 850[b]	200			6%

General notes:

- MWth = Megawatt thermal input on HHV basis; N/A = not applicable; NDA = Non-degraded airshed; DA = Degraded airshed (poor air quality); Airshed should be considered as being degraded if nationally legislated air quality standards are exceeded or, in their absence, if WHO Air Quality Guidelines are exceeded significantly; CFB = circulating fluidized bed coal-fired; PC = pulverized coal-fired; Nm^3 is at one atmospheric pressure, 0 degree Celsius; MWth category is to apply to the entire facility consisting of multiple units that are reasonably considered to be emitted from a common stack. Guideline limits apply to facilities operating more than 500 hours per year. Emission levels should be evaluated on a one hour average basis and be achieved 95% of annual operating hours.
- a. Targeting the lower guidelines values and recognizing issues related to quality of available fuel, cost effectiveness of controls on smaller units, and the potential for higher energy conversion efficiencies (FGD may consume between 0.5% and 1.6% of electricity generated by the plant). b. Targeting the lower guidelines values and recognizing variability in approaches to the management of SO_2 emissions (fuel quality vs. use of secondary controls) and the potential for higher energy conversion efficiencies (FGD may consume between 0.5% and 1.6% of electricity generated by the plant). Larger plants are expected to have additional emission control measures. Selection of the emission level in the range is to be determined by EA considering the project's sustainability, development impact, and cost-benefit of the pollution control performance. c. Stoker boilers may require different emissions values which should be evaluated on a case-by-case basis through the EA process.

Comparison of the Guideline limits with standards of selected countries / region (as of August 2008):

- Natural Gas-fired Boiler – NOx
  - ○ Guideline limits: 240
  - ○ EU: 150 (50 to 300 MWth), 200 (> 300 MWth)
- Solid Fuels-fired Boiler - PM
  - ○ Guideline limits: 50
  - ○ EU: 50 (50 to 100 MWth), 30 (> 100 MWth), China: 50, India: 100 - 150
- Solid Fuels-fired Boiler – SO_2
  - ○ Guideline limits: 900 – 1,500 (Plant > 50 MWth to < 600 MWth), 200 – 850 (Plant ≥ 600 MWth)
  - ○ EU: 850 (50 – 100 MWth), 200 (> 100 MWth)
  - ○ US: 180 ng/J gross energy output OR 95% reduction (≈ 200 mg/Nm3 at 6%O_2 assuming 38% HHV efficiency)
  - ○ China: 400 (general), 800 (if using coal < 12,550 kJ/kg), 1,200 (if mine-mouth plant located in non-double control area of western region and burning low S coal (<0.5%))

Source: EU (LCP Directive 2001/80/EC October 23 2001), US (NSPS for Electric Utility Steam Generating Units (Subpart Da), Final Rule – June 13, 2007), China (GB 13223-2003)

Table 7 – Typical Air Emission Monitoring Parameters / Frequency for Thermal Power Plants
(Note: Detailed monitoring programs should be determined based on EA)

Combustion Technology / Fuel	Emission Monitoring			Stack Emission Testing				Ambient Air Quality	Noise
	Particulate Matter (PM)	Sulfur Dioxide (SO_2)	Nitrogen Oxides (NOx)	PM	SO_2	NOx	Heavy Metals		
Reciprocating Engine									
Natural Gas (Plant >50 MWth to <300 MWth)	N/A	N/A	Continuous or indicative	N/A	N/A	Annual	N/A	If incremental impacts predicted by EA >/= 25 % of relevant short-term ambient air quality standards or if the plant >/= 1,200 MWth: - Monitor parameters (e.g., $PM_{10}/PM_{2.5}/SO_2$/NOx to be consistent with the relevant ambient air quality standards) by continuous ambient air quality monitoring system (typically a minimum of 2 systems to cover predicted maximum ground level concentration point / sensitive receptor / background point). If incremental impacts predicted by EA < 25% of relevant short term ambient air quality standards and if the facility < 1,200 MWth but >/= 100 MWth - Monitor parameters either by passive samplers (monthly average) or by seasonal manual sampling (e.g., 1 weeks/season) for parameters consistent with the relevant air quality standards. Effectiveness of the ambient air quality monitoring program should be reviewed regularly. It could be simplified or reduced if alternative program is developed (e.g., local government's monitoring network). Continuation of the program is recommended during the life of the project if there are sensitive receptors or if monitored levels are not far below the relevant ambient air quality standards.	If EA predicts noise levels at residential receptors or other sensitive receptors are close to the relevant ambient noise standards / guidelines, or if there are such receptors close to the plant boundary (e.g., within 100m) then, conduct ambient noise monitoring every year to three years depending on the project circumstances. Elimination of noise monitoring can be considered acceptable if a comprehensive survey showed that there are no receptors affected by the project or affected noise levels are far below the relevant ambient noise standards / guidelines.
Natural Gas (Plant >/= 300 MWth)	N/A	N/A	Continuous	N/A	N/A	Annual	N/A		
Liquid (Plant >50 MWth to <300 MWth)	Continuous or indicative	Continuous if FGD is used or monitor by S content.	Continuous or indicative	Annual					
Liquid (Plant >/=300 MWth)	Continuous or indicative		Continuous						
Biomass	Continuous or indicative	N/A	Continuous or indicative	Annual	N/A	Annual	N/A		
Combustion Turbine									
Natural Gas (all turbine types of Unit > 50MWth)	N/A	N/A	Continuous or indicative	N/A	N/A	Annual	N/A		
Fuels other than Natural Gas (Unit > 50MWth)	Continuous or indicative	Continuous if FGD is used or monitor by S content.	Continuous or indicative	Annual					
Boiler									
Natural Gas	N/A	N/A	Continuous or indicative	N/A	N/A	Annual	N/A		
				Annual	Annual	Annual	N/A		
Other Gaseous fuels	Indicative	Indicative	Continuous or indicative	Annual					
Liquid (Plant >50 MWth to <600 MWth)	Continuous or indicative	Continuous if FGD is used or monitor by S content.	Continuous or indicative						
Liquid (Plant >=600 MWth)		Continuous							
Solid (Plant >50 MWth to <600 MWth)		Continuous if FGD is used or monitor by S Content.	Continuous or indicative						
Solid (Plant >/=600 MWth)		Continuous							

Note: Continuous or indicative means "Continuously monitor emissions or continuously monitor indicative parameters". Stack emission testing is to have direct measurement of emission levels to counter check the emission monitoring system.

2.2 Occupational Health and Safety

Occupational Health and Safety Guidelines

Occupational health and safety performance should be evaluated against internationally published exposure guidelines, of which examples include the Threshold Limit Value (TLV®) occupational exposure guidelines and Biological Exposure Indices (BEIs®) published by American Conference of Governmental Industrial Hygienists (ACGIH),[36] the Pocket Guide to Chemical Hazards published by the United States National Institute for Occupational Health and Safety (NIOSH),[37] Permissible Exposure Limits (PELs) published by the Occupational Safety and Health Administration of the United States (OSHA),[38] Indicative Occupational Exposure Limit Values published by European Union member states,[39] or other similar sources.

Additional indicators specifically applicable to electric power sector activities include the ICNIRP exposure limits for occupational exposure to electric and magnetic fields listed in Table 8. Additional applicable indicators such as noise, electrical hazards, air quality, etc. are presented in Section 2.0 of the **General EHS Guidelines**.

Table 8 - ICNIRP exposure limits for occupational exposure to electric and magnetic fields.

Frequency	Electric Field (V/m)	Magnetic Field (µT)
50 Hz	10,000	500
60 Hz	8300	415

Source: ICNIRP (1998) : "Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz)

Accident and Fatality Rates

Projects should try to reduce the number of accidents among project workers (whether directly employed or subcontracted) to a rate of zero, especially accidents that could result in lost work time, different levels of disability, or even fatalities. The accident and fatality rates of the specific facility may be benchmarked against the performance of facilities in this sector in developed countries through consultation with published sources (e.g., US Bureau of Labor Statistics and UK Health and Safety Executive)[40].

Occupational Health and Safety Monitoring

The working environment should be monitored for occupational hazards relevant to the specific project. Monitoring should be designed and implemented by accredited professionals[41] as part of an occupational health and safety monitoring program. Facilities should also maintain a record of occupational accidents and diseases and dangerous occurrences and accidents. Additional guidance on occupational health and safety monitoring programs is provided in the **General EHS Guidelines**.

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[36] http://www.acgih.org/TLV/[36] Available at: http://www.acgih.org/TLV/ and http://www.acgih.org/store/

[37] Available at: http://www.cdc.gov/niosh/npg/

[38] Available at: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992

[39] Available at: http://europe.osha.eu.int/good_practice/risks/ds/oel/

[40] Available at: http://www.bls.gov/iif/ and http://www.hse.gov.uk/statistics/index.htm

[41] Accredited professionals may include Certified Industrial Hygienists, Registered Occupational Hygienists, or Certified Safety Professionals or their equivalent.

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Annex A: General Description of Industry Activities

Thermal power plants burn fossil fuels or biomass to generate electrical energy and heat. Mechanical power is produced by a heat engine, which transforms thermal energy from combustion of a fossil fuel into rotational energy. A generator converts that mechanical energy into electrical energy by creating relative motion between a magnetic field and a conductor. Figure A-1 is a generalized flow diagram of a boiler-based thermal power plant and its associated operations.

Not all thermal energy can be transformed to mechanical power, according to the second law of thermodynamics. Therefore, thermal power plants also produce low-temperature heat. If no use is found for the heat, it is lost to the environment. If reject heat is employed as useful heat (e.g., for industrial processes or district heating), the power plant is referred to as a cogeneration power plant or CHP (combined heat-and-power) plant.

Types of Thermal power plants

Thermal power plants can be divided based on the type of combustion or gasification: boilers, internal reciprocating engines, and combustion turbines. In addition, combined-cycle and cogeneration systems increase efficiency by utilizing heat lost by conventional combustion systems. The type of system is chosen based on the loads, the availability of fuels, and the energy requirements of the electric power generation facility. Other ancillary processes, such as coal processing and pollution control, must also be performed to support the generation of electricity. The following subsections describe each system and then discuss ancillary processes at the facility (USEPA 1997).

Boilers (Steam Turbines)

Conventional steam-producing thermal power plants generate electricity through a series of energy conversion stages: fuel is burned in boilers to convert water to high-pressure steam, which is then used to drive a steam turbine to generate electricity. Heat for the system is usually provided by the combustion of coal, natural gas, oil, or biomass as well as other types of waste or recovered fuel. High-temperature, high-pressure steam is generated in the boiler and then enters the steam turbine. At the other end of the steam turbine is the condenser, which is maintained at a low temperature and pressure. Steam rushing from the high-pressure boiler to the low-pressure condenser drives the turbine blades, which powers the electric generator.

Low-pressure steam exiting the turbine enters the condenser shell and is condensed on the condenser tubes, which are maintained at a low temperature by the flow of cooling water. As the steam is cooled to condensate, the condensate is transported by the boiler feedwater system back to the boiler, where it is used again. A constant flow of low-temperature cooling water in the condenser tubes is required to keep the condenser shell (steam side) at proper pressure and to ensure efficient electricity generation. Through the condensing process, the cooling water is warmed. If the cooling system is an open or a once-through system, this warm water is released back to the source water body.[42] In a closed system, the warm water is cooled by recirculation through cooling towers, lakes, or ponds, where the heat is released into the air through evaporation and/or sensible heat transfer. If a recirculating cooling system is used, only a relatively small amount of make-up water is required to offset the evaporative losses and cooling tower blowdown that must be discharged periodically to control the build-up of solids. A recirculating system uses about one-twentieth the water of a once-through system.

Steam turbines typically have a thermal efficiency of about 35 percent, meaning that 35 percent of the heat of combustion is transformed into electricity. The remaining 65 percent of the heat either goes up the stack (typically 10 percent) or is

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[42] If groundwater is used for cooling, the cooling water is usually discharged to a

discharged with the condenser cooling water (typically 55 percent).

Coal and lignite are the most common fuels in thermal power plants although heavy fuel oil is also used. Coal-fired steam generation systems are designed to use pulverized coal or crushed coal. Several types of coal-fired steam generators are in use, and are generally classified based on the characteristics of the coal fed to the burners and the mode of burning the coal. In fluidized-bed combustors, fuel materials are forced by gas into a state of buoyancy. The gas cushion between the solids allows the particles to move freely, thus flowing like a liquid. By using this technology, SO_2 and NO_X emissions are reduced because an SO_2 sorbent, such as limestone, can be used efficiently. Also, because the operating temperature is low, the amount of NO_X gases formed is lower than those produced using conventional technology.

Natural gas and liquid fuels are usually transported to thermal power plants via pipelines. Coal and biomass fuels can be transported by rail, barge, or truck. In some cases, coal is mixed with water to form slurry that can be pumped to the thermal power plant in a pipeline. Once coal arrives at the plant, it is unloaded to storage or directly to the stoker or hopper. In transporting coal during warmer months and in dry climates, dust suppression may be necessary.

Coal may be cleaned and prepared before being either crushed or pulverized. Impurities in coal such as ash, metals, silica, and sulfur can cause boiler fouling and slagging. Coal cleaning can be used to reduce sulfur in the coal to meet sulfur dioxide (SO_2) emissions regulations and also reduce ash content and the amount of heavy metals. Cleaning the coal is costly, but the cost can be at least partially offset by an increase in fuel efficiency, reduced emission control requirements, and lower waste management costs. Coal cleaning is typically performed at the mine by using gravity concentration, flotation, or dewatering methods.

Coal is transported from the coal bunker or silo to be crushed, ground, and dried further before it is fired in the burner or combustion system. Many mechanisms can be used to grind the coal and prepare it for firing. Pulverizers, cyclones, and stokers are all used to grind and dry the coal. Increasing the coal's particle surface area and decreasing its moisture content greatly boosting its heating capacity. Once prepared, the coal is transported within the plant to the combustion system. Devices at the bottom of the boilers catch ash and/or slag.

Reciprocating Engines

Internal combustion engines convert the chemical energy of fuels (typically diesel fuel or heavy fuel oil) into mechanical energy in a design similar to a truck engine, and the mechanical energy is used to turn a generator. Two types of engines normally used: the medium-speed, four-stroke trunk piston engine and the low-speed, two-stroke crosshead engine. Both types of engine operate on the air-standard diesel thermodynamic cycle. Air is drawn or forced into a cylinder and is compressed by a piston. Fuel is injected into the cylinder and is ignited by the heat of the compression of the air. The burning mixture of fuel and air expands, pushing the piston. The products of combustion are then removed from the cylinder, completing the cycle.

The exhaust gases from an engine are affected by the load profile of the prime mover; ambient conditions such as air humidity and temperature; fuel oil quality, such as sulfur content, nitrogen content, viscosity, ignition ability, density, and ash content; and site conditions and the auxiliary equipment associated with the prime mover, such as cooling properties and exhaust gas back pressure. The engine parameters that affect NO_X emissions are fuel injection in terms of timing, duration, and atomization; combustion air conditions, which are affected by

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surface water body.

valve timing, the charge air system, and charge air cooling before cylinders; and the combustion process, which is affected by air and fuel mixing, combustion chamber design, and the compression ratio.[43] The particulate matter emissions are dependent on the general conditions of the engine, especially the fuel injection system and its maintenance, in addition to the ash content of the fuel, which is in the range 0.05–0.2%. SOx emissions are directly dependent on the sulfur content of the fuel. Fuel oil may contain as little as 0.3% sulfur and, in some cases, up to 5% sulfur.

Diesel engines are fuel flexible and can use fuels such as diesel oil, heavy fuel oil, natural gas, crude oil, bio-fuels (such as palm oil, etc.) and emulsified fuels (such as Orimulsion, etc.).

Typical electrical efficiencies in single mode are typically ranging from 40 % for the medium speed engines up to about 50 % for large engines and even higher efficiencies in combined cycle mode. Total efficiency in CHP (Combined Heat and Power) is typically in liquid operation up to 60 – 80 % and in gas mode even higher dependent on the application. The heat to power ratio is typically 0.5 to 1.3 in CHP applications, dependent on the application.

Lean Burn Gas Engines

Typical electrical efficiencies for bigger stationary medium speed engines in single mode are typically 40 – 47 % and up to close to 50 % in combined cycle mode. Total efficiency in CHP facilities is typically up to 90 % dependent on the application. The heat to power ratios are typically 0.5 to 1.3 in CHP-applications, dependent on the application.

Spark Ignition (SG)

Often a spark ignited gas-otto engine works according to the lean burn concept meaning that a lean mixture of combustion air and fuel is used in the cylinder (e.g., much more air than needed for the combustion). In order to stabilize the ignition and combustion of the lean mixture, in bigger engine types a prechamber with a richer air/fuel mixture is used. The ignition is initiated with a spark plug or some other device located in the prechamber, resulting in a high-energy ignition source for the main fuel charge in the cylinder. The most important parameter governing the rate of NOx formation in internal combustion engines is the combustion temperature; the higher the temperature the higher the NOx content of the exhaust gases. One method is to lower the fuel/air ratio, the same specific heat quantity released by the combustion of the fuel is then used to heat up a larger mass of exhaust gases, resulting in a lower maximum combustion temperature. This method low fuel/air ratio is called lean burn and it reduces NOx effectively. The spark-ignited lean-burn engine has therefore low NOx emissions. This is a pure gas engine; it operates only on gaseous fuels.

Dual fuel engines (DF)

Some DF engine types are fuel versatile, these can be run on low pressure natural gas or liquid fuels such as diesel oil (as back-up fuel, etc.), heavy fuel oil, etc. This engine type can operate at full load in both fuel modes. Dual Fuel (DF) engines can also be designed to work in gas mode only with a pilot liquid fuel used for ignition of the gas.

Combustion Turbines

Gas turbine systems operate in a manner similar to steam turbine systems except that combustion gases are used to turn the turbine blades instead of steam. In addition to the electric generator, the turbine also drives a rotating compressor to pressurize the air, which is then mixed with either gas or liquid

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[43] If the fuel timing is too early, the cylinder pressure will increase, resulting in higher nitrogen oxide formation. If injection is timed too late, fuel consumption and turbocharger speed will increase. NO_X emissions can be reduced by later injection timing, but then particulate matter and the amount of unburned species will increase.

fuel in a combustion chamber. The greater the compression, the higher the temperature and the efficiency that can be achieved in a gas turbine. Higher temperatures, however, typically lead to increases in NO_X emissions. Exhaust gases are emitted to the atmosphere from the turbine. Unlike a steam turbine system, gas turbine systems do not have boilers or a steam supply, condensers, or a waste heat disposal system. Therefore, capital costs are much lower for a gas turbine system than for a steam system.

In electrical power applications, gas turbines are often used for peaking duty, where rapid startup and short runs are needed. Most installed simple gas turbines with no controls have only a 20- to 30-percent efficiency.

Combined Cycle

Combined-cycle generation is a configuration using both gas turbines and steam generators. In a combined-cycle gas turbine (CCGT), the hot exhaust gases of a gas turbine are used to provide all, or a portion of, the heat source for the boiler, which produces steam for the steam generator turbine. This combination increases the thermal efficiency to approximately 50 - 60 percent. Combined-cycle systems may have multiple gas turbines driving one steam turbine. Combined-cycle systems with diesel engines and steam generators are also sometimes used.

In addition, integrated coal gasification combined-cycle (IGCC) units are emerging technologies. In an IGCC system, coal gas is manufactured and cleaned in a "gasifier" under pressure, thereby reducing emissions and particulates.[44] The coal gas then is combusted in a CCGT generation system.

Cogeneration

Cogeneration is the merging of a system designed to produce electric power and a system used for producing industrial heat and steam and/or municipal heating. This system is a more efficient way of using energy inputs and allows the recovery of otherwise wasted thermal energy for use in an industrial process. Cogeneration technologies are classified as "topping cycle" and "bottoming cycle" systems, depending on whether electrical (topping cycle) or thermal (bottoming cycle) energy is derived first. Most cogeneration systems use a topping cycle.

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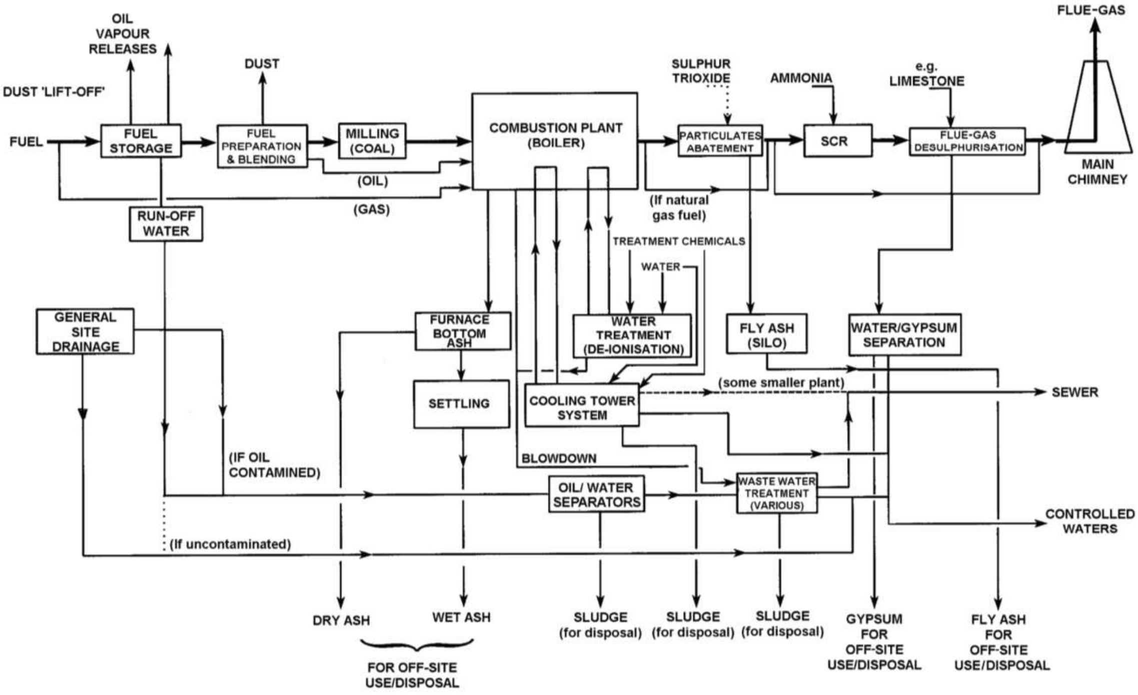
[44] Gasification is a process in which coal is introduced to a reducing atmosphere with oxygen or air and steam.

Figure A-1
Generalized Flow Diagram of a Thermal power plant[45] and Associated Operations



Source: EC 2006

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[45] Applicable to boiler plant with cooling tower only. Diagram does not apply to engines and turbines which have completely different configurations.

Annex B: Environmental Assessment Guidance for Thermal Power Projects

The development of an environmental assessment (EA) for a thermal power project should take into account any government energy and/or environmental policy or strategy including strategic aspects such as energy efficiency improvements in existing power generation, transmission, and distribution systems, demand side management, project siting, fuel choice, technology choice, and environmental performance.

New Facilities and Expansion of Existing Facilities

An (EA) for new facilities and a combined EA and environmental audit for existing facilities should be carried out early in the project cycle in order to establish site-specific emissions requirements and other measures for a new or expanded thermal power plant. Table B-1 provides suggested key elements of the EA, the scope of which will depend on project-specific circumstances.

Table B-1 Suggested Key EHS Elements for EA of New Thermal Power Project	
Analysis of Alternatives	• Fuel selection including non-fossil fuel options (coal, oil, gas, biomass, other renewable options – wind, solar, geothermal, hydro), fuel supply sources • Power generation technology ○ Thermal generating efficiency (HHV-gross, LHV-gross, HHV-net, LHV-net) ○ Cost ○ CO_2 emissions performance (gCO2/kWh) • GHG emissions reduction / offset options ○ Energy conversion efficiency ○ Offset arrangement ○ Use of renewable energy sources, etc. • Baseline water quality of receiving water bodies • Water supply ○ Surface water, underground water, desalination • Cooling system ○ Once-through, wet closed circuit, dry closed circuit • Ash disposal system - wet disposal vs. dry disposal • Pollution control ○ Air emission – primary vs. secondary flue gas treatment (cost, performance) ○ Effluent (cost, performance) • Effluent discharge ○ Surface water ○ Evaporation ○ Recycling – zero discharge • Siting ○ Land acquisition consideration ○ Access to fuel / electricity grid ○ Existing and future land use zoning ○ Existing and predicted environmental baseline (air, water, noise)
Impact Assessment	• Estimation of GHG emissions (tCO_2/year, gCO_2/kWh) • Air quality impact ○ SO_2, NO_2, PM_{10}, $PM_{2.5}$, Heavy metals as appropriate, Acid deposition if relevant ○ Incremental impacts to the attainment of relevant air quality standards ○ Isopleth concentration lines (short-term, annual average, as appropriate) overlaid with land use and topographic map ○ Cumulative impacts of existing sources / future projects if known ○ Stack height determination ○ Health impact consideration • Water quality / intake impact ○ thermal discharge if once-through cooling system is used ○ other key contaminants as appropriate ○ water intake impact • Noise impact ○ Noise contour lines overlaid with land use and locations of receptors • Determination of pollution prevention and abatement measures
Mitigation Measures /	• Air (Stack height, pollution control measures, cost)

Management Program	• Effluent (wastewater treatment measures, cost) • Noise (noise control measures, cost) • Waste utilization / disposal (e.g., ash, FGD by-product, used oil) ○ Ash management plan (quantitative balance of ash generation, disposal, utilization, size of ash disposal site, ash transportation arrangement) • Fuel supply arrangement • Emergency preparedness and response plan • Industrial risk assessment if relevant
Monitoring Program	• Parameters • Sampling Frequency • Evaluation Criteria • Sampling points overlaid with relevant site layout / surrounding maps • Cost

Tasks related to carrying out the quality impact analysis for the EA should include:

- Collection of baseline data ranging from relatively simple qualitative information (for smaller projects) to more comprehensive quantitative data (for larger projects) on ambient concentrations of parameters and averaging time consistent with relevant host country air quality standards (e.g., parameters such as PM_{10}, $PM_{2.5}$, SO_2 (for oil and coal-fired plants), NO_X, and ground-level ozone; and averaging time such as 1-hour maximum, 24-hour maximum, annual average), within a defined airshed encompassing the proposed project;[46]
- Evaluation of the baseline airshed quality (e.g., degraded or non-degraded);
- Evaluation of baseline water quality, where relevant;
- Use of appropriate mathematical or physical air quality dispersion models to estimate the impact of the project on the ambient concentrations of these pollutants;
- If acid deposition is considered a potentially significant impact, use of appropriate air quality models to evaluate long-range and trans-boundary acid deposition;
- The scope of baseline data collection and air quality impact assessment will depend on the project circumstances (e.g., project size, amount of air emissions and the potential impacts on the airshed). Examples of suggested practices are presented in Table B-2.

Table B-2 - Suggested Air Quality Impact Assessment Approach	
Baseline air quality collection	• Qualitative information (for small projects e.g., < 100MWth) • Seasonal manual sampling (for mid-sized projects e.g., < 1,200MWth) • Continuous automatic sampling (for large projects e.g., >= 1,200MWth) • Modeling existing sources
Baseline meteorological data collection	• Continuous one-year data for dispersion modeling from nearby existing meteorological station (e.g., airport, meteorological station) or site-specific station, if installed, for mid-sized and large projects
Evaluation of airshed quality	• Determining if the airshed is degraded (i.e., ambient air quality standards are not attained) or non-degraded (i.e., ambient air quality standards are attained)
Air quality impact assessment	• Assess incremental and resultant levels by screening models (for small projects) • Assess incremental and resultant levels by refined models (for mid-sized and large projects, or for small projects if determined necessary after using screening models)[47] • Modify emission levels, if needed, to ensure that incremental impacts are small (e.g., 25% of relevant ambient air quality standard levels) and that the airshed will not become degraded.

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[46] The term "airshed" refers to the local area around the plant whose ambient air quality is directly affected by emissions from the plant. The size of the relevant local airshed will depend on plant characteristics, such as stack height, as well as on local meteorological conditions and topography. In some cases, airsheds are defined in legislation or by the relevant environmental authorities. If not, the EA should clearly define the airshed on the basis of consultations with those responsible for local environmental management.

[47] For further guidance on refined / screening models, see Appendix W to Part 51 – Guidelines on Air Quality Models by US EPA (Final Rule, November 9, 2005)

When there is a reasonable likelihood that in the medium or long term the power plant will be expanded or other pollution sources will increase significantly, the analysis should take account of the impact of the proposed plant design both immediately and after any formally planned expansion in capacity or in other sources of pollution. Plant design should allow for future installation of additional pollution control equipment, should this prove desirable or necessary based upon predicted air quality impacts and/or anticipated changes in emission standards (i.e., impending membership into the EU). The EA should also address other project-specific environmental concerns, such as fuel and emissions from fuel impurities. In cases where fuel impurities lead to known hazardous emissions, the EA should estimate the emission amount, assess impacts and propose mitigations to reduce emissions.[48] Examples of compounds which may be present in certain types of coal, heavy fuel oil, petroleum coke, etc. include cadmium, mercury, and other heavy metals.

Rehabilitation of Existing Facilities

An environmental assessment of the proposed rehabilitation should be carried out early in the process of preparing the project in order to allow an opportunity to evaluate alternative rehabilitation options before key design decisions are finalized. The assessment should include an environmental audit that examines the impacts of the existing plant's operations on nearby populations and ecosystems, supplemented by an EA that examines the changes in these impacts that would result under alternative specifications for the rehabilitation, and the estimated capital and operating costs associated with each option. Depending on the scale and nature of the rehabilitation, the audit/environmental assessment may be relatively narrow in scope, focusing on only a small number of specific concerns that would be affected by the project, or it may be as extensive as would be appropriate for the construction of a new unit at the same site. Normally, it should cover the following points:

- Ambient environmental quality in the airshed or water basin affected by the plant, together with approximate estimates of the contribution of the plant to total emissions loads of the main pollutants of concern
- The impact of the plant, under existing operating conditions and under alternative scenarios for rehabilitation, on ambient air and water quality affecting neighboring populations and sensitive ecosystems
- The likely costs of achieving alternative emissions standards or other environmental targets for the plant as a whole or for specific aspects of its operations
- Recommendations concerning a range of cost effective measures for improving the environmental performance of the plant within the framework of the rehabilitation project and any associated emissions standards or other requirements implied by the adoption of specific measures.

These issues should be covered at a level of detail appropriate to the nature and scale of the proposed project. If the plant is located in an airshed or water basin that is polluted as a result of emissions from a range of sources, including the plant itself, comparisons should be made of the relative costs of improving ambient air or water quality by reducing emissions from the plant or by reducing emissions from other sources.

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[48] Several U.S. states have adopted regulations that give coal-fired power plants the option to meet either a mercury emissions standard based on electricity output or a control-based standard. For instance, Illinois requires all coal-fired power plants of 25 MW electrical capacity or greater to meet either an emissions standard of 0.0080 lbs mercury per gigawatt hour (GWh) gross electrical output or an emissions control requirement of 90 percent relative to mercury input.

Appendix 3: SAMPLING METHODOLOGY

Baseline studies for ambient air quality, water quality, soil quality, noise and ecology were conducted. Each sampling methodology is as follows.

3.1 Ambient Air Quality Sampling Methodology

Sampling Methodology

SO_2, NO and NO_2 were measured using diffusion tubes; whereas particulate matter (PM_{10} and $PM_{2.5}$) was measured using Tactical Air Sampler (MiniVol) (Table 3.1-1).

Photographs of diffusion tubes and Tactical Air Sampler installed at sampling locations are given in Figure 3.1-1.

Table 3.1-1: Ambient Air Quality Sampling Equipment and Exposure Duration

Parameter	*Equipment*	*From*	*to*	*Exposure Duration*	*Analysis*
Air Quality					
NO and NO_2	Passive Diffusion Tubes	February 14, 2014	March 8, 2014	3 Weeks	Gradko Laboratory, UK
SO_2	Passive Diffusion Tubes	February 14, 2014	March 8, 2014	3 Weeks	Gradko Laboratory, UK
PM_{10}	Low Vol Sampler	February 17, 2014	March 4, 2014	24 Hours at Each Location	HBP Laboratory
$PM_{2.5}$	Low Vol Sampler	February 17, 2014	March 4, 2014	24 Hours at Each Location	HBP Laboratory

Passive Tubes Deployed at Location A5

Particulate Matter Sampling at Location A5

Particulate Matter Sampling at Location A3

Particulate Matter Sampling at Location A2

Figure 3.1-1 : Ambient Air Quality Sampling Photographs

3.2 Water Quality Sampling Methodology

Collection Method

- Water samples were collected directly from the river or nearest tap to the pumping motor.
- Powder-free disposable gloves be worn at all times when transferring water from the sampler to the sample bottles.
- The various bottles that need to be filled with water from each depth are shown in **Table 3.1-2**.
- Field physical parameters which include pH, DO, Temperature, Specific conductivity, TDS, Salinity and Turbidity recorded during the sampling
- The bottles shown in **Table 3.1-2** then were filled. The bottles were opened for the minimum amount of time needed to rinse and fill them.
- Most sample bottles were rinsed with water from the sampler except for those containers in which preservative is already in the bottle.
- Sample bottles were fill to the top to eliminate air space.
- Sample bottles were capped as soon as filled, placed in lean plastic bags, then placed into coolers with plenty of ice packs. Photographs of them are shown in **Figure 3.1-2**.

Table 3.1-2 Parameters, Bottles and Preservatives

Parameter Type	*Bottle*	*Filtered*	*Preservative*
Common Ions	1 L plastic or glass	No	None –cool to 4 ^{o}C
Total metals (Cd, Cr, Cu, Pb, Hg, Se, Ni, Ag, Zn, As, Ba, Fe, Mn, B)	125 ml plastic, acid washed	No	HNO_3

Collection of Indus River sample

Collection of groundwater sample from water bore in north of the Plant

Figure 3.1-2 : Water Sampling Photographs

Quality Control Samples

One duplicate sample was collected as part of QC check.

Sample Handling and Collection

- Water quality Sample was given in the form of: WPSTW01, where
  - W indicates it is a water sample
  - PST indicates the project ID
  - W01 indicates the unique number of the sample
- Quality control sample was labeled similar to normal samples and identity was kept confidential from the testing laboratory.
- Sample labels will include:
  - Sample ID
  - collection date and time
  - Sample type Groundwater or freshwater
  - Parameter group e.g. metals, nutrients, physical + major ions, et.

- Preservative if any was added
- In addition to the above information, the field notes were recorded GPS coordinates, well depth, and photograph.

Sample Storage & Shipment

All samples should be preserved according to **Table 3.1-2** and shipped to the testing laboratory as soon samples from all stations are collected.

Parameters Selection for Analysis

Water samples were analyzed as per parameters listed in **Table 3.1-3**. The sample taken upstream to plant intake water (WPSTW02) had been analyzed for parameters of National Environmental Quality Standards (NEQS) based on the information that communities in the study Area are consuming water from plant intake line for domestic purposes including drinking. The other sample (WPSTW01) analyzed downstream to intake and plant waste water fall point just to detect any contamination from the plant, incase. Although there is no signs found of the groundwater use for drinking purpose in the study area but to cover this aspect one sample (WPSTW04) from water bore was also analyzed for NEQS.

Table 3.1-3 Parameters Selection for Analysis

Sample ID	*Sample Type/ Source*	*Heavy Metals*	*NEQS[1] for Drinking Water and Waste Water*	*Common Ions*
WPSTW01	River Water	Analyzed	Not Analyzed	Analyzed
WPSTW02	River Water	Analyzed	Analyzed	Not Analyzed
WPSTW03	Groundwater	Analyzed	Not Analyzed	Not Analyzed
WPSTW04	Groundwater	Analyzed	Analyzed	Not Analyzed
WPSTW05	Plant Effluent	Analyzed	Not Analyzed	Analyzed

Chain of Custody

The chain of custody record is presented in **Appendix 4.**

3.3 Soil Sampling Methodology

Total four soil samples were collected from the Study Area.

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[1] NEQS: National Environmental Quality Standards

Selection of Sampling Sites

The sampling locations were chosen considering wind direction of current ash disposal site. One sample was collected from agriculture land to check top soil fertility characteristics.

Total four surface soil samples were collected form the study area. The sampling locations are listed below.

Soil Quality Sampling Locations

Sample ID	*Coordinates*	*Site Description*	*rationale*
SPSTS01	25° 41' 54.1"N 68° 17' 00.9"E	500 m south of the plant, flat barren land, gravel and sandy laom	Upwind (downwind in summer) of the existing plant
SPSTS02	25 42 ' 42.0"N 68° 17' 23.0"E	500 m north of the plant, flat barren land, gravel and sandy laom	Downwind (Upwind in summer) of the existing plant
SPSTS03	25° 41' 39.5"N 68° 16' 40.0"E	750 m southwest of the plant, flat barren land, gravel and sandy laom	Near ash disposal site of the existing plant
SPSTS04	25° 42' 14.7"N 68° 18' 16.8"E	1000 m east of the plant, flat agricultural land, sandy loam	To check agricultural productivity

Sampling Methodology

Equipment

Following sampling equipment was used as per requirement of the surface soil conditions.

- Shovel
- Plastic Spoon

Sample Collection

Surface soil samples were collected by removing 15m upper surface layer with a shovel (See **Photograph**). Samples were taken in a manner to minimize loss of volatile compounds, and sealed immediately in sample containers with minimal headspace.

Soil Sample Containers

For chemistry, 250 mg of soil samples were collected in glass jars.

Sample Storage & Shipment

All samples were kept chill and sent for analysis to laboratory soon upon collection.

Chain of Custody

The chain of custody record was maintained**.**

Soil Sampling Photographs

Photograph 01: Soil Sample Collection in Barren Land of the Study Area

Photograph 02: Soil Sample Collection in Agricultural Fields in the Study Area

3.4 Ecological Survey Methodology

The methodology for the ecological surveys has been compiled to meet the requirements of the environmental assessment of the Project. The baseline study was conducted from 14th February 2014 to 16th February, 2014 (February 2014 survey) to determine the abundance and diversity of terrestrial and aquatic ecological resources in the Study Area during the spring season. To address seasonal aspects of ecology, information from previous survey in the vicinity of the Study Area[2] (carried out in June 2012 to cover the summer period) was also consulted and used in compilation of the report.

The methodology for the field survey was compiled to obtain objective data, and to determine the baseline conditions for assessment of the resulting impacts of the Project for the data collected. The timing, location, and scope of the surveys are summarized in **Table 3.1-4.**

Table 3.1-4 Timing, Location, and Scope of Surveys in the Study Area

Survey Period	*Area Studied*	*Scope*	*Comments*
February 2014	Terrestrial habitats, river and ponds in Study Area	Vegetation, mammals, herpeto-fauna, birds and fish.	A total of twelve sampling locations were selected for terrestrial sampling of vegetation, mammals, herpeto-fauna and birds. A grid of 2x2 km was drawn on a map of the Study Area and the sampling points were marked. The points were then adjusted to ensure habitat representation, accessibility, with a focus on the areas to be impacted. Some additional sampling points were selected on the river bank/riparian areas. Three trapping sites for small mammals were selected. A total of five sampling locations were selected for sampling of fish. Three of these sampling locations were located in the main Indus River while two were located in the ponds. (Two small wetlands or ponds can be observed on the eastern side of the Project site that have been created by flood water from the Indus River).

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[2] Asian Development Bank (ADB), October 2013, Environmental Impact Assessment of Jamshoro Power Generation Project. Report prepared by Hagler Bailly Pakistan.

Details on survey techniques and data collection are provided below.

Study Components and Survey Design

Fish

Fish fauna from the selected sampling points were collected using cast nets of two different mesh sizes, (small one having mesh size of 1centimeter (cm) × 1 cm and having a circumference of 3 meters (m). and the large one with mesh size of 2.5 cm × 2.5 cm and with a circumference of 4.5 m) so that the fish fauna of all the age classes and sizes could be collected. Ten nets of each mesh size were cast at each sampling point along a line transect of about 500 m. The collected specimens were identified and photographed and then released back into the water. Literature review and interviews with locals were used to supplement the information collected in the field.

Floral Diversity (Vegetation) and Habitats

Data was collected from each sampling point by the quadrat method[3] taking three quadrats of 10×10 m at each sampling point. The quadrats were positioned in the following manner: one at the start of the transect line, one in the middle (150 m) and one at the end (300 m). All sampling points were sampled to include representative habitats, topographic and physiographic conditions of the Study Area. The species and canopy cover of each plant species in each quadrat were recorded. Plants from each quadrate were noted and collected for the assessment of the plant species if required. Additional plant species in the area adjacent to the quadrate were also noted down and collected to record the occurrence of the species.

The Cover and Relative Cover of species were calculated using the following formula:

$$\text{Cover} = \frac{\text{Total cover (cm) of a specie}}{\text{Number of plants of a species}}$$

$$\text{Relative Cover} = \frac{\text{Total cover (sq cm) of all plants of a species x 100}}{\text{Total cover (sq cm) of plants of all species}}$$

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[3] Sutherland, W.J. 1997. *Ecological Census Techniques a Handbook*. Cambridge: Cambridge University Press. 336pp.

The Density and Relative Density of the species in the area were calculated using the following formulae:

$$\text{Density} = \frac{\text{Total number of individuals of a species in all quadrats taken}}{\text{Total number of quadrats taken}}$$

$$\text{Relative Density} = \frac{\text{Total number of individuals of a species in all quadrats x 100}}{\text{Total number of individual of all species in all quadrats}}$$

The Frequency and Relative Frequency percentages of the species were determined using the following formulae:

$$\text{Frequency} = \frac{\text{Number of quadrats of occurrence of a species x 100}}{\text{Total number of quadrats lay out}}$$

$$\text{Relative Frequency} = \frac{\text{Frequency of a species x 100}}{\text{Total Frequency of all species}}$$

Importance Value Index (IVI) of all the recorded species was calculated using the following formulae:

$$\text{IVI} = \frac{\text{Relative cover + Relative frequency + Relative density}}{3}$$

Plants collected were identified following the nomenclature from Flora of Pakistan.[4, 5]

Local people were consulted to gather information about local names, uses, value and cultural values of the plants of the area.

Mammals

The mammal surveys were categorized into a) large mammals, b) small mammals,

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[4] S. I. and Nasir. 1972-1994. Flora of Pakistan Fascicles. Islamabad

[5] Ali, S. I. and Qaiser, M. 1995 to date. Flora of Pakistan Fascicles. Karachi

Large Mammals

Line transects (300 m by 20 m) were placed at each sampling location to record all animals or their signs detected. All the animals sighted, or their signs (foot marks, droppings, dens) were recorded. GPS coordinates of the location and habitat type were documented. Samples of feces and photographs of tracks were taken and conserved for potential subsequent confirmatory analysis. Transects were started as early as possible in the day and will cover all possible habitat types in order to avoid bias of stratification.

In addition, incidental sightings of all mammals were recorded; number of individuals, location and habitat type were recorded for each sighting. Anecdotal information regarding specific mammals was collected from the local people and relevant literature was also consulted.

Live Trapping for Small Mammals

Live trapping for small mammals was carried out at various sampling sites. Trapped animals were identified and released alive after taking measurements.

Bait

A mixture of different food grains mixed with fragrant seeds was used as bait to attract the small mammals. Wheat and rice were used as food grains while peanut butter, coriander, oats, and onion were used for fragrance. Freshly prepared bait was used on every trapping day. Only a small amount of bait was put on the rear side of the traps. Care was taken while putting the bait on the rear side of the trap to make sure that it was placed properly on the trap platform.

Traps and Trapping Procedure

Sherman traps were used for the present study to collect live specimens. Thirty to forty traps were set at a specific area in two lines approximately 10 m apart. A colorful ribbon to locate traps the next day was used to mark each trap. The traps were set in the evening and checked early the next morning, ensuring that the trapped animals are not killed by heat.

Data Collection

The traps were checked the following morning as early as possible. The trapped animals were carefully transferred one after the other into an already weighed transparent polythene bag. Utmost care was taken to avoid direct handling and harassing the specimens. The species of the trapped animals were noted. The polythene bag along with the specimen were weighed and the net weight of the animal were noted down in a note book. The sex of the specimens was also observed and documented carefully. The important relevant data, such as the date of trap setting, date of data collection, habitat, location, elevation, and weather conditions, was recorded on the spot on a data sheet.

The specimens were identified with the help of the most recent keys available in literature.[6]

Birds

The line transects (300 m by 50 m) were placed at each sampling location to record all birds observed. Transects were started as early as possible in the morning and in late afternoon and will cover all possible habitats. The start time and coordinates of the starting point were recorded. The birds were identified using the most recent keys available in literature.[7]

Herpeto-fauna

Line transects 300 m long and 20 m wide were placed systematically at each sampling site in the Study Area.

An effective way to survey reptiles is by active searching, particularly during the daytime. This method is equally applicable to both nocturnal and diurnal species. The sampling sites were actively searched for all types of reptiles and amphibians along the line transects. Active searching was also carried out in sampling areas with a focus on suitable microhabitats. Nocturnal sampling was carried out at one sampling location. The species collected or observed during the survey were photographed with a digital camera and necessary field data was recorded. The coordinates and elevations were recorded using GPS, and other features of interest like habitat type were documented.

The presence of signs such as an impression of body, tail or footprints, fecal pellets, tracks, dens or egg laying excavations were recorded.

Samples were collected and preserved for identification purposes where the species could not be identified in the field for any reason. Hand picking (using bare hands or with the help of long forceps or a snake clutch) is the most efficient way of collecting different

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[6] Roberts, T.J. 1997. The Mammals of Pakistan. Oxford University Press Karachi. 525 pp

[7] Grimmett, R., Roberts, T., and Inskipp, T. 2008. Birds of Pakistan, Yale University Press.

species of reptiles. However, for larger noose traps or other appropriate techniques were used. For handling snakes, especially poisonous ones, snake clutches/sticks were used.

The specimens were identified with the help of the most recent keys available in literature.[8]

Basis for Determination of Conservation Status of Species and Performance Standard for Preparation of the Baseline

The basis for determination of the conservation status of the species and the standard followed for preparation of this baseline are outlined below.

Pakistan Mammals National Red List: This National list is based on country-wide surveys conducted by IUCN in 2005 to assess the conservation status of mammals in Pakistan. The list was officially published in 2006.

IUCN Red List of Threatened Species: The IUCN Red List of Threatened Species[9] (IUCN Red List) is widely recognized as the most comprehensive, objective global approach for evaluating the conservation status of plant and animal species. The location of the sightings of the species appearing in the IUCN Red List has been provided in the report.

CITES: The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international convention of governments to insure that international trade in specimens of wild animals and plants does not threaten their survival. CITES works by regulating international trade in specimens of selected species. All import and export species covered by the Convention have to be authorized through a licensing system. Species are assigned to one of three Appendices depending upon the degree of protection deemed necessary with Appendix I being the most restricted use. The CITES lists available online were consulted for this study in March 2014. The location of the sightings of the species listed under CITES have been provided in the report. It may be noted that the focus of the CITES is to regulate the movement of the species with the ultimate aim of safeguarding the resources for the future, the species may not be endangered. In terms of environmental management

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[8] Muhammad Sharif Khan. 2006. Amphibians and Reptiles of Pakistan. Krieger Publishing Company, Malabar, Florida, pp. 311.

[9] IUCN 2013. IUCN Red List of Threatened Species. Version 2013.2. <www.iucnredlist.org>. Downloaded on 04 March 2014.

related to a project, designs and activities that can facilitate utilization of a species (particularly regarding across the border) is of concern.

Equator Principles and IFC Performance Standard 6: This ecological baseline document was developed to address the requirements of the Equator Principles[10] and International Finance Corporation (IFC) Performance Standards.[11]

The Equator Principles were created to determine, assess, and manage social and environmental risk in project financing. The principles provide a framework for each Equator Principle Financial Institution (lenders) to develop its own procedures and standards. In general they require, in the initial stages: review and categorization of the proposed project, social and environmental assessment, and the application of applicable social and environmental standards. There are other steps in the Equator Principles, and while they all apply to any proposed project, for the purpose of this baseline, it is the particulars of IFC Performance Standard 6 that are considered.

The IFC Performance Standards were developed from the broad principles of the Equator Principles and specifically address components of the assessment of projects (and any alternatives) applying for international funding. The baseline report (its information) becomes the foundation of the analysis of the potential impacts, as well as the management of those impacts for the proposed Project.

To address the IFC Performance Standard 6, each ecological baseline report should address the biodiversity of the Study Area, which includes habitats (both abiotic factors such as topography, soils and water, and biotic factors, which includes flora) and fauna (which includes all life, from invertebrates to megafauna). If the Project will have a potentially significant impact, greater care is required in the analysis.

Habitat descriptions should include critical habitat, both modified and natural habitats, particularly those with high biodiversity value for the survival of threatened (threatened with or in danger of extinction) species, if any are determined. Those habitats having special significance for endemic or restricted range species, or having importance for migratory species or congregatory species, or unique assemblages of species with key

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[10] The Equator Principle. June 2006. Adopted by The Equator Principles Financial Institutions, www.equator-principles.com, Accessed 14 March 2014.

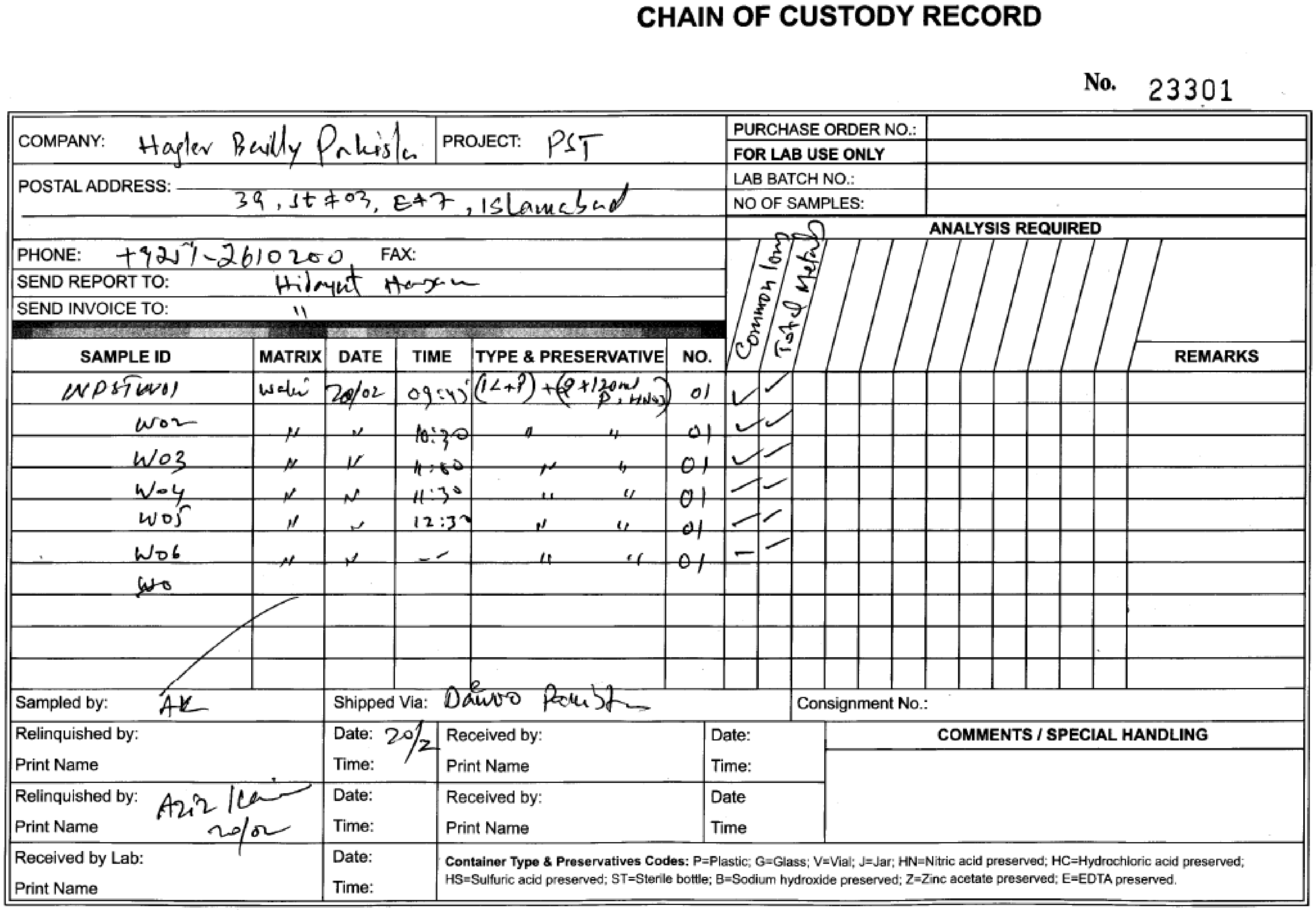
[11] Policy on Social and Environmental Sustainability, January 2012. Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources, International Finance Corporation. The World Bank Group.

evolutionary processes, or provide key ecosystem services, or lastly, areas that have biodiversity of significance to social, economic or cultural importance to local communities should also be delineated. This document should describe the accuracy, reliability and sources of the data. In addition, the baseline further must describe methods used to collect and analyze data and should be relevant to project location (and any alternatives), design, operation and potential mitigation measures (to be determine from the baseline).

Limitations of the Study

Carnivores: Large carnivore species (e.g. Common Red Fox *Vulpes vulpes* Asiatic Jackal *Canis aureus,* cats *Felis sp.,* etc) are highly elusive and predominantly nocturnal, which make their detection difficult. These species also have large home ranges and exist in sparse populations (or primarily individually), which further reduce chances of encountering them or their signs. Intensive sign surveys were conducted and local informants were consulted to evaluate survey findings. However, it is recognized that sign surveys have limitations; for example, tracks are especially difficult to determine on hard substrates making it confusing to differentiate between signs of related species.

Appendix 4: WATER QUALITY BASELINE - LABORATORY RESULTS



CHAIN OF CUSTODY RECORD

No. 23301

COMPANY: Hagler Bailly Pakistan
PROJECT: PST
POSTAL ADDRESS: 39, St #03, E-7, Islamabad
PHONE: +92-51-2610200
FAX:
SEND REPORT TO: Hidayat Hasan
SEND INVOICE TO: "

PURCHASE ORDER NO.:
FOR LAB USE ONLY
LAB BATCH NO.:
NO OF SAMPLES:

ANALYSIS REQUIRED

SAMPLE ID	MATRIX	DATE	TIME	TYPE & PRESERVATIVE	NO.	Common Ions	Total Metals	REMARKS
INDPSTW01	Water	20/02	09:45	(1L+P) + (2×120ml P, HNO3)	01	✓	✓	
W02	"	"	10:30	" "	01	✓	✓	
W03	"	"	11:00	" "	01	✓	✓	
W04	"	"	11:30	" "	01	✓	✓	
W05	"	"	12:30	" "	01	✓	✓	
W06	"	"	--	" "	01	–	✓	
Wo								

Sampled by: AK
Shipped Via: Daewoo Rawalpindi
Consignment No.:

Relinquished by:
Print Name
Date: 20/2
Time:
Received by:
Print Name
Date:
Time:

Relinquished by: Aziz Khan 20/02
Print Name
Date:
Time:
Received by:
Print Name
Date
Time

Received by Lab:
Print Name
Date:
Time:

COMMENTS / SPECIAL HANDLING

Container Type & Preservatives Codes: P=Plastic; G=Glass; V=Vial; J=Jar; HN=Nitric acid preserved; HC=Hydrochloric acid preserved; HS=Sulfuric acid preserved; ST=Sterile bottle; B=Sodium hydroxide preserved; Z=Zinc acetate preserved; E=EDTA preserved.

Sample ID	WPSTW01
Lab. ID	E 04193
Sample Collected By	Aziz Karim
Sampling Date	02/20/2014
Time of Sampling (hours)	9:45
Sample Received Date	02/21/2014
Sample	Water - Surface sample
Nature of Sample	Grab
Sample Collected from	River Water
Location	Downstream of Plant Intake
Northings	N25 41 46.4
Eastings	E68 19 50.2

Parameter	*Analytical Method*	*Unit*	*LOR*	*Analysis Results*
Temperature	US EPA 170.1	°C	1.000	19.50
DO	US EPA 360.1	mg/l	1.000	9.30
Conductivity	USEPA 120.1	µS/cm	1.000	539.00
TDS	US EPA 160.1	mg/l	10.000	480.00
pH	US EPA 150.1		0.100	7.79
TSS	US EPA 160.2	mg/l	4.000	11.67
Fluoride	US EPA 340.1	mg/l	0.100	ND
Sulfate	US EPA 375.3	mg/l	10.000	88.06
Chloride	SMEW	mg/l	5.000	58.49
Ammonia	SMEW	mg/l	0.500	ND
Calcium	US EPA 215.2	mg/l	1.000	28.22
Magnesium	SMEW	mg/l	1.000	11.87
Cadmium	US EPA 200.8	mg/l	0.001	ND
Chromium	US EPA 200.8	mg/l	0.001	0.041
Copper	US EPA 200.8	mg/l	0.001	0.054
Lead	US EPA 200.8	mg/l	0.001	0.009
Mercury	US EPA 200.8	mg/l	0.001	ND
Selenium	US EPA 200.8	mg/l	0.001	ND

Analyst

Saeed Nawaz

Checked By

Asif Mahmood
Manager, EMA Services

Parameter	*Analytical Method*	*Unit*	*LOR*	*Analysis Results*
Nickel	US EPA 200.8	mg/l	0.001	0.016
Silver	US EPA 200.8	mg/l	0.001	ND
Zinc	US EPA 200.8	mg/l	0.001	0.028
Arsenic	US EPA 200.8	mg/l	0.001	ND
Barium	US EPA 200.8	mg/l	0.001	0.127
Iron	US EPA 200.8	mg/l	0.001	0.023
Manganese	US EPA 200.8	mg/l	0.001	0.109
Boron	US EPA 200.8	mg/l	0.001	0.040
Sodium	US EPA 200.8	mg/l	0.001	66.961
Potassium	US EPA 200.8	mg/l	0.001	4.206
Phosphate	US EPA 300.1	mg/l	0.001	0.019

SMEW: Standard Methods for Examination of Water and Wastewater, 19th Edition

USEPA: United States Environmental Protection Agency

µS/cm: Micro Siemens Per Centimeter

TSS: Total Suspended Solids

TDS: Total Dissolved Solids

LOR: Level of Reporting

mg/l: Milligram Per Liter

DO: Dissolved Oxygen

ND: Not Detected

Analyst

Saeed Nawaz

Checked By

Asif Mahmood
Manager, EMA Services

Environmental Monitoring & Analysis

HaglerBailly Pakistan

Sample ID	WPSTW02
Lab. ID	E 04194
Sample Collected By	Aziz Karim
Sampling Date	02/20/2014
Time of Sampling (hours)	10:30
Sample Received Date	02/21/2014
Sample	Water - Surface sample
Nature of Sample	Grab
Sample Collected from	River Water
Location	Upstream of Plant Intake
Northings	N25 42 20.5
Eastings	E68 19 13.7

Parameter	*Analytical Method*	*Unit*	*LOR*	*Analysis Results*
Temperature	US EPA 170.1	°C	1.000	19.50
DO	US EPA 360.1	mg/l	1.000	9.27
Conductivity	USEPA 120.1	µS/cm	1.000	525.00
TDS	US EPA 160.1	mg/l	10.000	470.00
pH	US EPA 150.1		0.100	7.82
Fluoride	US EPA 340.1	mg/l	0.100	ND
Chloride	SMEW	mg/l	5.000	54.95
Color	US EPA 110.2	CU	1.000	ND
Odor	US EPA 140.1	TON	1.000	Acceptable
Turbidity	HACH 8237	NTU	0	0
Nitrate	US EPA 300.1	mg/l	0.001	0.703
Nitrite	US EPA 354.1	mg/l	0.010	ND
Residual Chlorine	SMEW	mg/l	0.100	ND
Total Hardness	US EPA 130.2	mg/l	1.000	120.00
Cadmium	US EPA 200.8	mg/l	0.001	0.002
Chromium	US EPA 200.8	mg/l	0.001	0.030
Copper	US EPA 200.8	mg/l	0.001	0.036
Lead	US EPA 200.8	mg/l	0.001	0.007

Analyst

Saeed Nawaz

Checked By

Asif Mahmood
Manager, EMA Services

Parameter	*Analytical Method*	*Unit*	*LOR*	*Analysis Results*
Mercury	US EPA 200.8	mg/l	0.001	ND
Selenium	US EPA 200.8	mg/l	0.001	ND
Nickel	US EPA 200.8	mg/l	0.001	0.011
Silver	US EPA 200.8	mg/l	0.001	ND
Zinc	US EPA 200.8	mg/l	0.001	0.023
Arsenic	US EPA 200.8	mg/l	0.001	ND
Barium	US EPA 200.8	mg/l	0.001	0.131
Iron	US EPA 200.8	mg/l	0.001	0.020
Manganese	US EPA 200.8	mg/l	0.001	0.097
Boron	US EPA 200.8	mg/l	0.001	0.015

SMEW: Standard Methods for Examination of Water and Wastewater, 19th Edition

USEPA: United States Environmental Protection Agency

μS/cm: Micro Siemens Per Centimeter

NTU: Nephlometric Turbidity Units

TDS: Total Dissolved Solids

TON: Threshold Odor No.

CU: Chloroplatinate Unit

LOR: Level of Reporting

mg/l: Milligram Per Liter

DO: Dissolved Oxygen

ND: Not Detected

Analyst

Saeed Nawaz

Checked By

Asif Mahmood
Manager, EMA Services

Environmental Monitoring & Analysis

Hagler Bailly Pakistan

Sample ID	WPSTW03
Lab. ID	E 04195
Sample Collected By	Aziz Karim
Sampling Date	02/20/2014
Time of Sampling (hours)	11:00
Sample Received Date	02/21/2014
Sample	Water
Nature of Sample	Grab
Sample Collected from	Bore
Location	Mosque Manzoorabad
Northings	N25 42 03.0
Eastings	E68 17 55.1

Parameter	*Analytical Method*	*Unit*	*LOR*	*Analysis Results*
Temperature	US EPA 170.1	°C	1.000	30.50
DO	US EPA 360.1	mg/l	1.000	4.00
Conductivity	USEPA 120.1	µS/cm	1.000	6,710.00
TDS	US EPA 160.1	mg/l	10.000	5,070.00
pH	US EPA 150.1		0.100	7.20
Cadmium	US EPA 200.8	mg/l	0.001	ND
Chromium	US EPA 200.8	mg/l	0.001	0.046
Copper	US EPA 200.8	mg/l	0.001	0.097
Lead	US EPA 200.8	mg/l	0.001	0.008
Mercury	US EPA 200.8	mg/l	0.001	0.001
Selenium	US EPA 200.8	mg/l	0.001	0.003
Nickel	US EPA 200.8	mg/l	0.001	0.018
Silver	US EPA 200.8	mg/l	0.001	0.010
Zinc	US EPA 200.8	mg/l	0.001	0.025
Arsenic	US EPA 200.8	mg/l	0.001	0.009
Barium	US EPA 200.8	mg/l	0.001	0.073
Iron	US EPA 200.8	mg/l	0.001	0.058

Analyst

Saeed Nawaz

Checked By

Asif Mahmood
Manager, EMA Services

Parameter	*Analytical Method*	*Unit*	*LOR*	*Analysis Results*
Manganese	US EPA 200.8	mg/l	0.001	0.178
Boron	US EPA 200.8	mg/l	0.001	0.064

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USEPA: United States Environmental Protection Agency

µS/cm: Micro Siemens Per Centimeter

TDS: Total Dissolved Solids

LOR: Level of Reporting

mg/l: Milligram Per Liter

DO: Dissolved Oxygen

ND: Not Detected

Analyst	**Checked By**
Saeed Nawaz	Asif Mahmood Manager, EMA Services

Sample ID	WPSTW04
Lab. ID	E 04196
Sample Collected By	Aziz Karim
Sampling Date	02/20/2014
Time of Sampling (hours)	11:30
Sample Received Date	02/21/2014
Sample	Water
Nature of Sample	Grab
Sample Collected from	Bore
Location	Mosque Habibullah More Near Indus Mines Road
Northings	N25 43 35.6
Eastings	E68 17 25.5

Parameter	*Analytical Method*	*Unit*	*LOR*	*Analysis Results*
Temperature	US EPA 170.1	°C	1.000	30.40
DO	US EPA 360.1	mg/l	1.000	3.80
Conductivity	USEPA 120.1	µS/cm	1.000	5,520.00
TDS	US EPA 160.1	mg/l	10.000	4,066.00
pH	US EPA 150.1		0.100	7.10
Fluoride	US EPA 340.1	mg/l	0.100	ND
Chloride	SMEW	mg/l	5.000	1,352.42
Color	US EPA 110.2	CU	1.000	ND
Odor	US EPA 140.1	TON	1.000	Acceptable
Turbidity	HACH 8237	NTU	0	0
Nitrate	US EPA 300.1	mg/l	0.001	0.492
Nitrite	US EPA 354.1	mg/l	0.010	ND
Residual Chlorine	SMEW	mg/l	0.100	ND
Total Hardness	US EPA 130.2	mg/l	1.000	1,308.00
Cadmium	US EPA 200.8	mg/l	0.001	0.002
Chromium	US EPA 200.8	mg/l	0.001	0.047
Copper	US EPA 200.8	mg/l	0.001	0.136
Lead	US EPA 200.8	mg/l	0.001	0.009

Analyst

Saeed Nawaz

Checked By

Asif Mahmood
Manager, EMA Services

Parameter	*Analytical Method*	*Unit*	*LOR*	*Analysis Results*
Mercury	US EPA 200.8	mg/l	0.001	ND
Selenium	US EPA 200.8	mg/l	0.001	0.005
Nickel	US EPA 200.8	mg/l	0.001	0.019
Silver	US EPA 200.8	mg/l	0.001	0.002
Zinc	US EPA 200.8	mg/l	0.001	0.052
Arsenic	US EPA 200.8	mg/l	0.001	0.006
Barium	US EPA 200.8	mg/l	0.001	0.260
Iron	US EPA 200.8	mg/l	0.001	0.049
Manganese	US EPA 200.8	mg/l	0.001	0.125
Boron	US EPA 200.8	mg/l	0.001	0.053

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USEPA: United States Environmental Protection Agency

µS/cm: Micro Siemens Per Centimeter

NTU: Nephlometric Turbidity Units

TDS: Total Dissolved Solids

TON: Threshold Odor No.

CU: Chloroplatinate Unit

LOR: Level of Reporting

mg/l: Milligram Per Liter

DO: Dissolved Oxygen

ND: Not Detected

Environmental Monitoring & Analysis

HaglerBailly Pakistan

Sample ID	WPSTW05
Lab. ID	E 04197
Sample Collected By	Aziz Karim
Sampling Date	02/20/2014
Time of Sampling (hours)	12:30
Sample Received Date	02/21/2014
Sample	Wastewater
Nature of Sample	Grab
Sample Collected from	Wastewater Collection Pit
Site/Location	Near Plant Cooling Tower
Northings	N25 42 10.3
Eastings	E68 17 20.0

Parameter	*Analytical Method*	*Unit*	*LOR*	*Analysis Results*
Temperature	US EPA 170.1	°C	1.000	20.20
DO	US EPA 360.1	mg/l	1.000	6.91
Conductivity	USEPA 120.1	µS/cm	1.000	850.00
TDS	US EPA 160.1	mg/l	10.000	684.00
pH	US EPA 150.1		0.100	7.02
TSS	US EPA 160.2	mg/l	4.000	13.00
Fluoride	US EPA 340.1	mg/l	0.100	ND
Sulfate	US EPA 375.3	mg/l	10.000	231.26
Chloride	SMEW	mg/l	5.000	179.02
Ammonia	SMEW	mg/l	0.500	ND
Calcium	US EPA 215.2	mg/l	1.000	38.80
Magnesium	SMEW	mg/l	1.000	19.92
Cadmium	US EPA 200.8	mg/l	0.001	ND
Chromium	US EPA 200.8	mg/l	0.001	0.037
Copper	US EPA 200.8	mg/l	0.001	0.026
Lead	US EPA 200.8	mg/l	0.001	0.005
Mercury	US EPA 200.8	mg/l	0.001	ND
Selenium	US EPA 200.8	mg/l	0.001	ND

Analyst

Saeed Nawaz

Checked By

Asif Mahmood
Manager, EMA Services

Appendix 5: ECOLOGICAL BASELINE - SPECIES LIST

Table 5-1: Vegetation Field Data, Survey Conducted February 2014

ID	*Coordinates*		*Habitat*	*Tamarix dioica*		*Alhagi maurorum*		*Blapharis scindicus*		*Saccharum sp.*		*Salvadora oleoides*		*Aristida sp*		*Rhazya stricta*		*Fagonia indica*	
	Latitude (N)	*Longitude (E)*		*Cover %*	*Count*	*Cover %*	*Count*	*Cover %*	*Count*	*Cover %*	*Count*	*Cover %*	*Count*	*Cover %*	*Count*	*Cover %*	*Count*	*Cover %*	*Count*
S–6	25 42 19.40	68 19 13.60	Agricultural Fields	0.1104	75	–	–	–	–	–	–	–	–	–	–	–	–	–	–
S–12	25 41 39.90	68 20 07.50	River/pond	0.0003	1	0.0001	10	–	–	0.005084	5	–	–	–	–	–	–	–	–
S–8	25 44 46.40	68 17 20.50	Plains	–	–	–	–	–	–	–	–	–	–	–	–	0.000205	10	–	–
S–9	25 44 20.20	68 19 14.40	Agricultural Fields	–	–	0.0002	16	–	–	–	–	–	–	–	–	–	–	–	–
S–7	25 44 28.90	68 15 33.30	Hills	–	–	–	–	–	–	–	–	–	–	0.000024	10	–	–	0.000213	5
S–4	25 42 16.30	68 15 02.30	Hills	–	–	–	–	–	–	–	–	–	–	0.000149	30	–	–	0.000039	3
S–11	25 42 40.40	68 18 07.30	River/pond	0.0007	17	0.0003	16	–	–	–	–	–	–	–	–	–	–	–	–
S–5	25 42 18.40	68 16 22.50	Plains	–	–	–	–	–	–	–	–	0.026320	1	–	–	–	–	0.000136	10
S–1	25 40 09.10	68 14 54.90	Hills	–	–	–	–	–	–	–	–	–	–	0.000013	37	0.000144	2	0.000022	6
S–2	25 40 17.10	68 16 55.10	Plains	–	–	–	–	0.000003	3	–	–	–	–	0.000007	22	–	–	0.000058	9
S–10	25 39 38.80	68 18 08.26	Vegetation Cluster	–	–	–	–	–	–	–	–	0.039711	2	–	–	–	–	–	–
S–3	25 40 12.10	68 19 22.20	Agricultural Fields	–	–	0.0001	7	–	–	–	–	–	–	–	–	–	–	–	–

ID	*Coordinates*		*Habitat*	*Zygophylum simplex*		*Cassia italica*		*Prosopis juliflora*		*Ziziphus mauritiana*		*Typha sp.*		*Heliotropium sp.*		*Acacia nilotica*		***Total Cover %***	***Total Count***
	Latitude (N)	*Longitude (E)*		*Cover %*	*Count*	*Cover %*	*Count*	*Cover %*	*Count*	*Cover %*	*Count*	*Cover %*	*Count*	*Cover %*	*Count*	*Cover %*	*Count*		
S–6	25 42 19.40	68 19 13.60	Agricultural Fields	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**0.1104**	**75**
S–12	25 41 39.90	68 20 07.50	River/pond	–	–	–	–	0.003000	3	–	–	–	–	–	–	–	–	**0.0085**	**19**
S–8	25 44 46.40	68 17 20.50	Plains	0.000009	2	0.000034	5	–	–	0.000261	1	–	–	–	–	–	–	**0.0005**	**18**
S–9	25 44 20.20	68 19 14.40	Agricultural Fields	–	–	0.000046	5	–	–	–	–	–	–	–	–	0.012672	1	**0.0129**	**22**
S–7	25 44 28.90	68 15 33.30	Hills	0.000324	3	–	–	–	–	–	–	–	–	–	–	–	–	**0.0006**	**18**
S–4	25 42 16.30	68 15 02.30	Hills	0.000025	1	–	–	–	–	–	–	–	–	0.000028	2	–	–	**0.0002**	**36**
S–11	25 42 40.40	68 18 07.30	River/pond	–	–	–	–	0.002742	2	–	–	0.000004	7	–	–	–	–	**0.0037**	**42**
S–5	25 42 18.40	68 16 22.50	Plains	0.000404	5	–	–	0.007219	2	–	–	–	–	–	–	–	–	**0.0341**	**18**
S–1	25 40 09.10	68 14 54.90	Hills	0.000089	2	–	–	–	–	–	–	–	–	0.000011	1	–	–	**0.0003**	**48**
S–2	25 40 17.10	68 16 55.10	Plains	0.000036	2	–	–	–	–	–	–	–	–	–	–	–	–	**0.0001**	**36**
S–10	25 39 38.80	68 18 08.26	Vegetation Cluster	–	–	–	–	–	–	0.002984	1	–	–	–	–	0.024474	1	**0.0672**	**4**
S–3	25 40 12.10	68 19 22.20	Agricultural Fields	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**0.0001**	**7**

Table 5-2: Mammals Field Data, Survey Conducted February 2014

ID	*Date*	*Coordinates*		*Habitat*	*Asiatic Jackal*			*Desert Hare or Indian Hare*			*Indian Crested Porcupine*			*Bengal Fox*			***Sightings***		***Signs***	
		Latitude (N)	*Longitude (E)*		*Sighting*	*Signs*	***Total***	*Sighting*	*Signs*	***Total***	*Sighting*	*Signs*	***Total***	*Sighting*	*Signs*	***Total***	***Total***	***Species Count***	***Total***	***Species Count***
S9	02/15/14	25 44 20.20	68 19 14.40	Agricultural Fields	–	1	1	–	–	–	–	1	1	–	1	1	**–**	**–**	**3**	**3**
S3	02/16/14	25 40 12.10	68 19 22.20	Agricultural Fields	–	–	–	–	–	–	–	–	–	–	–	–	**–**	**–**	**–**	**–**
S10	02/16/14	25 39 38.80	68 18 08.26	Agricultural Fields	–	1	**1**	–	–	**–**	–	–	–	–	1	**1**	**–**	**–**	**2**	**2**
S1	02/16/14	25 40 09.10	68 14 54.90	Hills	–	3	3	–	10	10	–	–	–	–	–	–	**–**	**–**	**13**	**2**
S7	02/15/14	25 44 28.90	68 15 33.30	Hills	–	–	**–**	–	3	**3**	–	–	–	–	–	**–**	**–**	**–**	**3**	**1**
S4	02/15/14	25 42 16.30	68 15 02.30	Hills	–	–	**–**	–	–	**–**	–	–	–	–	–	**–**	**–**	**–**	**–**	**–**
S5	02/16/14	25 42 18.40	68 16 22.50	Plains	–	5	**5**	1	8	**9**	–	–	–	–	3	**3**	**1**	**1**	**16**	**3**
S2	02/16/14	25 40 17.10	68 16 55.10	Plains	–	–	–	–	2	2	–	–	–	–	–	–	**–**	**–**	**2**	**1**
S8	02/14/14	25 44 46.40	68 17 20.50	Plains	–	2	**2**	–	–	**–**	–	–	–	–	–	**–**	**–**	**–**	**2**	**1**
S11	02/16/14	25 42 40.40	68 18 07.30	River/ Riparian	–	1	1	–	–	–	–	–	–	–	1	1	**–**	**–**	**2**	**2**
S6	02/14/14	25 42 19.40	68 19 13.60	River/ Riparian	–	2	2	–	–	–	–	1	1	–	–	–	**–**	**–**	**3**	**2**
S12	02/14/14	25 41 39.90	68 20 07.50	River/ Riparian	–	1	1	–	–	–	–	–	–	–	1	1	**–**	**–**	**2**	**2**

Table 5-3: Small Mammals Trapping Data, Survey Conducted February 2014

ID	*Date*	*Latitude*	*Longitude*	*Habitat*	*Wind*	*Cloud %*	*Mus Musculus*	*Rattus rattus*	*Suncus Murinus*	***Total***	***No of Species***	***Traps***
S3	02/16/14	25 40 12.10	68 19 22.20	Agricultural Fields	Light	10%	2	1	1	4	3	40
S10	02/16/14	25 39 38.80	68 18 08.26	Agricultural Fields	Light	–	2	2	–	4	2	40
S6	02/14/14	25 42 19.40	68 19 13.60	River/ Riparian	Light	–	–	–	1	1	1	40
							4	**3**	**2**	**9**	**3**	**120**

Table 5-4: Herpeto-fauna Field Data, Survey Conducted February 2014

ID	*Date*	*Latitude*	*Longitude*	*Habitat*	*Acanthodactylus cantoris*	*Calotes v. versicolor*	*Cyrtopodion scabrum*	*Euphlyctis cyanophlyctis*	*Eutropis dissimilis*	*Naja naja*	*Nilssonia gangetica*	*Pangshura smitii*	*Pangshura tecta*	*Platyceps v. ventromaculatus*	*Spalerosophis atriceps*	*Trapelus agilis*	*Varanus bengalensis*	***Abundance***	***Diversity***
S9	02/15/14	25 44 20.20	68 19 14.40	Agricultural Fields	–	–	–	–	1	–	–	–	–	–	–	–	–	1	1
S3	02/16/14	25 40 12.10	68 19 22.20	Agricultural Fields	–	–	–	–	1	–	–	–	–	–	–	–	1	2	2
S10	02/16/14	25 39 38.80	68 18 08.26	Agricultural Fields	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
S7	02/15/14	25 44 28.90	68 15 33.30	Hills	–	–	2	–	–	–	–	–	–	1	–	1	–	4	3
S4	02/15/14	25 42 16.30	68 15 02.30	Hills	–	–	1	–	–	–	–	–	–	–	–	–	–	1	1
S1	02/16/14	25 40 09.10	68 14 54.90	Hills	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
S8	02/14/14	25 44 46.40	68 17 20.50	Plains	–	–	2	–	–	–	–	–	–	–	–	1	–	3	2
S5	02/16/14	25 42 18.40	68 16 22.50	Plains	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
S2	02/16/14	25 40 17.10	68 16 55.10	Plains	–	–	–	–	–	–	–	–	–	–	–	1	–	1	1
S6	02/14/14	25 42 19.40	68 19 13.60	River/ Riparian	2	–	–	3	–	–	2	1	5	–	–	–	–	13	5
S12	02/14/14	25 41 39.90	68 20 07.50	River/ Riparian	–	1	–	–	1	1	2	–	3	–	1	–	2	11	7
S11	02/16/14	25 42 40.40	68 18 07.30	River/ Riparian	–	2	–	–	–	1	–	–	–	–	–	–	–	3	2
					2	**3**	**5**	**3**	**3**	**2**	**4**	**1**	**8**	**1**	**1**	**3**	**3**	**39**	**13**

Table 5-5: Birds Field Data, Survey Conducted February 2014

ID	*Date*	*Coordinates*		*Habitat*	*Prinia socialis*	*Himantopus himantopus*	*Dicrurus macrocercus*	*Pterocles orientalis*	*Bubulcus ibis*	*Upapa epops*	*Apus apus*	*Ammomanes deserti*	*Circus aeruginosus*	*Casmerodius albus*	*Centropus sinensis*	*Corvus splendens*	*Passer domesticus*	*Ardeola grayii*	*Phalacrocorax niger*	*Egretta garzetta*	*Tachybaptus ruficollis*	*Calidris minuta*	*Ceryle rudis*	*Hirundo daurica*	*Vanellus indicus*	*Streptopelia senegalensis*	*Sterna aurantia*	*Columba livia*	*Alauda gulgula*	*Aquila rapax nipalensis*	*Motacilla alba*	***Total***	***Species Count***
		Lat	*Long*		*Ashy Prinia*	*Balck Wing Stilt*	*Black Drongo*	*Black-bellied Sandgrouse*	*Cattle Egret*	*Common Hoopoe*	*Common Swift*	*Desert Lark*	*Eurasian Marsh Harrier*	*Great Egret*	*Greater Coucal*	*House Crow*	*House Sparrow*	*Indian Pond Heron*	*Little Cormorant*	*Little Egret*	*Little grebe*	*Little Stint*	*Pied Kingfisher*	*Red-rumped Swallow*	*Red-Wattled Lapwing*	*Little Brown Dove or Laughing Dove*	*River Tern*	*Rock Pigeon or Blue Rock Pigeon*	*Small Skylark or Oriental Skylark*	*Steppe Eagle*	*White Wagtail*		
S9	2/15/14	25 44 20.20	68 19 14.40	Agricultural Fields	–	–	–	–	–	2	–	–	2	2	–	–	–	–	–	–	–	1	–	–	–	–	5	–	–	–	–	**12**	**5**
S3	2/16/14	25 40 12.10	68 19 22.20	Agricultural Fields	–	–	–	–	5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7	–	15	–	–	–	**27**	**3**
S10	2/16/14	25 39 38.80	68 18 8.26	Agricultural Fields	–	–	–	–	–	–	–	2	–	–	–	10	20	–	–	–	–	–	–	–	–	8	–	–	–	–	–	**40**	**4**
S8	2/14/14	25 44 46.40	68 17 20.50	Plains	–	–	–	–	–	–	–	5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**5**	**1**
S5	2/16/14	25 42 18.40	68 16 22.50	Plains	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	20	–	1	–	**21**	**2**
S2	2/16/14	25 40 17.10	68 16 55.10	Plains	–	–	–	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7	–	–	–	**22**	**2**
S7	2/15/14	25 44 28.90	68 15 33.30	Hills	–	–	–	–	–	–	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7	–	–	–	**10**	**2**
S4	2/15/14	25 42 16.30	68 15 2.30	Hills	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**2**	**1**
S1	2/16/14	25 40 9.10	68 14 54.90	Hills	1	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**2**	**2**
S6	2/14/14	25 42	68 19	River/	–	1	–	–	2	–	20	–	–	–	–	–	–	–	–	3	–	1	1	–	–	–	–	–	10	–	–	**38**	**7**

ID	Date	Coordinates		Habitat	*Prinia socialis*	*Himantopus himantopus*	*Dicrurus macrocercus*	*Pterocles orientalis*	*Bubulcus ibis*	*Upapa epops*	*Apus apus*	*Ammomanes deserti*	*Circus aeruginosus*	*Casmerodius albus*	*Centropus sinensis*	*Corvus splendens*	*Passer domesticus*	*Ardeola grayii*	*Phalacrocorax niger*	*Egretta garzetta*	*Tachybaptus ruficollis*	*Calidris minuta*	*Ceryle rudis*	*Hirundo daurica*	*Vanellus indicus*	*Streptopelia senegalensis*	*Sterna aurantia*	*Columba livia*	*Alauda gulgula*	*Aquila rapax nipalensis*	*Motacilla alba*	***Total***	***Species Count***
		Lat	*Long*		*Ashy Prinia*	*Balck Wing Stilt*	*Black Drongo*	*Black-bellied Sandgrouse*	*Cattle Egret*	*Common Hoopoe*	*Common Swift*	*Desert Lark*	*Eurasian Marsh Harrier*	*Great Egret*	*Greater Coucal*	*House Crow*	*House Sparrow*	*Indian Pond Heron*	*Little Cormorant*	*Little Egret*	*Little grebe*	*Little Stint*	*Pied Kingfisher*	*Red-rumped Swallow*	*Red-Wattled Lapwing*	*Little Brown Dove or Laughing Dove*	*River Tern*	*Rock Pigeon or Blue Rock Pigeon*	*Small Skylark or Oriental Skylark*	*Steppe Eagle*	*White Wagtail*		
		19.40	13.60	Riparian																													
S12	2/14/14	25 41 39.90	68 20 07.50	River/ Riparian	–	–	1	–	–	1	–	–	–	–	–	–	–	7	–	–	–	–	–	150	7	–	–	–	–	–	–	**166**	**5**
S11	2/16/14	25 42 40.40	68 18 07.30	River/ Riparian	2	–	–	–	–	–	20	–	–	–	1	–	–	–	5	8	20	11	7	–	–	–	–	–	–	–	4	**78**	**9**
				Total	**3**	**1**	**1**	**15**	**7**	**3**	**40**	**13**	**2**	**2**	**1**	**10**	**20**	**7**	**5**	**11**	**20**	**13**	**8**	**150**	**7**	**15**	**5**	**49**	**10**	**1**	**4**	**423**	**27**

Table 5-6: Fish Data, Survey Conducted February 2014

Locality/ Site	*Coordinates*			*Gudusia chapra*	*Tenualosa ilisha*	*Chitala chitala*	*Notopterus notopterus*	*Chela cachius*	*Salmophasia bacaila*	*Securicula gora*	*Amblypharyngodonmola*	*Aspidoparia morar*	*Barilius vagra*	*Esomus danricus*	*Cirrhinus mrigala*	*Cirrhinus reba*	*Gibelion catla*	*Labeo calbasu*	*Labeo gonius*	*Labeo rohita*	*Osteobrama cotio*	*Puntius sophore*	*Puntius ticto*	*Cyprinus carpio*	*Mystus bleekeri*	*Mystus cavasius*	*Mystus vittatus*	*Bagarius bagarius*	*Ompok pabda*	*Wallago attu*	*Heteropneuste sfossilis*	*Ailia coila*	*Clupisoma garua*	*Eutropiichthys vacha*	*Xenentodon cancila*	*Channa marulia*	*Channa punctata*	*Chanda nama*	*Parambasis baculis*	*Parambasis ranga*	*Glossogobius giuris*	*Oreochromis mossambicus*	*Mastacembelus armatus*	***Abundance***	***Species Count***
	Latitude	*Longitude*	*Habitat*																																										
F1	25 44 39.24	68 19 00.00		2	–	1	1	3	5	–	1	–	2	1	3	–	–	2	1	1	2	3	2	2	4	1	–	–	2	–	–	–	–	–	1	–	–	2	1	1	–	4	–	**48**	**24**
F2	25 43 45.37	68 19 35.25		–	–	–	–	2	–	1	–	–	–	–	–	2	–	1	–	–	3	–	–	–	2	1	–	–	–	–	–	–	–	1	–	–	–	3	2	–	–	–	–	**18**	**10**
F3	25 42 38.23	68 19 11.47		2	–	–	1	1	–	–	–	1	–	–	1	–	–	1	1	1	1	–	–	–	3	–	–	–	–	2	–	3	1	3	1	–	–	1	1	–	–	–	–	**25**	**17**
F4	25 42 40.69	68 18 13.32		–	–	–	–	2	2	–	2	–	–	1	–	1	1	2	–	–	2	4	5	–	1	–	3	–	2	–	2	–	–	–	–	–	2	2	1	2	2	3	1	**43**	**21**
F5	25 41 46.48	68 20 00.00		–	1	–	2	–	–	1	–	–	–	–	–	2	–	2	3	–	2	–	–	–	4	2	–	2		1	–	1	–	–	–	1	–	–	1	1	–	–	–	**26**	**15**
Total				**4**	**1**	**1**	**4**	**8**	**7**	**2**	**3**	**1**	**2**	**2**	**4**	**5**	**1**	**8**	**5**	**2**	**10**	**7**	**7**	**2**	**14**	**4**	**3**	**2**	**4**	**3**	**2**	**4**	**1**	**4**	**2**	**1**	**2**	**8**	**6**	**4**	**2**	**7**	**1**	**160**	

Appendix 6: ECOLOGICAL BASELINE - SPECIES LIST

Table 6-1: List of Reptile and Amphibian Species in the Study Area Surveys Conducted February 2014

	Scientific Name	*Common Name*	*Conservation Status*			*Observed/ Reported*
			Endemism	*IUCN Status*[1]	*CITES Appendix*[2]	
	Agamidae					
1.	*Trapelus agilis pakistanensis*	Pakistan's Brilliant Ground Agama		Not evaluated		Observed
2.	*Trapelus megalonyx*	Afghan Ground Agama		Not evaluated		Reported
3.	*Trapelus rubrigularis*	Red-throated Ground Agama		Not evaluated		Reported
4.	*Calotes versicolor*	Indian Garden Lizard		Not evaluated		Observed
	Boidae					
5.	*Eryx johnii*	Common Sand Boa		Not evaluated	II	Reported
6.	*Gongylophis conicus*	Russell's Sand Boa		Not evaluated	II	Reported
	Bufinidae					
7.	*Duttaphrynus stomaticus*	Indus or Marbled Toad		Least Concern		Reported
	Colubridae					
8.	*Amphiesma stolatum*	Striped keel-back		Not evaluated		Reported
9.	*Argyrogena fasciolata*	Banded Racer		Not evaluated		Reported
10.	*Lycodons striatus*	Spotted Wolf Snake		Not evaluated		Reported
11.	*Oligodon a. arnensis*	Banded kukri snake		Not evaluated		Reported
12.	*Platyceps v ventromaculatus*	Glossy bellied Racer		Not evaluated		Observed
13.	*Platyceps rhodorachis*	Cliff/Mountain Racer		Not evaluated		Reported
14.	*Psammophis l. leithii*	Sindhi ribbon snake		Not evaluated		Reported

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[1] IUCN 2013. IUCN Red List of Threatened Species. Version 2013.2. <www.iucnredlist.org>. Downloaded on 10 March 2014

[2] UNEP-WCMC. 20 February 2014. UNEP-WCMC Species Database: CITES-Listed Species

	Scientific Name	*Common Name*	*Conservation Status*			*Observed/ Reported*
			Endemism	*IUCN Status*[1]	*CITES Appendix*[2]	
15.	*Ptyas mucosus*	Dhaman		Not evaluated	II	Reported
16.	*Spalerosophis arenarius*	Red-spotted diadem snake		Not evaluated		Reported
17.	*Spalerosophis atriceps*	Royal Snake		Not evaluated		Observed
18.	*Xenochrophis piscator*	Checkered Keel Back		Not evaluated	III	Reported
	Dicroglossidae					
19.	*Euphlyctis cyanophylyctis*	Skittering Frog		Not evaluated		Observed
20.	*Hoplobatrachus tigerinus*	Bull Frog		Least Concern	II	Reported
21.	*Zakerana syhadrensis*	Southern Cricket Frog		Least Concern		Reported
	Elapidae					
22.	*Naja naja*	Indian Cobra		Not evaluated	II	Observed
23.	*Bungarus caeruleus*	Indian Krait		Not evaluated		Reported
	Eublepharidae					
24.	*Eublepharis macularius*	Fat-tailed Gecko		Not evaluated		Reported
	Gekkonidae					
25.	*Cyrtopodion scabrum*	Rough Bent-toed Gecko		Least Concern		Observed
26.	*Hemidactylus brookii*	Spotted Indian House Gecko				Reported
27.	*Hemidactylus flaviviridis*	Yellow-bellied House Gecko				Reported
	Geoemydidae					
28.	*Geoclemys hamiltonii*	Spotted Pond Turtle		**Vulnerable**	I	Reported
29.	*Hardella thurjii*	Common River Turtle		**Vulnerable**	II	Reported

	Scientific Name	*Common Name*	*Conservation Status*			*Observed/ Reported*
			Endemism	*IUCN Status*[1]	*CITES Appendix*[2]	
30.	*Pangshura smithii*	Brown Roofed Turtle		**Near Threatened**	II	Observed
31.	*Pangshura tecta*	Indian Roofed Turtle		Least Concern	I	Observed
	Lacertidae					
32.	*Eremias cholistanica*	Cholistan Desert Lacerta	Endemic	Not evaluated		Reported
33.	*Acanthodactylus cantoris*	Indian Fringe-toed Sand Lizard		Not evaluated		Reported
34.	*Ophisops jerdonii*	Punjab Snake-eyed Lacerta		Least concern		Reported
	Scincidae					
35.	*Eurylepis taeniolatus*	Yellow-bellied Mole Skink		Not evaluated		Reported
36.	*Eutropis dissimilis*	Striped Glass Skink		Not evaluated		Observed
37.	*Eutropis macularia*	Bronze Grass Skink		Not evaluated		Reported
38.	*Ophiomorus tridactylus*	Three Toed Sand Swimmer		Not evaluated		Reported
	Trionychidae					
39.	*Chitra indica*	Narrow-headed Soft-shell Turtle		**Endangered**	I	Reported
40.	*Lissemys punctata andersoni*	Indian Flap Shell Turtle		Least concern	II	Reported
41.	*Nilssonia gangetica*	Indian Softshell Turtle		**Vulnerable**	I	Observed
42.	*Nilssonia hurum*	Peacock Soft-shell Turtle		**Vulnerable**	I	Reported
	Typhlopidae					
43.	*Typhlops porrectus*	Slender Worm Snake		Not evaluated		Reported

	Scientific Name	*Common Name*	*Conservation Status*			*Observed/ Reported*
			Endemism	*IUCN Status*[1]	*CITES Appendix*[2]	
44.	**Uromastycidae**					
45.	*Saara hardwickii*	Indian Spiny-tailed Ground Lizard		Not evaluated	II	Reported
	Varanidae					
46.	*Varanus bengalensis*	Bengal Monitor Lizard		Least concern	I	Observed
47.	*Varanus griseus koniecznyi*	Indo-Pak Desert Monitor		Not evaluated	I	Reported
	Viperidae					
48.	*Daboia russelii*	Russel's Viper		Not evaluated	III	Reported
49.	*Echis carinatus sochureki*	Sochurek's Saw Scaled Viper		Not evaluated		Reported

Table 6-2: List of Mammal Species in the Study Area Surveys Conducted February 2014

No.	*Scientific Name*	*Common Name*	*Conservation Status*		
			National Status[3]	*IUCN Status*[4]	*CITES Appendix*[5]
	Canidae				
1.	*Canis aureus*	Asiatic Jackal	Near Threatened	Least Concern	**III**
2.	*Vulpes bengalensis*	Bengal Fox	**Near Threatened**	Least Concern	**III**
3.	*Vulpes vulpes*	Common Red Fox	Near Threatened	Least Concern	**III**
	Ericinaceidae				
4.	*Hemiechinus collaris*	Long-eared Desert Hedgehog	Least Concern	Least Concern	
	Felidae				
5.	*Felis chaus*	Jungle Cat	Least Concern	Least Concern	II
	Herpestidae				
6.	*Herpestes edwardsii*	Grey Mongoose	Least Concern	Least Concern	III
7.	*Herpestes javanicus*	Small Indian Mongoose	Least Concern	Least Concern	III
	Hystricidae				
8.	*Hystrix indica*	Indian Crested Porcupine	**Near Threatened**	Least Concern	
	Leporidae				
9.	*Lepus nigricollis*	Desert Hare or Indian Hare	Least Concern	Least Concern	
	Muridae				
10.	*Mus musculus*	House Mouse	Least Concern	Least Concern	
11.	*Tatera indica*	Indian Gerbil	Least Concern	Least Concern	

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[3] Status and Red List of Pakistan Mammals. 2006. Biodiversity Programme IUCN Pakistan

[4] IUCN 2013. IUCN Red List of Threatened Species. Version 2013.2. <www.iucnredlist.org>. Downloaded on 10 March 2014.

[5] UNEP-WCMC. 4 March 2014. UNEP-WCMC Species Database: CITES-Listed Species

No.	*Scientific Name*	*Common Name*	*Conservation Status*		
			National Status[3]	*IUCN Status*[4]	*CITES Appendix*[5]
12.	*Bandicota bengalensis*	Indian Mole Rat	Least Concern	Least Concern	
13.	*Rattus rattus*	Roof Rat	Least Concern	Least Concern	
14.	*Nesokia indica*	Short Tailed Mole Rat	Least Concern	Least Concern	
	Mustellidae				
15.	*Lutrogale perspicillata*	Smooth Coated Otter	**Near Threatened**	**Vulnerable**	**II**
	Platanistidae				
16.	*Platanista minor*	Indus Blind Dolphin	**Endangered**	**Endangered**	
	Sciuridae				
17.	*Funambulus pennantii*	Palm Squirrel	Least Concern	Least Concern	
	Soricidae				
18.	*Suncus murinus*	House Shrew	Least Concern	Least Concern	
	Suidae				
19.	*Sus scrofa*	Indian Wild Boar	Least Concern	Least Concern	
	Vespertilionidae				
20.	*Pipistrellus kuhlii*	Kuhl's Bat	Least Concern	Least Concern	
	Viverridae				
21.	*Viverricula indica*	Small Indian Civet	**Near Threatened**	Least Concern	

Table 6-3: List of Bird Species in the Study Area, Surveys Conducted February 2014

	Scientific name	*Common Name*	*IUCN Status*[6]	*CITES Appendix*[7]	*Observed/ Reported*	*Status in Study Area*
	Accipitridae					
1.	*Circus aeruginosus*	Eurasian Marsh Harrier	Least Concern		Observed	Winter Migrant
2.	*Aquila rapax nipalensis*	Steppe Eagle	Least Concern	II	Observed	Winter Migrant
3.	*Milvus migrans*	Black Kite	Least Concern	II	Reported	Year-Round Resident
4.	*Elanus caeruleus*	Black-shouldered Kite	Least Concern	II	Reported	Year-Round Resident
	Acrocephalidae					
5.	*Acrocephalus dumetorum*	Blyth's Reed Warbler	Least Concern		Reported	Passage Migrant
	Alaudidae					
6.	*Ammomanes deserti*	Desert Lark	Least Concern		Observed	Year-Round Resident
7.	*Alauda gulgula*	Small Skylark or Oriental Skylark	Least Concern		Observed	Year-Round resident
	Alcedinidae					
8.	*Alcedo atthis*	Common Kingfisher	Least Concern	Not Listed	Reported	Year-Round Resident
	Anatinae					
9.	*Aythya ferina*	Common Pochard	Least Concern	Not Listed	Reported	Winter Migrant
10.	*Anas crecca*	Common Teal	Least Concern	Not Listed	Reported	Winter Migrant

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[6] IUCN 2013. IUCN Red List of Threatened Species. Version 2013.2. <www.iucnredlist.org>. Downloaded on 10 March 2014.

[7] UNEP-WCMC. 4 March 2014. UNEP-WCMC Species Database: CITES-Listed Species

	Scientific name	*Common Name*	*IUCN Status*[6]	*CITES Appendix*[7]	*Observed/ Reported*	*Status in Study Area*
11.	*Anas penelope*	Eurasian Wigeonl	Least Concern	Not Listed	Reported	Winter Migrant
12.	*Anas strepera*	Gadwall	Least Concern	Not Listed	Reported	Winter Migrant
13.	*Anas querquedula*	Garganey	Least Concern	Not Listed	Reported	Winter Migrant
14.	*Anas clypeata*	Northern Shoveler	Least Concern	Not Listed	Reported	Winter Migrant
	Apodidae					
15.	*Apus apus*	Common Swift	Least Concern	Not Listed	Observed	Summer Visitor
	Ardeidae					
16.	*Casmerodius albus*	Great Egret	Least Concern	Not Listed	Observed	Winter Migrant
17.	*Ardeola grayii*	Indian Pond Heron	Least Concern		Observed	Year-Round Resident
18.	*Egretta garzetta*	Little Egret	Least Concern	Not Listed	Observed	year-Round Resident /passage migrant
19.	*Bubulcus ibis*	Cattle Egret	Least Concern	Not Listed	Observed	Year-Round Resident
20.	*Ardea cinerea*	Grey Heron	Least Concern	Not Listed	Reported	Winter Migrant
	Cerylidae					
21.	*Ceryle rudis*	Pied Kingfisher	Least Concern	Not Listed	Observed	Year-Round Resident
	Charadriidae					
22.	*Vanellus indicus*	Red-Wattled Lapwing	Least Concern		Observed	Year-Round Resident
	Cisticolidae					
23.	*Prinia socialis*	Ashy Prinia	Least Concern		Observed	Year-Round Resident

	Scientific name	*Common Name*	*IUCN Status*[6]	*CITES Appendix*[7]	*Observed/ Reported*	*Status in Study Area*
	Columbidae					
24.	*Streptopelia senegalensis*	Laughing Dove	Least Concern		Observed	not found in the book
25.	*Streptopelia decaocto*	Eurasian Collared-dove or Collared Dove	Least Concern		Reported	Year-Round Resident
26.	*Columba livia*	Rock Pigeon or Blue Rock Pigeon	Least Concern	Not Listed	Reported	Year-Round Resident
	Corvidae					
27.	*Corvus splendens*	House Crow	Least Concern		Observed	Year-Round Resident
	Cuculidae					
28.	*Centropus sinensis*	Greater Coucal	Least Concern		Observed	Year-Round Resident
	Dicruridae					
29.	*Dicrurus macrocercus*	Black Drongo	Least Concern		Observed	Year-Round Resident
	Glareolidae					
30.	*Glareo lalactea*	Pratincole	Least Concern		Reported	Summer Migrant
	Gruidae					
31.	*Grus grus*	Common Crane	Least Concern	II	Reported	Passage Migrant
	Halcyonidae					
32.	*Halcyon smyrnensis*	White-throated Kingfisher	Least Concern	Not Listed	Reported	Year-Round Resident
	Hirundinidae					
33.	*Hirundo daurica*	Red-rumped Swallow	Least Concern		Observed	Passage Migrant

	Scientific name	*Common Name*	*IUCN Status*[6]	*CITES Appendix*[7]	*Observed/ Reported*	*Status in Study Area*
	Laridae					
34.	*Larus ridibundus*	Black-headed Gull	Least Concern		Reported	Winter Migrant
35.	*Larus cachinnans*	Caspian Gull	Least Concern	Not Listed	Reported	Winter Migrant
	Meropidae					
36.	*Merops orientalis*	Little Green Bee-eater	Least Concern		Reported	Year-Round Resident
	Motacillidae					
37.	*Motacilla alba*	White Wagtail	Least Concern	Not Listed	Observed	Winter Migrant
38.	*Motacilla alba*	White Wagtail	Least Concern	II	Reported	Winter Migrant
39.	*Motacilla flava*	Yellow wagtail	Least Concern	Not Listed	Reported	Passage Migrant
	Muscicapidae					
40.	*Oenanthe picata*	Variable Wheatear	Least Concern		Reported	Winter Migrant
	Nectariniidae					
41.	*Nectarinia asiatica*	Purple Sunbird	Least Concern		Reported	Year-Round Resident
	Passerdidae					
42.	*Petronia xanthocollis*	Chestnut-shouldered Pretonia	Least Concern		Reported	Summer Breeder/ Migrant
43.	*Passer domesticus*	House Sparrow	Least Concern		Observed	Year-Round Resident
	Phalacrocoracidae					
44.	*Phalacrocorax niger*	Little Cormorant	Least Concern		Observed	Year-Round Resident
45.	*Phalacrocorax carbo*	Great Cormorant	Least Concern	Not Listed	Reported	Winter Migrant

	Scientific name	*Common Name*	*IUCN Status*[6]	*CITES Appendix*[7]	*Observed/ Reported*	*Status in Study Area*
	Phylloscopidae					
46.	*Phylloscopus collybita*	Common Chiffchaff	Least Concern		Reported	Winter Migrant
	Podicipedidae					
47.	*Tachybaptus ruficollis*	Little Grebe	Least Concern	Not Listed	Observed	Year-Round Resident
	Pteroclididae					
48.	*Pterocles orientalis*	Black-bellied Sandgrouse	Least Concern	Not Listed	Observed	Winter Migrant
	Pycnonotidae					
49.	*Pycnonotus cafer*	Red-vented Bulbul	Least Concern		Reported	Year-Round Resident
50.	*Pycnonotus leucotis*	White-eared Bulbul	Least Concern		Reported	Year-Round Resident
	Rallidae					
51.	*Fulica Atra*	Common Coot	Least Concern		Reported	Winter Migrant
52.	*Gallinula chloropus*	Common Moorhen	Least Concern		Reported	Year-Round Resident
	Recurvirostridae					
53.	*Himantopus himantopus*	Balck Wing Stilt	Least Concern	Not Listed	Observed	Year-Round Resident
	Rynchopidae					
54.	*Rynchops albicollis*	Indian Skimmer	Vulnerable		Reported	Summer Breeder
	Scolopacidae					
55.	*Calidris minuta*	Little Stint	Least Concern	Not Listed	Observed	Passage Migrant
56.	*Tringa nebularia*	Common Greenshank	Least Concern	Not Listed	Reported	Winter Migrant
57.	*Actitis hypoleucos*	Common Sandpiper	Least Concern	Not Listed	Reported	Winter Migrant

	Scientific name	*Common Name*	*IUCN Status*[6]	*CITES Appendix*[7]	*Observed/ Reported*	*Status in Study Area*
	Sternidae					
58.	*Sterna aurantia*	River Tern	Near Threatened		Observed	Winter Migrant
	Sturnidae					
59.	*Acridotheres ginginianus*	Bank Myna	Least Concern		Reported	Year-Round Resident
60.	*Acridotheres tristis*	Common Myna	Least Concern		Reported	Year-Round Resident
61.	*Sturnus roseus*	Rosy Starling	Least Concern		Reported	Passage Migrant
	Sylviidae					
62.	*Sylvia nana*	Desert Warbler	Least Concern		Reported	Winter Migrant
	Timaliidae					
63.	*Turdoides caudatus*	Common Babbler	Least Concern		Reported	Year-Round Resident
64.	*Turdoides earlei*	Striated Babbler	Least Concern		Reported	Year-Round Resident
	Upupidae					
65.	*Upupa epops*	Common Hoopoe	Least Concern		Observed	Winter Migrant

Table 6-4: List of Fish Species in the Study Area, Surveys Conducted February 2014

Nos.	*Scientific Name*	*Common name*	*Max. size (cm)*	*Commercial value*	*IUCN status*[8]	*Status in the project area*
	Clupeidae					
1.	*Gudusia chapra*	Indian River Shad	20	Non	Least Concern	Common
2.	*Tenualosa ilisha*	Hilsa Shad (Palla)	60	Very high	Not evaluated	Rare
	Notopteridat					
3.	*Chitala chitala*	Humped Featherback	120	High	**Near Threatened**	Rare
4.	*Notopterus notopterus*	Grey Featherback	25	Low	Least Concern	Common
	Cyprinidae/Cultrinae					
5.	*Chela cachius*	Silver Hatchet Chela	6	Low	Least Concern	Common
6.	*Salmophasia bacaila*	Large Razorbelly Minnow	15	Low	Least Concern	Common
7.	*Securicula gora*	Gora Chela	22	Low	Least Concern	Common
	Cyprinidae/ Rasborinae					
8.	*Amblypharyngodonmola*	Mola Carplet	20	Low	Least Concern	Common
	Cyprinidae/ Aspidoparinae					
9.	*Aspidoparia morar*	Carplet, aspidoparia	17	Low	Least Concern	Common
	Cyprinidae/ Rasborinae					
10.	*Barilius vagra*	Vagra Baril	12	Low	Least Concern	Common

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[8] IUCN 2013. IUCN Red List of Threatened Species. Version 2013.2. <www.iucnredlist.org>. Downloaded on 10 March 2014.

Nos.	*Scientific Name*	*Common name*	*Max. size (cm)*	*Commercial value*	*IUCN status*[8]	*Status in the project area*
11.	*Esomus danricus*	Flying Barb	9	Low	Least Concern	Common
	Cyprinidae/Barbinae					
12.	*Cirrhinus mrigala*	Mrigal	100	Very high	Least Concern	Common
13.	*Cirrhinus reba*	Reba Carp	30	Low	Least Concern	Common
14.	*Gibelion catla*	Catla	180	Very high	Least Concern	Common
15.	*Labeo calbasu*	Orange Fin Labeo	90	Low	Least Concern	Common
16.	*Labeo gonius*	Kuria Labeo	150	Low	Least Concern	Common
17.	*Labeo rohita*	Rohu	200	Very high	Least Concern	Common
18.	*Osteobrama cotio*	Cotio	15	Low	Least Concern	Common
19.	*Puntius sophore*	Spotfin Swamp Barb	17	Low	Least Concern	Common
20.	*Puntius ticto*	Scarlet Barb	10	Low	Least Concern	Common
	Cyprinidae/ Cyprininae					
21.	*Cyprinus carpio*	Common Carp	120	Very high	**Vulnerable**	Common
	Bagridae/ Bagrinae					
22.	*Mystus bleekeri*	Day's Mystus	15	Low	Least Concern	Common
23.	*Mystus cavasius*	Gangetic Mystus	40	High	Least Concern	Common
24.	*Mystus vittatus*	Striped Dwarf Catfish	21	Low	Least Concern	Common
	Sisoridae					
25.	*Bagarius bagarius*	Gangetic Goonch	250	High	**Near Threatened**	Common

Nos.	*Scientific Name*	*Common name*	*Max. size (cm)*	*Commercial value*	*IUCN status*[8]	*Status in the project area*
	Siluridae					
26.	*Ompok pabda*	Pabdah Catfish	45	Low	**Near Threatened**	Common
27.	*Wallago attu*	Freshwater Shark	240	Very high	**Near Threatened**	Common
	Heteropneustidae					
28.	*Heteropneuste sfossilis*	Stinging Catfish	30	Low	Least Concern	Common
	Schilbeidae/ Ailininae					
29.	*Ailia coila*	Gangeti Cailia	30	Low	**Near Threatened**	Common
	Schilbeidae/ Schilbeinae					
30.	*Clupisoma garua*	Garua Bachcha	60	Very high	Least Concern	Common
31.	*Eutropiichthys vacha*	Batchwa Vacha	40	High	Least Concern	Common
	Belonidae					
32.	*Xenentodon cancila*	Freshwater Garfish	40	Low	Least Concern	Common
	Channidae					
33.	*Channa marulia*	Great Snakehead	180	Very high	Least Concern	Common
34.	*Channa punctata*	Spotted Snakehead	30	Low	Least Concern	Common
35.	*Chanda nama*	Elongate Glass Perchlet	10	Low	Least Concern	Common
36.	*Parambasis baculis*	Himalayan Glassy Perchlet	5	Low	Least Concern	Common
37.	*Parambasisranga* (Hamilton, 1822)	Glassy fish	8	Low	Least Concern	Common

Nos.	*Scientific Name*	*Common name*	*Max. size (cm)*	*Commercial value*	*IUCN status*[8]	*Status in the project area*
	Gobiidae					
38.	*Glossogobius giuris*	Tank Goby	35	Low	Least Concern	Common
	Cichlidae					
39.	*Oreochromis mossambicus*	Mozambique Tilapia	39	High	**Near Threatened**	Common
	Mastacembelidae					
40.	*Mastacembelus armatus*	Zig-Zag Eel	90	Low	Least Concern	Common

Table 6-5: List of Vegetation Species in the Study Area, Surveys Conducted February 2014

Species	*Life Form*	*Status*
Monocotyledoneae		
Poaceae		
Aristida adscensionis	Grass	Common
Aristida funiculata	Grass	Common
Chrysopogon aucherii	Grass	Infrequent
Lasiurus scindica	Grass	Infrequent
Ochthohloa compressa	Grass	Very common
Saccharum spontaneum	Grass	Very common
Typhacea		
Typha sp.	Sedge	Very common
Dicotyledoneae		
Apocynaceae		
Rhazia stricta	Shrub	Infrequent
Asclepiadaceae		
Periploca aphylla	Shrub	Infrequent
Asteraceae		
Iphiona grantioides	Chemophyte	Infrequent
Capparidaceae		
Capparis decidua	Tree	Infrequent
C. spinosa	Shrub	Infrequent
Convolvulaceae		
Seddera latifolia	Shrub	Common
Cucurbitaceae		
Citrullus colocynthis	Therophyte	Infrequent

Species	*Life Form*	*Status*
Mimosaceae		
Prosopis cineraria	Tree	Infrequent
P. glandulosa	Shrub	Very Common
P. juliflora	Shrub	Very Common
Papilionaceae		
Indigofera cordifolia	Herb	Infrequent
Rhamnaceae		
Ziziphus mauritiana	Tree	Infrequent
Z. nummularia	Tree	Common
Solanaceae		
Solanum soratans	Shrub	Common
Tamaricacea		
Tamarix dioica	Shrub	Very Common
Zygophyllaceae		
Fagonia indica var. indica	Herb	Common
F. indica var. schweinfurthii	Herb	Common
Tribulus terrestaris	Herb	Common

Appendix 7: TRAFFIC DATA

Direction 01: **Badin to Mithi** **Point No. 7**
Coordinates: 24 38 28.2N 69 20 47.9E

Date	Time	Bikes	Cars	Pickups	Buses	Truck (2X)	Truck (3X)	Truck (4X)	Truck (5X)	Truck (6X)	Trailer
	PCU	0.5	1	2	2	3	3	3	3	3	3
2014/3/12	12:00 to 13:00	2	8	5			1				
2014/3/12	13:00 to 14:00	9	10	20	1	7	2			1	
2014/3/12	14:00 to 15:00	9	5	9			4			1	
2014/3/12	15:00 to 16:00	14	9	3		1					
2014/3/12	16:00 to 17:00	11	6	5		1	3			2	
2014/3/12	17:00 to 18:00	4	4	6		2	1				
2014/3/12	18:00 to 19:00	13	8	8			11			1	
2014/3/12	19:00 to 20:00	2	3	5		1	6			3	
2014/3/12	20:00 to 21:00	1	1	5		2					
2014/3/12	21:00 to 22:00	3	2			1					
2014/3/12	22:00 to 23:00	3	1	2		6	1				
2014/3/12	23:00 to 00:00		4	1		1				3	
2014/3/12	00:00 to 01:00		1	4							
2014/3/13	01:00 to 02:00			3		1					
2014/3/13	02:00 to 03:00						1			1	
2014/3/13	03:00 to 04:00					2	1			2	
2014/3/13	04:00 to 05:00					3				2	
2014/3/13	05:00 to 06:00			2	1	3	3			6	
2014/3/13	06:00 to 07:00			2			2			1	
2014/3/13	07:00 to 08:00			3		6	2			1	2
2014/3/13	08:00 to 09:00	7	2	5		2					1
2014/3/13	09:00 to 10:00	9	7	10		7	2				
2014/3/13	10:00 to 11:00	6	6	4		5	5				
2014/3/13	11:00 to 12:00	14	14	10	6	6	2			5	
	24hrs	107	91	112	8	57	47	0	0	29	3

Direction 02: **Mithi to Badin** **Point No. 7**
Coordinates: 24 38 28.2N 69 20 47.9E

Date	Time	Bikes	Cars	Pickups	Buses	Truck (2X)	Truck (3X)	Truck (4X)	Truck (5X)	Truck (6X)	Trailer
	PCU	0.5	1	2	2	3	3	3	3	3	3
2014/3/12	12:00 to 13:00	5	4	5		3	2				
2014/3/12	13:00 to 14:00	7	5	5		3	2				
2014/3/12	14:00 to 15:00	17	9	8	1	1	2			1	
2014/3/12	15:00 to 16:00	13	5	4	1	1	4	3		3	
2014/3/12	16:00 to 17:00	15	9	8		3	1				
2014/3/12	17:00 to 18:00	13	2	9		4	2				
2014/3/12	18:00 to 19:00	13	9	8			1				3
2014/3/12	19:00 to 20:00	4	9	2		1	2			3	
2014/3/12	20:00 to 21:00	5	4	5		5					
2014/3/12	21:00 to 22:00	3	3	3			2				
2014/3/12	22:00 to 23:00	2	2	1		2					
2014/3/12	23:00 to 00:00		3	4		1	3			3	
2014/3/12	00:00 to 01:00		1	2			5			5	
2014/3/13	01:00 to 02:00		1	9							
2014/3/13	02:00 to 03:00										
2014/3/13	03:00 to 04:00									3	
2014/3/13	04:00 to 05:00									2	
2014/3/13	05:00 to 06:00		1	1	1	3					
2014/3/13	06:00 to 07:00			1							
2014/3/13	07:00 to 08:00	5	4	4		2	9			1	2

Direction 01: **Mithi to Islamkot** **Point No. 6**
Coordinates:

Date	*Time*	*Bikes*	*Cars*	*Pickups*	*Buses*	*Truck (2X)*	*Truck (3X)*	*Truck (4X)*	*Truck (5X)*	*Truck (6X)*	*Trailer*	***Total***
	PCU	*0.5*	*1*	*2*	*2*	*3*	*3*	*3*	*3*	*3*	*3*	
2014/3/13	08:30 to 09:30	12	9	12	2	2	3					**40**
2014/3/13	09:30 to 10:30	10	11	6	2	5	2					**36**
2014/3/13	10:30 to 11:30	4		8	4	2	2			1		**21**
2014/3/13	11:30 to 12:30	14	2	8	2	2	1					**29**
2014/3/13	12:30 to 13:30	17	3	9	5	3	4				2	**43**
2014/3/13	13:30 to 14:30	12	8	8	8	1	3					**40**
2014/3/13	14:30 to 15:30	21	2	9	2	2	1					**37**
2014/3/13	15:30 to 16:30	15	5	10	5					1		**36**
2014/3/13	16:30 to 17:30	23	4	6	7	9	6					**55**
2014/3/13	17:30 to 18:30	15	5	10	4	1	4					**39**
2014/3/13	18:30 to 19:30	6	10	4	3	3	5					**31**
2014/3/13	19:30 to 20:30	12	4	6	1	1	1			3		**28**
2014/3/13	20:30 to 21:30	8	8	3	2	3	2			2		**28**
2014/3/13	21:30 to 22:30	1		5		4	1					**11**
2014/3/13	22:30 to 23:30	2		2								**4**
2014/3/13	23:30 to 00:30		1	3								**4**
2014/3/14	00:30 to 01:30		1	1			3			3		**8**
2014/3/14	01:30 to 02:30											**0**
2014/3/14	02:30 to 03:30											**0**
2014/3/14	03:30 to 04:30		1	3			1					**5**
2014/3/14	04:30 to 05:30			1		1				1		**3**
2014/3/14	05:30 to 06:30		1							3		**4**
2014/3/14	06:30 to 07:30	3	2	5		8	2					**20**
2014/3/14	07:30 to 08:30	2	3	5			3			3		**16**
	24hrs	177	80	124	47	47	44	0	0	17	2	538

Direction 02: **Islamkot to Mithi** **Point No. 6**
Coordinates:

Date	*Time*	*Bikes*	*Cars*	*Pickups*	*Buses*	*Truck (2X)*	*Truck (3X)*	*Truck (4X)*	*Truck (5X)*	*Truck (6X)*	*Trailer*	***Total***
	PCU	*0.5*	*1*	*2*	*2*	*3*	*3*	*3*	*3*	*3*	*3*	
2014/3/13	08:30 to 09:30	33	5	19	6	6						**69**
2014/3/13	09:30 to 10:30	29	6	8	5	1	6					**55**
2014/3/13	10:30 to 11:30	20	5	11	6	2	7			3		**54**
2014/3/13	11:30 to 12:30	20	8	11	6	4	5					**54**
2014/3/13	12:30 to 13:30	16	5	11	6	18				1		**57**
2014/3/13	13:30 to 14:30	19	6	5	4	9	2					**45**
2014/3/13	14:30 to 15:30	11	4	17	4	1	1			1		**39**
2014/3/13	15:30 to 16:30	22	7	7	3	7	2			1		**49**
2014/3/13	16:30 to 17:30	14	4	9	2	4						**33**
2014/3/13	17:30 to 18:30	17	4	10	3	1	2					**37**
2014/3/13	18:30 to 19:30	15	9	8	1	2	2					**37**
2014/3/13	19:30 to 20:30	5	9	4	5	1						**24**
2014/3/13	20:30 to 21:30	1	1	4	1	2	3				1	**13**
2014/3/13	21:30 to 22:30	1	4	3		1				2		**11**
2014/3/13	22:30 to 23:30	1	4	3			1					**9**
2014/3/13	23:30 to 00:30	1	1	7			7			2		**18**
2014/3/14	00:30 to 01:30											**0**
2014/3/14	01:30 to 02:30						1					**1**
2014/3/14	02:30 to 03:30		1			1				1		**3**
2014/3/14	03:30 to 04:30		1			2						**3**

Direction 01: **Noukot to Mithi** **Point No. 5**
Coordinates: 24 49 59.3 69 36 35.2

Date	*Time*	*Bikes*	*Cars*	*Pickups*	*Buses*	*Truck (2X)*	*Truck (3X)*	*Truck (4X)*	*Truck (5X)*	*Truck (6X)*	*Trailer*	***Total***
	PCU	*0.5*	*1*	*2*	*2*	*3*	*3*	*3*	*3*	*3*	*3*	
2014/3/12	12:00 to 13:00	14	9	13	5	1	3					**45**
2014/3/12	13:00 to 14:00	12	12	13	4	2	2	1				**46**
2014/3/12	14:00 to 15:00	7	4	3	4							**18**
2014/3/12	15:00 to 16:00	8	2	6	4	1	2					**23**
2014/3/12	16:00 to 17:00	9	1	6	3	7						**26**
2014/3/12	17:00 to 18:00	14	4	6	3	1						**28**
2014/3/12	18:00 to 19:00	9	5	2	2	4						**22**
2014/3/12	19:00 to 20:00	3	2	2	1							**8**
2014/3/12	20:00 to 21:00	3	5		4	4	1					**17**
2014/3/12	21:00 to 22:00	2	1	3	1	1						**8**
2014/3/12	22:00 to 23:00	2	3	5	1	4						**15**
2014/3/12	23:00 to 00:00		7	3		6	2					**18**
2014/3/12	00:00 to 01:00	1	2	3		3	3	1				**13**
2014/3/13	01:00 to 02:00			1		3				1		**5**
2014/3/13	02:00 to 03:00		2	1		3						**6**
2014/3/13	03:00 to 04:00		1	1		4						**6**
2014/3/13	04:00 to 05:00			1		4						**5**
2014/3/13	05:00 to 06:00		2			2						**4**
2014/3/13	06:00 to 07:00	1	2			8						**11**
2014/3/13	07:00 to 08:00	9	2	4	1	9	7					**32**
2014/3/13	08:00 to 09:00	14	6	5	3	6						**34**
2014/3/13	09:00 to 10:00	18	8	18	3	6	3					**56**
2014/3/13	10:00 to 11:00	9	5	4	2	4						**24**
2014/3/13	11:00 to 12:00	15	4	6	10	10	4					**49**
	24hrs	150	89	106	51	93	27	2	0	1	0	519

Direction 02: **Mithi to Noukot** **Point No. 5**
Coordinates: 24 49 59.3 69 36 35.2

Date	*Time*	*Bikes*	*Cars*	*Pickups*	*Buses*	*Truck (2X)*	*Truck (3X)*	*Truck (4X)*	*Truck (5X)*	*Truck (6X)*	*Trailer*	***Total***
	PCU	*0.5*	*1*	*2*	*2*	*3*	*3*	*3*	*3*	*3*	*3*	
2014/3/12	12:00 to 13:00	7	10	6	5	5	4					**37**
2014/3/12	13:00 to 14:00	12	12	1	7	7	4					**43**
2014/3/12	14:00 to 15:00	10	11	5	4	5						**35**
2014/3/12	15:00 to 16:00	11	14	6	3	3	9			2		**48**
2014/3/12	16:00 to 17:00	19	8	7	2	1	1					**38**
2014/3/12	17:00 to 18:00	18	13	6	3		1					**41**
2014/3/12	18:00 to 19:00	10	13	9	2	5	4					**43**
2014/3/12	19:00 to 20:00	15	9	2			3					**29**
2014/3/12	20:00 to 21:00	8	9	6		4						**27**
2014/3/12	21:00 to 22:00	2	8	5		1	1					**17**
2014/3/12	22:00 to 23:00	2	4	3		3						**12**
2014/3/12	23:00 to 00:00	1	2	1		2	2					**8**
2014/3/12	00:00 to 01:00		2	1		1				1	1	**6**
2014/3/13	01:00 to 02:00		2	1								**3**
2014/3/13	02:00 to 03:00											**0**
2014/3/13	03:00 to 04:00			1								**1**
2014/3/13	04:00 to 05:00			2		1						**3**
2014/3/13	05:00 to 06:00			1		1						**2**
2014/3/13	06:00 to 07:00		2	2		1	4					**9**
2014/3/13	07:00 to 08:00	6	3	1		2	6					**18**

Direction 01: **Mirpur to Digri** **Point No. 4**
Coordinates: 25 9 48.7N 69 6 32.0E

Date	*Time*	*Bikes*	*Cars*	*Pickups*	*Buses*	*Truck (2X)*	*Truck (3X)*	*Truck (4X)*	*Truck (5X)*	*Truck (6X)*	*Trailer*	***Total***
	PCU	*0.5*	*1*	*2*	*2*	*3*	*3*	*3*	*3*	*3*	*3*	
2014/3/11	10:00 to 11:00	77	46	9	11	10	3			2	2	**160**
2014/3/11	11:00 to 12:00	116	37	3	9	18					5	**188**
2014/3/11	12:00 to 13:00	94	36	10	9	1	3				3	**156**
2014/3/11	13:00 to 14:00	130	42	9	7	10	1			1	5	**205**
2014/3/11	14:00 to 15:00	109	36	6	9	4	3			1	2	**170**
2014/3/11	15:00 to 16:00	106	23	10	7	14					6	**166**
2014/3/11	16:00 to 17:00	85	59	15	8	6					2	**175**
2014/3/11	17:00 to 18:00	53	51	12	6	7					5	**134**
2014/3/11	18:00 to 19:00	62	48	10	4	8	6				11	**149**
2014/3/11	19:00 to 20:00	31	42	7	6	15	1				2	**104**
2014/3/11	20:00 to 21:00	36	53	10	6	19	1				1	**126**
2014/3/11	21:00 to 22:00	10	42	6	2	6					1	**67**
2014/3/11	22:00 to 23:00	4	30	2		9	2					**47**
2014/3/11	23:00 to 00:00	4	27	4		8						**43**
2014/3/12	00:00 to 01:00	2	30	4	2	4						**42**
2014/3/12	01:00 to 02:00		8	2		4						**14**
2014/3/12	02:00 to 03:00	1	4			8						**13**
2014/3/12	03:00 to 04:00		1	1	2	8	2					**14**
2014/3/12	04:00 to 05:00		2	2		4	4					**12**
2014/3/12	05:00 to 06:00		2			2	1					**5**
2014/3/12	06:00 to 07:00	3	3	2	1	1						**10**
2014/3/12	07:00 to 08:00	7	4	7	4	7	1			2	2	**34**
2014/3/12	08:00 to 09:00	40	16	7	3	4						**70**
2014/3/12	09:00 to 10:00	42	9	9	3	4	3	1			2	**73**
	24hrs	1012	651	147	99	181	31	1	0	6	49	**2,177**

Direction 02: **Digri to Mirpur** **Point No. 4**
Coordinates: 25 9 48.7N 69 6 32.0E

Date	*Time*	*Bikes*	*Cars*	*Pickups*	*Buses*	*Truck (2X)*	*Truck (3X)*	*Truck (4X)*	*Truck (5X)*	*Truck (6X)*	*Trailer*	***Total***
	PCU	*0.5*	*1*	*2*	*2*	*3*	*3*	*3*	*3*	*3*	*3*	
2014/3/11	10:00 to 11:00	100	57	9	6	5					1	**178**
2014/3/11	11:00 to 12:00	107	51	5	8	3					1	**175**
2014/3/11	12:00 to 13:00	104	32	4	7	2		1			3	**153**
2014/3/11	13:00 to 14:00	78	48	5	4	7	2				2	**146**
2014/3/11	14:00 to 15:00	100	54	8	5	4					5	**176**
2014/3/11	15:00 to 16:00	101	39	9	7	11	1				4	**172**
2014/3/11	16:00 to 17:00	111	41	15	11	2						**180**
2014/3/11	17:00 to 18:00	66	35	10	6	8	1				4	**130**
2014/3/11	18:00 to 19:00	91	53	20	6	12	3				4	**189**
2014/3/11	19:00 to 20:00	28	13	7	3	10	51				4	**116**
2014/3/11	20:00 to 21:00	15	20	9	3	7	2			1	2	**59**
2014/3/11	21:00 to 22:00	11	20	13	1	20	2					**67**
2014/3/11	22:00 to 23:00	9	15	3		7	2					**36**
2014/3/11	23:00 to 00:00	6	8	5		6	1					**26**
2014/3/12	00:00 to 01:00	1	3	2		4						**10**
2014/3/12	01:00 to 02:00	2	2			4	3		1			**12**
2014/3/12	02:00 to 03:00		1			1						**2**
2014/3/12	03:00 to 04:00		1		1	2	1					**5**
2014/3/12	04:00 to 05:00		2		1	1						**4**
2014/3/12	05:00 to 06:00		1									**1**

Direction 01: **Matli to Talhar** **Point No. 13**
Coordinates: 24 59 44.6 N 68 39 16.2E

Date	Time	Bikes	Cars	Pickups	Buses	Truck (2X)	Truck (3X)	Truck (4X)	Truck (5X)	Truck (6X)	Trailer	**Total**
	PCU	0.5	1	2	2	3	3	3	3	3	3	
2014/3/10	08:00 to 09:00	95	61	27	8	8	1	1	1		8	**210**
2014/3/10	09:00 to 10:00	148	77	27	12	9	2			1	3	**279**
2014/3/10	10:00 to 11:00	145	82	32	10	10	1	1			1	**282**
2014/3/10	11:00 to 12:00	164	95	20	12	6	4			1	1	**303**
2014/3/10	12:00 to 13:00	171	77	25	7	21	4	2		1	6	**314**
2014/3/10	13:00 to 14:00	151	60	23	8	17	4			2	8	**273**
2014/3/10	14:00 to 15:00	127	62	27	13	16	3	1		1	4	**254**
2014/3/10	15:00 to 16:00	134	61	18	8	10	16	6			6	**259**
2014/3/10	16:00 to 17:00	129	82	24	9	13				1	6	**264**
2014/3/10	17:00 to 18:00	129	64	14	8	12	5	1			7	**240**
2014/3/10	18:00 to 19:00	108	83	17	5	13	1		1	1	4	**233**
2014/3/10	19:00 to 20:00	101	59	15		14	4	1			6	**200**
2014/3/10	20:00 to 21:00	41	74	12	3	5	1				9	**145**
2014/3/10	21:00 to 22:00	25	38	23		21	4	3	1		5	**120**
2014/3/10	22:00 to 23:00	5	20	16		8	4				2	**55**
2014/3/10	23:00 to 00:00		9	14		11	4					**38**
2014/3/11	00:00 to 01:00		10	9		9	5	5				**38**
2014/3/11	01:00 to 02:00		7	12		21		4				**44**
2014/3/11	02:00 to 03:00	5	3	10		19	8	1				**46**
2014/3/11	03:00 to 04:00		2	6		14	8	2				**32**
2014/3/11	04:00 to 05:00		20			18	2				1	**41**
2014/3/11	05:00 to 06:00	2	9			8	2				1	**22**
2014/3/11	06:00 to 07:00		8	4	3	9	4					**28**
2014/3/11	07:00 to 08:00	36	19	11	11	20	8	3				**108**
	24hrs	1716	1082	386	117	312	95	31	3	8	78	**3,828**

Direction 02: **Talhar to Matli** **Point No. 13**
Coordinates: 24 59 44.6 N 68 39 16.2E

Date	Time	Bikes	Cars	Pickups	Buses	Truck (2X)	Truck (3X)	Truck (4X)	Truck (5X)	Truck (6X)	Trailer	**Total**
	PCU	0.5	1	2	2	3	3	3	3	3	3	
2014/3/10	08:00 to 09:00	75	40	20	6	16					2	**159**
2014/3/10	09:00 to 10:00	103	40	12	8	6	2	3	3	2		**179**
2014/3/10	10:00 to 11:00	141	64	28	12	14	4	1		2	13	**279**
2014/3/10	11:00 to 12:00	121	80	13	28	6	2				2	**252**
2014/3/10	12:00 to 13:00	94	84	18	12	23	1	2	1	3	7	**245**
2014/3/10	13:00 to 14:00	95	70	20	8	14	3	3	1	3	6	**223**
2014/3/10	14:00 to 15:00	98	68	20	16	20	1	3		3	6	**235**
2014/3/10	15:00 to 16:00	110	108	34	15	12	8	3	1		9	**300**
2014/3/10	16:00 to 17:00	87	90	24	9	22	7	10	2	3	15	**269**
2014/3/10	17:00 to 18:00	73	81	37	8	12	5	3	1	2	2	**224**
2014/3/10	18:00 to 19:00	67	90	24	6	26	3	5			2	**223**
2014/3/10	19:00 to 20:00	39	63	18	4	14	5		1		5	**149**
2014/3/10	20:00 to 21:00	15	31	13		23	8		1	2	4	**97**
2014/3/10	21:00 to 22:00	17	25	16	2	22	5		1		9	**97**
2014/3/10	22:00 to 23:00	13	26	8		9	6				4	**66**
2014/3/10	23:00 to 00:00	2	23	7	3	6	2				2	**45**
2014/3/11	00:00 to 01:00		9	4	2	15					3	**33**
2014/3/11	01:00 to 02:00		18	8		21					3	**50**
2014/3/11	02:00 to 03:00	3	4	4		8	5				1	**25**

Direction 01: **Tando Allahyar to Hyderabad**
Coordinates: 25 26 06.2 68 33 34.2 **Point No. 3**

Date	*Time*	***Bikes***	***Cars***	***Pickups***	***Buses***	***Truck (2X)***	***Truck (3X)***	***Truck (4X)***	***Truck (5X)***	***Truck (6X)***	***railer/ Tracto***	***Total***
	PCU	0.5	1	2	2	3	3	3	3	3	3	
2014/3/6	11:30 to 12:30	180	224	26	13	29	5	1			2	**480**
2014/3/6	12:30 to 13:30	210	207	19	16	45	10		1			**508**
2014/3/6	13:30 to 14:30	178	143	24	16	42	7	2			1	**413**
2014/3/6	14:30 to 15:30	175	185	36	23	51	5	9		2		**486**
2014/3/6	15:30 to 16:30	194	215	40	16	47	8	3		2	3	**528**
2014/3/6	16:30 to 17:30	172	233	36	18	61	9	1				**530**
2014/3/6	17:30 to 18:30	174	250	40	11	69	6	1	2	2	4	**559**
2014/3/6	18:30 to 19:30	121	212	29	15	34	9	4	4	1		**429**
2014/3/6	19:30 to 20:30	52	157	10	11	45	6	1	3	1	3	**289**
2014/3/6	20:30 to 21:30	19	60	19	4	32	16	1	3			**154**
2014/3/6	21:30 to 22:30	17	105	2	9	29	4	2	8	2		**178**
2014/3/6	22:30 to 23:30	4	32	6		33	4	9	1	5		**94**
2014/3/6	23:30 to 00:30	2	16	14		49	5	2	1	1		**90**
2014/3/7	00:30 to 01:30	1	16	9	1	25	1	2				**55**
2014/3/7	01:30 to 02:30	1	6	3	1	20	2					**33**
2014/3/7	02:30 to 03:30	1	9	5	1	17		1				**34**
2014/3/7	03:30 to 04:30		6	5	1	12						**24**
2014/3/7	04:30 to 05:30	3	3	13	2	14						**35**
2014/3/7	05:30 to 06:30	4	2	16	14	4	16				1	**57**
2014/3/7	06:30 to 07:30	39	53	14	17	12	4	4			1	**144**
2014/3/7	07:30 to 08:30	106	77	19	19	7	2				2	**232**
2014/3/7	08:30 to 09:30	127	95	27	15	20	4	1		1		**290**
2014/3/7	09:30 to 10:30	183	120	54	13	22	1		3		2	**398**
2014/3/7	10:30 to 11:30	223	149	61	17	30	4				1	**485**
	24hrs	2186	2575	527	253	749	128	44	26	17	20	**6525**

Direction 02: **Hyderabad to Tando Allahyar** **Point No. 3**
Coordinates: 25 26 06.2 68 33 34.2

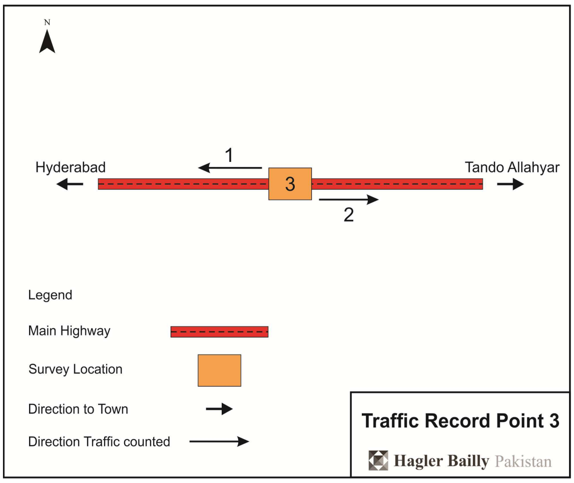
Date	Time	Bikes	Cars	Pickups	Buses	Truck (2X)	Truck (3X)	Truck (4X)	Truck (5X)	Truck (6X)	Trailer	**Total**
	PCU	*0.5*	*1*	*2*	*2*	*3*	*3*	*3*	*3*	*3*	*3*	
2014/3/6	*11:30 to 12:30*	*236*	*162*	*27*	*17*	*33*	*8*	*4*		*4*	*4*	***495***
2014/3/6	12:30 to 13:30	237	176	36	17	26	7		2	2	5	**508**
2014/3/6	13:30 to 14:30	255	179	28	27	22	3	3	3	0	3	**523**
2014/3/6	14:30 to 15:30	231	200	28	21	19	1	3	1	0	4	**508**
2014/3/6	15:30 to 16:30	267	224	36	21	31	2	10		1	3	**595**
2014/3/6	16:30 to 17:30	240	210	45	30	3	9		1	6		**544**
2014/3/6	17:30 to 18:30	237	209	35	14	29	1	2	2	0	1	**530**
2014/3/6	18:30 to 19:30	188	218	32	20	28	4	3		2	3	**498**
2014/3/6	19:30 to 20:30	97	180	17	14	24	1	3	2	0		**338**
2014/3/6	20:30 to 21:30	76	179	10	9	24	1	2	0	0		**301**
2014/3/6	21:30 to 22:30	33	135	13	4	28	4	1	0	0	3	**221**
2014/3/6	22:30 to 23:30	26	111	13	2	25	4		0	0		**181**
2014/3/6	23:30 to 00:30	9	71	17	1	32	6	2		1		**139**
2014/3/7	00:30 to 01:30	2	34	8	34	6	1	1	1			**87**
2014/3/7	01:30 to 02:30		36	8	28	1	1		1			**75**
2014/3/7	02:30 to 03:30	1	15	1	1	25	1					**44**
2014/3/7	03:30 to 04:30	2	6	2		8	1					**19**
2014/3/7	04:30 to 05:30	5	10	7	1	31	3		1	1		**59**
2014/3/7	05:30 to 06:30	8	14	16	3	43	8		1	1		**94**
2014/3/7	06:30 to 07:30	30	53	7	5	36	1	3	1	3		**139**
2014/3/7	07:30 to 08:30	59	52	20	3	40	6	3		3	1	**187**

Appendix 8: TRAFFIC SITUATION - COLLECTION METHOD

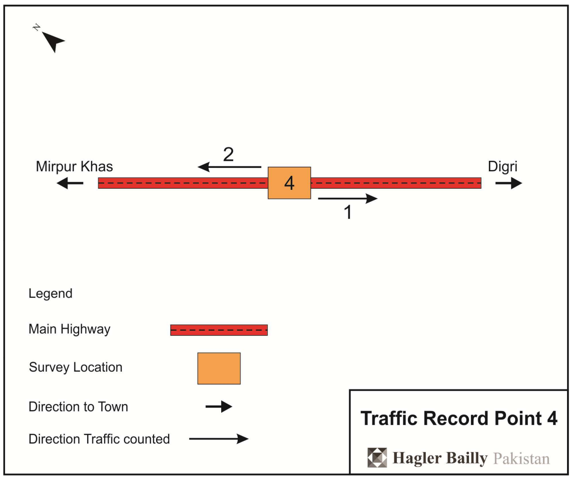
(1) Traffic Census

A team of trained qualified surveyors were selected locally and deployed under a supervisor. The team was trained and tested during a pilot count before the actual survey. At the counting site, two people were stationed at a time to separately count the traffic in both directions. Data was collected for day and night. Traffic data is provided in **Appendix 7** and directions detail of traffic count are presented in Figure 8-1.

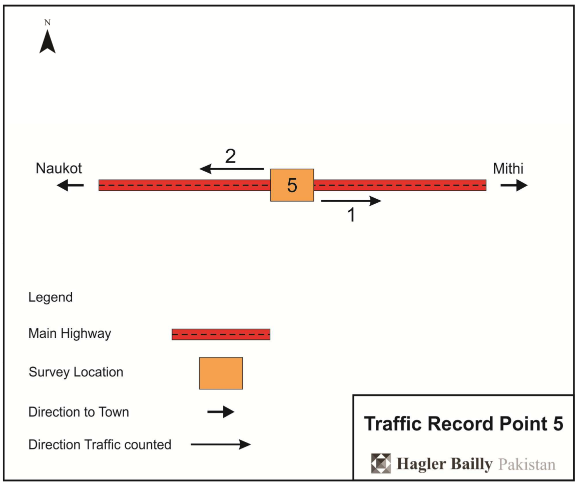
Figure 8-1: Details of Traffic Census Locations



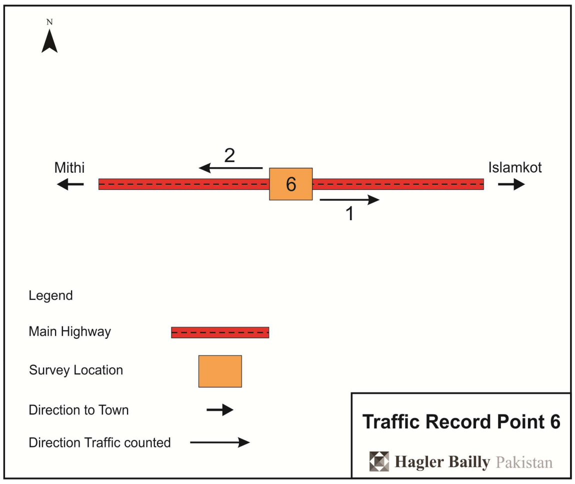
Sketch 01: Traffic census Location 3



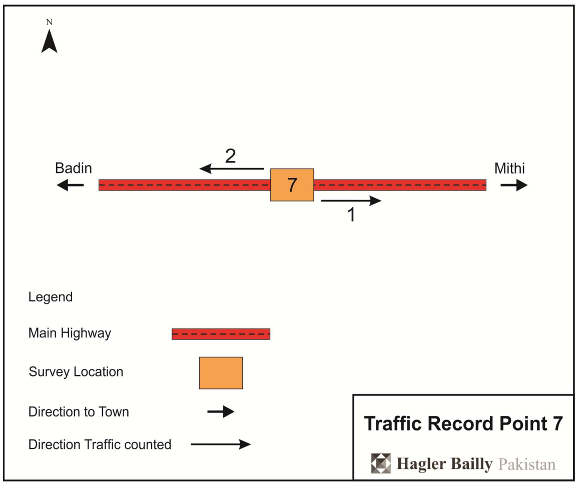
Sketch 02: Traffic census Location 4



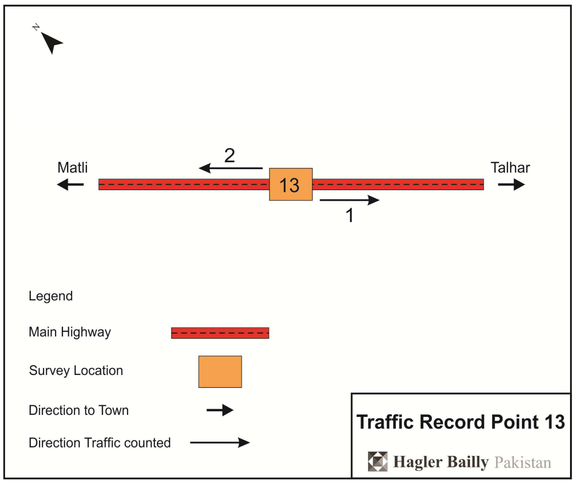
Sketch 03: Traffic census Location 5



Sketch 04: Traffic census Location 6



Sketch 05: Traffic census Location 7



Sketch 06: Traffic census Location 13

(2) Receptors

A team of surveyors traversed along the road on an all-terrain vehicle to identify and record the details of possible receptors on both sides of the road. A list of potential receptor types was prepared before the survey. Whenever a potential receptor was identified the following information was recorded:

- GPS location
- Observable details
- Sketch to describe the general setting and relative distances
- Photograph of the receptor, where relevant.

After completion of the survey, the field data was compiled into a database.

Appendix 9: RECEPTORS DATABASE

1. Database Field Description

Field Heading	*Description*	*Data Type*
Route Section	The road section in which the feature falls (See Section 2 below for details)	Numeric
Feature ID	Unique ID for the features	Text
Feature Description	Narrative description of the feature	Text
Position Type	Categorization of the section according to the relative position of road (See Section 3 below for details)	Text
WP Location	Location where way point (WP) is recorded. For many roadside features, the WP was recorded on the road not at the center, or edge of the feature.	Text
Distance to WP (m)	Approximate distance of the feature from the WP in meters	Numeric
Latitude (DD, MM, SS)	Geographcial coordinates of the feature (the' Way Point'). For *Point* entity type this is the WP of the point. For *Line* entity type, this is the WP of the starting point.	Numeric
Longitude (DD, MM, SS)		Numeric
Comments	Additional information	Text
Observation Date	Date on which the observations were made	Text

2. Route Section

No	*From*	*to*	*Length (km)*	*Route Number as per SOW*
1	Lakhra Power Plant (N-55)	Jamshoro Stop on N-5		
2	Jamshoro Stop (on N-5)	Hala Turning (on N-5)		
3	Hala Turning (on N-5)	Fateh Roundabout		
4	Fateh Roundabout	Mirpur Khas		
5	Mirpur Khas	Degri		
6	Degri	Mithi		
7	Mithi	Thar Coal Blocks		
8	Fateh Roundabout	Matli		
9	Matli	Badin		
10	Badin	Mithi		

3. Section and Position Type

Section type	*Road Relative Position*		*Feature Position Type*	
R	road	Road Only	R1	Left of the road
			R2	On the road
			R3	Right of the road
			R1 and R2	on both sides of the road

Note: Orientation (left or right) is defined with respect to movement towards the Thar Coal Blocks from Project Site

Route Section	*Feature ID*	*Category*	*Feature Name*	*Feature Description*	*Position Type*	*Waypoint*	*Latitude (DD)*	*Longitude (DD)*	*Comments*
1	1-001	Educational Facility	School	Primary School, on connecting road of plant to N-55	L	226	25.70435	68.29940833	20 feet wide single road
1	1-002	Mosque	Mosque		R	227	25.70111667	68.28984167	20 feet wide single road
1	1-003	Settlement	Settlement	Manzurabad	L	227	25.70111667	68.30159167	20 feet wide single road
1	1-004	Road Infrastructure	Bridge	Bridge and narrowed road	O	228	25.69666667	68.29558333	20 feet wide single road
1	1-005	Road Infrastructure	Bridge	Bridge and narrowed road	O	229	25.67855	68.2962	20 feet wide single road
1	1-006	Settlement	Settlement	Lakhra Housing Colony	R	230	25.66776667	68.28974167	20 feet wide single road
1	1-007	Educational Facility	School	Primary School	L	231	25.66443333	68.30134167	20 feet wide single road
1	1-008	Road Infrastructure	Bridge	Bridge and narrowed road	O	232	25.6536	68.30083333	20 feet wide single road
1	1-009	Settlement	Settlement		R	233	25.65031667	68.295125	20 feet wide single road
1	1-010	Settlement	Settlement	Aliabad	S	233	25.65031667	68.301	20 feet wide single road
1	1-011	Settlement	Settlement	Huts/ Homades	R	234	25.63228333	68.295975	20 feet wide single road
1	1-012	Settlement	Settlement		L	234	25.63228333	68.307725	20 feet wide single road
1	1-013	Road Infrastructure	Bridge	Bridge and narrowed road	O	235	25.6092	68.30418333	20 feet wide single road
1	1-014	Road Infrastructure	Bridge	Bridge and narrowed road	O	236	25.5795	68.31301667	20 feet wide single road
1	1-015	Mosque	Mosque		R	237	25.50118333	68.26699167	20 feet wide single road
1	1-016	Road Infrastructure	Road Infrastructure	Rail track crossing, gated	O	238	25.4668	68.27115	20 feet wide single road
1	1-017	Settlement	Settlement		L	238	25.4668	68.277025	20 feet wide single road
1	1-018	Mosque	Mosque		L	239	25.46308333	68.277975	20 feet wide single road
1	1-019	Road Infrastructure	Bridge	Bridge and narrowed road	O	241	25.45045	68.27308333	20 feet wide single road
1	1-020	Health Facility	Health		R	242	25.43811667	68.27049167	20 feet wide single road

Route Section	*Feature ID*	*Category*	*Feature Name*	*Feature Description*	*Position Type*	*Waypoint*	*Latitude (DD)*	*Longitude (DD)*	*Comments*
			Department						
1	1-021	Mosque	Mosque		L	242	25.43811667	68.28224167	20 feet wide single road
1	1-022	Educational Facility	School	Primary School	L	242	25.43811667	68.28224167	20 feet wide single road
1	1-023	Educational Facility	University	LUMS	R	244	25.43383333	68.27244167	20 feet wide single road
1	1-024	Mosque	Mosque		L	245	25.42905	68.28545833	20 feet wide single road
1	1-025	Settlement	Settlement	Youth Hostel	L	246	25.41908333	68.284225	20 feet wide single road
1	1-026	Educational Facility	University	Sindh University	R	247	25.41455	68.26670833	20 feet wide single road
1	1-027	Educational Facility	University	Sindh University	R	248	25.41301667	68.26515833	20 feet wide single road
1	1-028	Educational Facility	University	MUET	R	249	25.40492778	68.2625	20 feet wide single road
2	2-001	Road Infrastructure	Bridge	Bridge and narrowed road	O	250	25.40116667	68.28023333	Double Carriage way
2	2-002	Road Infrastructure	Bridge	Bridge and narrowed road	O	251	25.4022	68.28473333	Double Carriage way
2	2-003	Water Body	Canal	Bridge and narrowed road, Karachi Canal	O	252	25.40286667	68.28713333	Double Carriage way
2	2-004	Water Body	Indus River	15 feet wide bridge	O	254	25.40291667	68.30975	Double Carriage way
2	2-005	Mosque	Mosque		R	225	25.49243333	68.35421667	Double Carriage way
2	2-006		Bridge	Bridge and narrowed road	O	226	25.70435	68.29353333	Double Carriage way
2	2-007	Water Body	Channel	Bridge and narrowed road	O	237	25.50118333	68.27286667	bridge over Canal, Double Carriage way
2	2-008	Water Body	Channel	Bridge and narrowed road	O	258	25.42963333	68.35271667	bridge over Canal, Double Carriage way
2	2-009	Water Body	Channel	Bridge and narrowed road	O	259	25.43013333	68.3532	bridge over Canal, Double Carriage way
2	2-010	Mosque	Mosque		L	264	25.44198333	68.38308333	Double Carriage way
2	2-011	Settlement	Settlement	Hala Naka, Hyderabad, Route now turns right	R	261	25.44778333	68.38623333	Double Carriage way

Route Section	*Feature ID*	*Category*	*Feature Name*	*Feature Description*	*Position Type*	*Waypoint*	*Latitude (DD)*	*Longitude (DD)*	*Comments*
3	3-001	Educational Facility	School	Primary School	L	262	25.44156667	68.39014167	15 feet wide single carriage way
3	3-002	Mosque	Mosque		L	263	25.4408	68.38995833	15 feet wide single carriage way
3	3-003	Educational Facility	University		R	265	25.43606667	68.37705833	15 feet wide single carriage way
3	3-004	Health Facility	Hospital		R	266	25.43146667	68.37594167	15 feet wide single carriage way
3	3-005	Mosque	Mosque		L	267	25.42633333	68.38645833	15 feet wide single carriage way
3	3-006	Mosque	Mosque		L	268	25.42188333	68.38540833	15 feet wide single carriage way
3	3-007	Mosque	Mosque	Route now turns left	L	269	25.41883333	68.38499167	15 feet wide single carriage way
3	3-008	Water Body	Canal	bridge over the road and two canal runs in parallel, narrowed road	O	270	25.41586667	68.38521667	Double Carriage way
3	3-009	Road Infrastructure	Bridge	Bridge and narrowed road	O	272	25.39553333	68.40245	Double Carriage way
4	4-001	Road Infrastructure	Road	Near Fateh Chowk: Route now turns left	O	273	25.40013333	68.42281667	Double Carriage way
4	4-002	Road Infrastructure	Toll Plaza		R	274	25.39688333	68.43051667	Double Carriage way
4	4-003	Shrine	Shrine		R	275	25.39898333	68.43848333	Double Carriage way
4	4-004	Mosque	Mosque		L	276	25.41328333	68.45246667	Double Carriage way
4	4-005	Shrine	Shrine		R	277	25.40313333	68.45456667	Double Carriage way
4	4-006		Road		O	279	25.41825	68.49883333	Double Carriage way
4	4-007	Educational Facility	College		L	280	25.42538333	68.50645	Double Carriage way
4	4-008	Settlement	Settlement		L	281	25.42938333	68.52388333	Double Carriage way
4	4-009	Settlement	Settlement	Tando Jam road	L	282	25.4296	68.527	Double Carriage way

Route Section	*Feature ID*	*Category*	*Feature Name*	*Feature Description*	*Position Type*	*Waypoint*	*Latitude (DD)*	*Longitude (DD)*	*Comments*
4	4-010	Settlement	Settlement	Tando Jam bazar	L	282	25.4296	68.527	Double Carriage way
4	4-011	Educational Facility	University	Sindh Agricultural University	R	283	25.42138333	68.53481667	Double Carriage way
4	4-012	Play ground	Play ground		R	284	25.42391667	68.54248333	Double Carriage way
4	4-013	Educational Facility	College	Animal Institute	R	285	25.42553333	68.5474	Double Carriage way
4	4-014	Mosque	Mosque		L	286	25.43908333	68.55595	Double Carriage way
4	4-015	Settlement	Settlement	Hisna Mori	L	287	25.45006667	68.58363333	Double Carriage way
4	4-016	Settlement	Settlement	Hisna Mori	R	287	25.43943333	68.58363333	Double Carriage way
4	4-017	Water Body	Channel	Bridge and narrowed road	O	288	25.4447	68.5847	Canal
4	4-018	Mosque	Mosque		L	289	25.45568333	68.62388333	
4	4-019	Shrine	Shrine		R	290	25.44931667	68.66663333	
4	4-020	Health Facility	Hospital		R	291	25.45421667	68.67336667	
4	4-021	Educational Facility	School	Technical School	L	291	25.46485	68.67336667	
4	4-022	Road Infrastructure	Bypass Road		O	292	25.46078333	68.6923	
4	4-023	Road Infrastructure	Railway Track Crossing	Bridge and narrowed road	O	293	25.46348333	68.69371667	
4	4-024	Road Infrastructure	Single Road Started		O	294	25.46835	68.7031	
4	4-025	Water Body	Channel	Bridge and narrowed road	O	295	25.47981667	68.72501667	
4	4-026	Road Infrastructure	Railway Track Crossing	Bridge and narrowed road	O	296	25.4726	68.73733333	
4	4-027	Water Body	Channel	Bridge and narrowed road	O	297	25.47185	68.73901667	
4	4-028	Mosque	Mosque		O	M	25.47653333	68.76351667	
4	4-029	Mosque	Mosque		L	299	25.4855	68.78323333	

Route Section	*Feature ID*	*Category*	*Feature Name*	*Feature Description*	*Position Type*	*Waypoint*	*Latitude (DD)*	*Longitude (DD)*	*Comments*
4	4-030	Water Body	Channel	Bridge and narrowed road	O	300	25.4834	68.80205	
4	4-031	Mosque	Mosque		L	301	25.49631667	68.85466667	
4	4-032	Mosque	Mosque		R	302	25.4927	68.88443333	
4	4-033	Water Body	Channel	Bridge and narrowed road	O	303	25.50221667	68.90233333	
4	4-034	Settlement	Settlement	Toll Plaza	O	304	25.50878333	68.9275	
4	4-035	Water Body	Channel	Bridge and narrowed road	O	305	25.51396667	68.94858333	
4	4-036	Health Facility	hospital/ medical College		R	306	25.50953333	68.95753333	
4	4-037	Road Infrastructure	Bypass Road		O	307	25.51756667	68.96611667	
4	4-038	Road Infrastructure	Single Road		O	308	25.51453333	68.96278333	
4	4-039	Road Infrastructure	Bypass Road		O	309	25.51398333	68.9662	Broken Road
4	4-040	Educational Facility	College	Medical College	R	310	25.50455	69.00043333	
4	4-041	Settlement	Settlement	Jal Wari Shah Chowk	O	312	25.50785	69.01061667	
5	5-001	Educational Facility	Degree College		R	313	25.5027	69.00505833	
5	5-002		Single Road		O	314	25.468	69.0121	20 feet wide single road
5	5-003	Mosque	Mosque		L	315	25.43866667	69.02170833	
5	5-004	Settlement	Settlement	Ghot Makhan Saman	S	316	25.43615	69.01618333	
5	5-005	Mosque	Mosque/	Balouch Farm	R	317	25.40308333	69.01445833	
5	5-006	Settlement	Settlement	Bilard Bazar	L	318	25.3713	69.03109167	20 feet wide single road
5	5-007	Mosque	Mosque		L	319	25.35985	69.03195833	
5	5-008	Shrine	Shrine		R	319	25.35985	69.02020833	

Route Section	*Feature ID*	*Category*	*Feature Name*	*Feature Description*	*Position Type*	*Waypoint*	*Latitude (DD)*	*Longitude (DD)*	*Comments*
5	5-009	Mosque	Mosque		R	320	25.3411	69.02964167	
5	5-010	Water Body	Channel	Bridge and narrowed road	O	321	25.3332	69.03951667	
5	5-011	Settlement	Settlement	Mir Wah Gorchani	L	322	25.31226667	69.05604167	
5	5-012	Settlement	Settlement		L	323	25.30898333	69.05659167	
5	5-013	Water Body	Channel	Bridge and narrowed road	L	324	25.28938333	69.066875	
5	5-014	Settlement	Settlement	Office Building	L	324	25.28938333	69.066875	
5	5-015	Mosque	Mosque			325	25.27368333	69.06893333	
5	5-016	Educational Facility	School	Primary School		326	25.25583333	69.07723333	
5	5-017	Water Body	Channel	Bridge and narrowed road	O	327	25.23065	69.08691667	
5	5-018	Settlement	Settlement	Kangoro Shah	S	327	25.23065	69.08691667	
5	5-019	Road Infrastructure	Single Road		O	328	25.19393333	69.09878333	14 feet wide road
5	5-020	Settlement	Settlement	Hotel	R	329	25.16856667	69.10119167	
5	5-021	Settlement	Settlement	Degree City Gate	R	329	25.16856667	69.10119167	
5	5-022	Settlement	Settlement	Degree Bazar		330	25.16318333	69.10915	14 feet wide road
5	5-023	Settlement	Settlement	Degree Chowk	O	331	25.15576667	69.11181667	
6	6-017	Road Infrastructure	Single Road		O	465	24.86283333	69.38863333	18 feet wide road
6	6-018	Water Body	Channel	Bridge and narrowed road	O	466	24.87865	69.36266667	
6	6-019		Single Road		O	467	24.88563333	69.35243333	Broken Road 200m Long
6	6-020	Water Body	Channel	Bridge and narrowed road	O	468	24.88948333	69.34688333	Canal
6	6-021	Water Body	Channel	Bridge and narrowed road	O	469	24.9002	69.3319	
6	6-022	Shrine	Shrine		L	470	24.91525	69.328825	
6	6-023	Road Infrastructure	Single Road		O	471	24.93385	69.31536667	Broken Road

Route Section	*Feature ID*	*Category*	*Feature Name*	*Feature Description*	*Position Type*	*Waypoint*	*Latitude (DD)*	*Longitude (DD)*	*Comments*
6	6-024	Road Infrastructure	Single Road		O	472	24.94776667	69.30625	
6	6-025	Road Infrastructure	Railway Track Crossing	gated crossing	O	473	24.95791667	69.3016	
6	6-026	Educational Facility	School	Primary School	R	474	24.9618	69.29429167	
6	6-027	Settlement	Settlement	Settlement located on the left and right side of the road	S	475	24.96501667	69.29901667	
6	6-028	Mosque	Mosque		L	475	24.96501667	69.30489167	
6	6-029	Settlement	Settlement	Jurro Bazar	S	476	24.96713333	69.29825	
6	6-030	Mosque	Mosque		R	477	24.96838333	69.291925	
6	6-031	Health Facility	Hospital		L	478	24.97308333	69.301975	Jurro Broken road
6	6-032	Road Infrastructure	Single Road		O	479	24.9761	69.29503333	Jurro Ended
6	6-033	Educational Facility	School	Primary School	L	480	24.98305	69.29924167	
6	6-034	Road Infrastructure	Single Road		O	481	24.99091667	69.29151667	
6	6-035	Water Body	Channel	Bridge and narrowed road	O	482	24.99876667	69.28845	Canal
6	6-036	Mosque	Mosque		R	483	25.0125	69.26675833	
6	6-037	Settlement	Settlement		R	484	25.05791667	69.21359167	
6	6-038	Educational Facility	School	Primary School	L	484	25.05791667	69.22534167	
6	6-039	Mosque	Mosque		R	485	25.06915	69.21115833	
6	6-040	Settlement	Settlement	Settlement located on the left and right side of the road	S	485	25.06915	69.21703333	15 feet wide road
6	6-041	Mosque	Mosque		R	486	25.07521667	69.206825	
6	6-042	Health Facility	Hospital		L	487	25.0768	69.215925	
6	6-043	Educational Facility	College		L	488	25.08208333	69.20989167	

Route Section	*Feature ID*	*Category*	*Feature Name*	*Feature Description*	*Position Type*	*Waypoint*	*Latitude (DD)*	*Longitude (DD)*	*Comments*
6	6-044		Single road		O	489	25.10055	69.1795	
6	6-045	Educational Facility	School	Primary School	L	490	25.10953333	69.16844167	
6	6-046	Road Infrastructure	Single Road	15 feet wide road		491	25.14973333	69.1182	Broken Road
6	6-047	Mosque	Mosque		R	492	25.1535	69.10814167	
6	6-048	Settlement	Settlement	Degri Settlement located on the left and right side of the road	S	492	25.1535	69.11401667	
6	6-049	Road Infrastructure	Railway Track Crossing	gated crossing	O	493	25.1539	69.1136	
6	6-050	Settlement	Settlement	Degri Chowk	O	494	25.15533333	69.11206667	
7	7-001	Road Infrastructure	Bypass Road	Mithi By Pass	O	438	24.76803333	69.7766	Under construction
7	7-002	Road Infrastructure	Bypass Road		O	439	24.72875	69.82015	Under construction
7	7-003	Educational Facility	School	Primary School	R	440	24.71991667	69.85468333	
7	7-004	Mosque	Mosque		L	441	24.74378333	69.9936	
7	7-005	Mosque	Mosque		L	442	24.72713333	70.10961667	
7	7-006	Road Infrastructure	Bypass Road		O	443	24.70255	70.16915	
7	7-007	Road Infrastructure	Single Road		O	444	24.69828333	70.18618333	From Islam Kot City
7	7-008	Road Infrastructure	Single Road		O	445	24.69946667	70.23635	15 feet wide single road
7	7-009	Road Infrastructure	Single Road			446	24.69995	70.24941667	Transport Road turning to left
7	7-010	Settlement	Settlement		R	449	24.75676667	70.35578333	Block-II site office

Route Section	*Feature ID*	*Category*	*Feature Name*	*Feature Description*	*Position Type*	*Waypoint*	*Latitude (DD)*	*Longitude (DD)*	*Comments*
8	8-001	Settlement	Settlement	Fateh Chowk, Hyderabad	O	354	25.36866667	68.388	
8	8-002	Mosque	Mosque		R	353	25.33958333	68.39679167	
8	8-003	Educational Facility	School	Madras'sa	R	352	25.3122	68.40380833	
8	8-004	Mosque	Mosque		R	351	25.29511667	68.408275	
8	8-005	Road Infrastructure	Railway Track Crossing	gated crossing	O	350	25.24626667	68.44343333	
8	8-006	Mosque	Mosque		R	349	25.24375	68.439525	
8	8-007	Settlement	Settlement	Khetar	R	349	25.24375	68.439525	
8	8-008	Water Body	Channel	Bridge and narrowed road	O	348	25.22173333	68.47028333	
8	8-009	Settlement	Settlement	Dhaire	R	347	25.2217	68.465325	
8	8-010	Water Body	Channel	Bridge and narrowed road		346	25.2019	68.49148333	
8	8-011	Settlement	Settlement	Qadari Mour	R	346	25.2019	68.48560833	
8	8-012	Settlement	Settlement	Huts/ Homades	L	345	25.18753333	68.51114167	
8	8-013	Shrine	Shrine		L	344	25.16853333	68.52279167	
8	8-014	Educational Facility	College	Medical College	L	343	25.14006667	68.538125	
8	8-015	Educational Facility	College		L	342	25.13855	68.53865833	
8	8-016	Educational Facility	School	Primary School	R	342	25.13855	68.52690833	
8	8-017	Settlement	Settlement	located on the left and right side of the road		341	25.13111667	68.54853333	
8	8-018	Mosque	Mosque		L	340	25.13051667	68.56364167	
8	8-019	Settlement	Settlement	located on the left and right side of the road	S	340	25.13051667	68.55776667	
8	8-020	Water Body	Channel	Bridge and narrowed road	O	339	25.1018	68.58915	
8	8-021	Road Infrastructure	Single Road		O	338	25.07126667	68.6223	20 feet wide single road

Route Section	*Feature ID*	*Category*	*Feature Name*	*Feature Description*	*Position Type*	*Waypoint*	*Latitude (DD)*	*Longitude (DD)*	*Comments*
8	8-022	Water Body	Channel	Bridge and narrowed road	O	337	25.0648	68.63088333	Canal
8	8-023	Mosque	Mosque		R	336	25.06046667	68.63054167	20 feet wide single road
8	8-024	Road Infrastructure	Single road		O	335	25.05953333	68.63761667	
8	8-025	Educational Facility	Degree College		L	334	25.05078333	68.65469167	
9	9-001		Bypass Road		O	376	25.03433333	68.6564	
9	9-002	Water Body	Channel	Bridge and narrowed road	O	375	25.0398	68.64493333	
9	9-003	Road Infrastructure	Railway Track Crossing	gated crossing	O	374	25.04178333	68.64161667	
9	9-004	Water Body	Channel	Bridge and narrowed road			25.04861667	68.63433333	
9	9-005	Road Infrastructure	Bypass Road		O	372	25.05375	68.63593333	20 feet wide single road
9	9-006	Mosque	Mosque		R	382	24.97151667	68.67190833	
9	9-007	Road Infrastructure	Single Road		O	381	24.98231667	68.66445	
9	9-008	Road Infrastructure	Single Road		O	378	24.99906667	68.65236667	20 feet wide single road
9	9-009	Water Body	Channel	Bridge and narrowed road	O	377	25.01918333	68.652	
9	9-010	Water Body	Channel	Bridge and narrowed road	O	383	24.94151667	68.70298333	
9	9-011	Settlement	Settlement	Settlement located on the left and right side of the road	S	383	24.94151667	68.70298333	
9	9-012	Road Infrastructure	Single Road		O	384	24.92306667	68.7206	20 feet wide single road

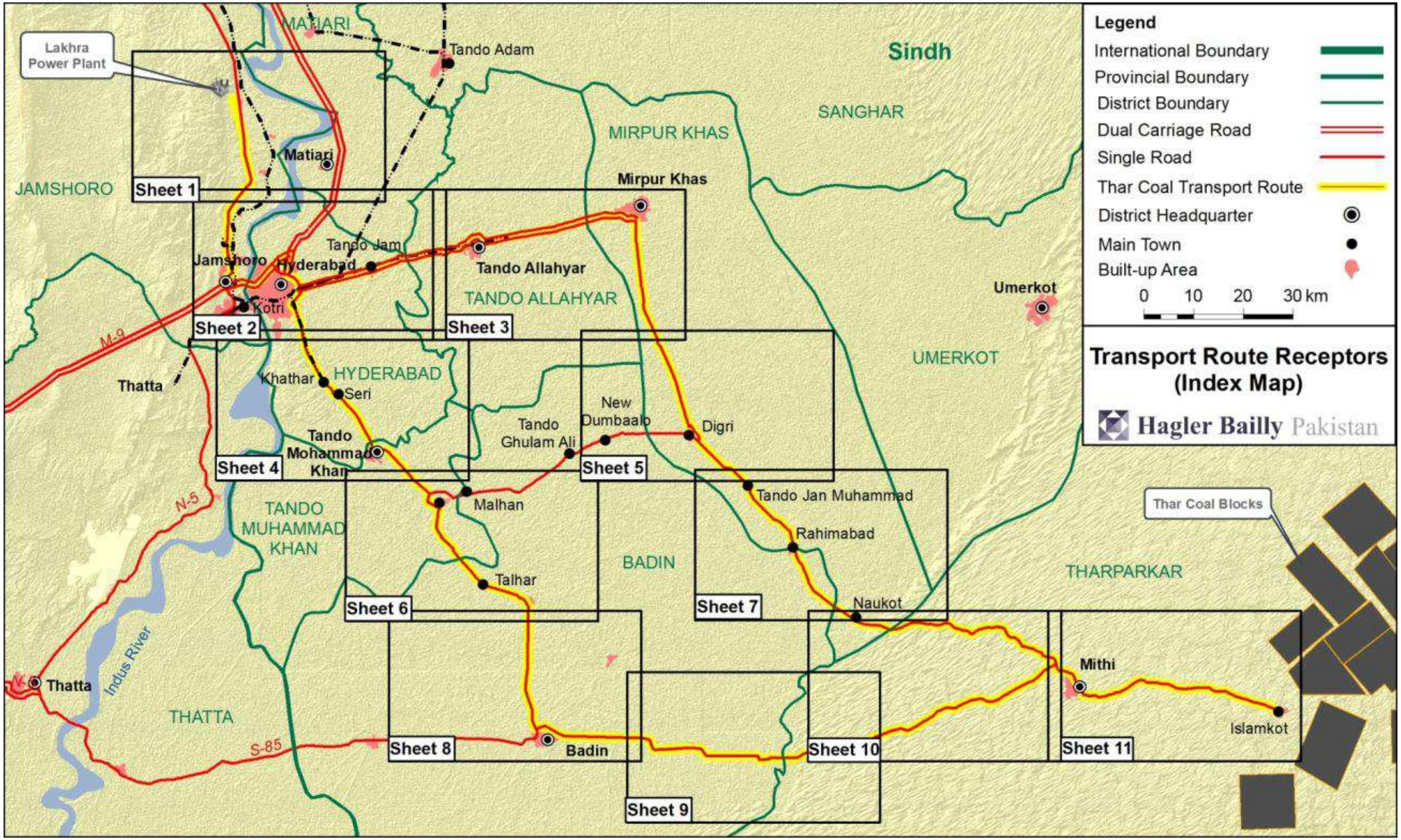
Route Section	*Feature ID*	*Category*	*Feature Name*	*Feature Description*	*Position Type*	*Waypoint*	*Latitude (DD)*	*Longitude (DD)*	*Comments*
9	9-013	Water Body	Channel	Bridge and narrowed road	O	385	24.90826667	68.7377	
9	9-014	Settlement	Settlement	Dokya Madi	L	385	24.90826667	68.743575	
9	9-015	Mosque	mosque		R	386	24.90073333	68.75924167	
9	9-016	Shrine	Shrine		L	386	24.90073333	68.77099167	
9	9-017	Shrine	Shrine		R	387	24.88973333	68.79234167	
9	9-018	Road Infrastructure	Single Road		O	388	24.88736667	68.80186667	
9	9-019	Water Body	Channel	Bridge and narrowed road	O	389	24.88703333	68.80303333	
9	9-020	Settlement	Settlement	Talher Bazar	S	390	24.88548333	68.80805	
9	9-021	Road Infrastructure	Single Road	Broken road	O	391	24.87975	68.81223333	
9	9-022	Road Infrastructure	Single Road		O	392	24.84355	68.81623333	20 feet wide single road
9	9-023	Settlement	Settlement	Bairad Lashari	L	393	24.76571667	68.81974167	
9	9-024	Road Infrastructure	Single Road		O	394	24.74361667	68.81171667	20 feet wide single road
9	9-025	Shrine	Shrine		R	395	24.70218333	68.81780833	Broken Road
9	9-026	Road Infrastructure	Single Road		O	396	24.69436667	68.82378333	Broken Road
10	10-001	Road Infrastructure	Single Road		O	397	24.67248333	68.83021667	
10	10-002	Road Infrastructure	Railway Track Crossing	gated crossing	O	398	24.67365	68.83478333	20 feet wide single road
10	10-003	Water Body	Channel	Bridge and narrowed road	O	399	24.67525	68.85058333	20 feet wide single road
10	10-004		Single Road		R	400	24.6692	68.85629167	20 feet wide single road
10	10-005	Mosque	Mosque		L	401	24.65988333	68.895675	

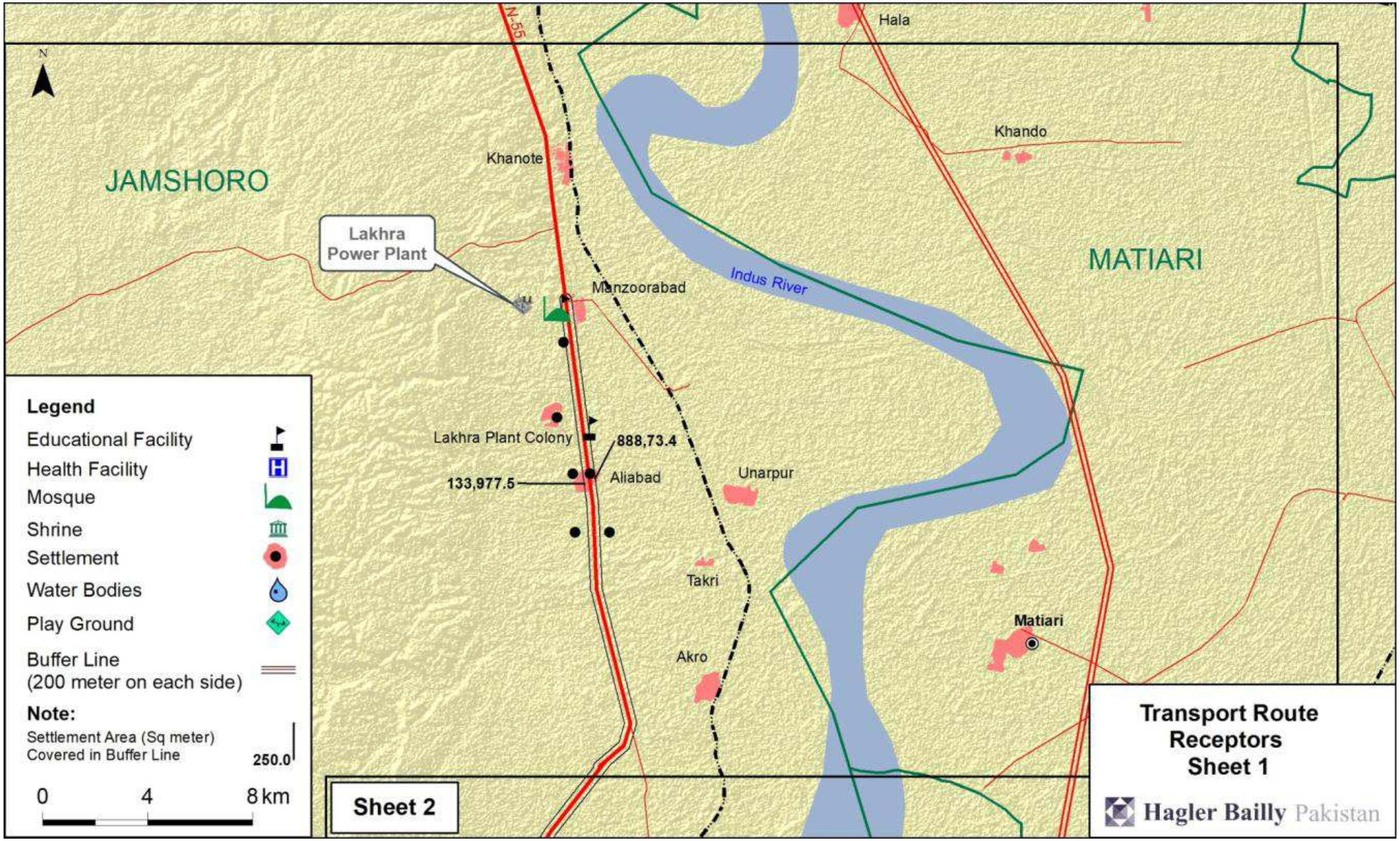
Route Section	*Feature ID*	*Category*	*Feature Name*	*Feature Description*	*Position Type*	*Waypoint*	*Latitude (DD)*	*Longitude (DD)*	*Comments*
10	10-006	Water Body	Channel	Bridge and narrowed road	O	402	24.65851667	68.94945	
10	10-007	Water Body	Channel	Bridge and narrowed road	O	403	24.65795	68.97316667	
10	10-008	Water Body	Channel	Bridge and narrowed road	O	404	24.65781667	68.97896667	
10	10-009	Water Body	Channel	Bridge and narrowed road	O	405	24.65686667	69.01941667	
10	10-010	Educational Facility	School	By Pass Started	L	406	24.65595	69.03440833	
10	10-011	Mosque	Mosque		R	408	24.64011667	69.03554167	
10	10-012	Mosque	Mosque		L	409	24.63791667	69.050325	
10	10-013	Road Infrastructure	Single Road	By Pass ended	O	410	24.6378	69.05031667	
10	10-014	Water Body	Channel	Bridge and narrowed road	O	411	24.63866667	69.07206667	
10	10-015	Road Infrastructure	Bypass Road	Under Construction	O	412	24.63973333	69.09076667	
10	10-016	Water Body	Channel	Bridge and narrowed road	O	413	24.64066667	69.10326667	
10	10-017	Settlement	Settlement	Khoski Bazar, located on the left and right side of the road	S	414	24.64046667	69.1157	
10	10-018	Road Infrastructure	Bypass Road	Under Construction	O	415	24.63193333	69.13476667	
10	10-019	Water Body	Channel	Bridge and narrowed road	O	416	24.62756667	69.16008333	
10	10-020	Settlement	Settlement	Settlement/ Shadi Large	R	417	24.62756667	69.17255833	
10	10-021	Water Body	Channel	Bridge and narrowed road		418	24.62755	69.18121667	
10	10-022	Settlement	Settlement		S	419	24.62755	69.18245	
10	10-023	Mosque	Mosque		L	419	24.62755	69.188325	

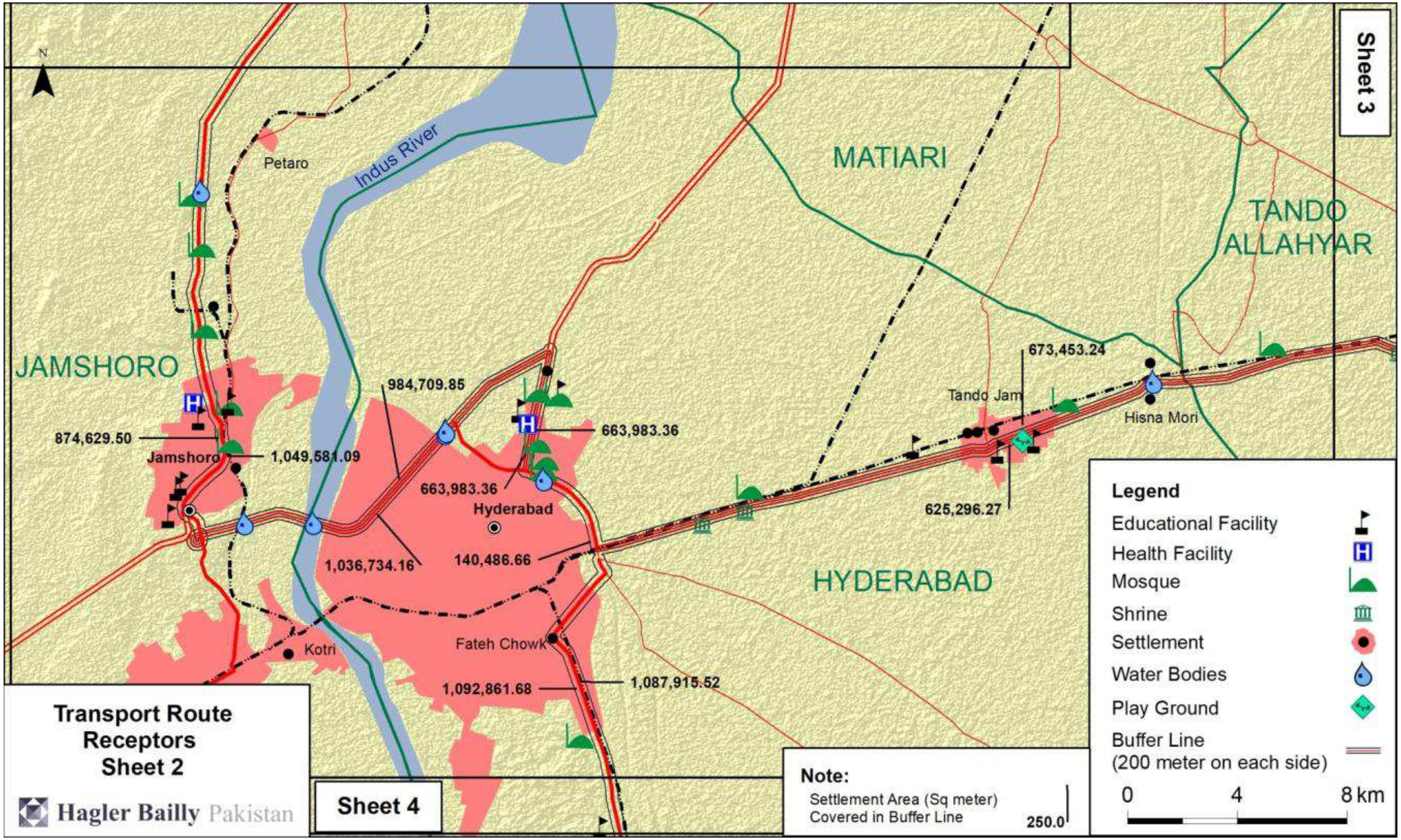
Route Section	*Feature ID*	*Category*	*Feature Name*	*Feature Description*	*Position Type*	*Waypoint*	*Latitude (DD)*	*Longitude (DD)*	*Comments*
10	10-024	Road Infrastructure	Bypass Road	By Pass Under Construction	O	420	24.6275	69.18965	
10	10-025	Water Body	Channel	Bridge and narrowed road	O	421	24.62735	69.21083333	Drain
10	10-026	Water Body	Channel	Bridge and narrowed road	O	422	24.62738333	69.21896667	Drain
10	10-027	Road Infrastructure	Single Road	broken road	O	423	24.62648333	69.23296667	Broken Road
10	10-028	Road Infrastructure	Single Road		O	424	24.62155	69.23671667	
10	10-029	Water Body	Channel	Bridge and narrowed road	O	425	24.62161667	69.2438	Drain
10	10-030	Settlement	Settlement	Base Zulfiqar	R	426	24.62178333	69.24220833	
10	10-031	Road Infrastructure	Single Road		O	428	24.62413333	69.25283333	
10	10-032	Road Infrastructure	Road	Desert Road	O	429	24.62423333	69.26356667	22 feet wide single road
10	10-033	Road Infrastructure	Single Road	Newly Constructed Road	O	430	24.6259	69.30471667	22 feet wide single road
10	10-034	Road Infrastructure	Single Road	Under Construction	O	431	24.63835	69.33051667	
10	10-035	Road Infrastructure	Single Road	Under Construction	O	432	24.64105	69.3433	
10	10-036	Road Infrastructure	Single Road	Under Construction	O	433	24.64146667	69.36445	
10	10-037	Road Infrastructure	Single Road		O	434	24.64283333	69.37955	
10	10-038	Road Infrastructure	Single Road		O	435	24.67136667	69.49536667	Old Road to be constructed
10	10-039	Road Infrastructure	Single Road	Under Construction	O	436	24.74506667	69.71306667	
10	10-040	Road Infrastructure	Single road		O	437	24.77826667	69.77125	

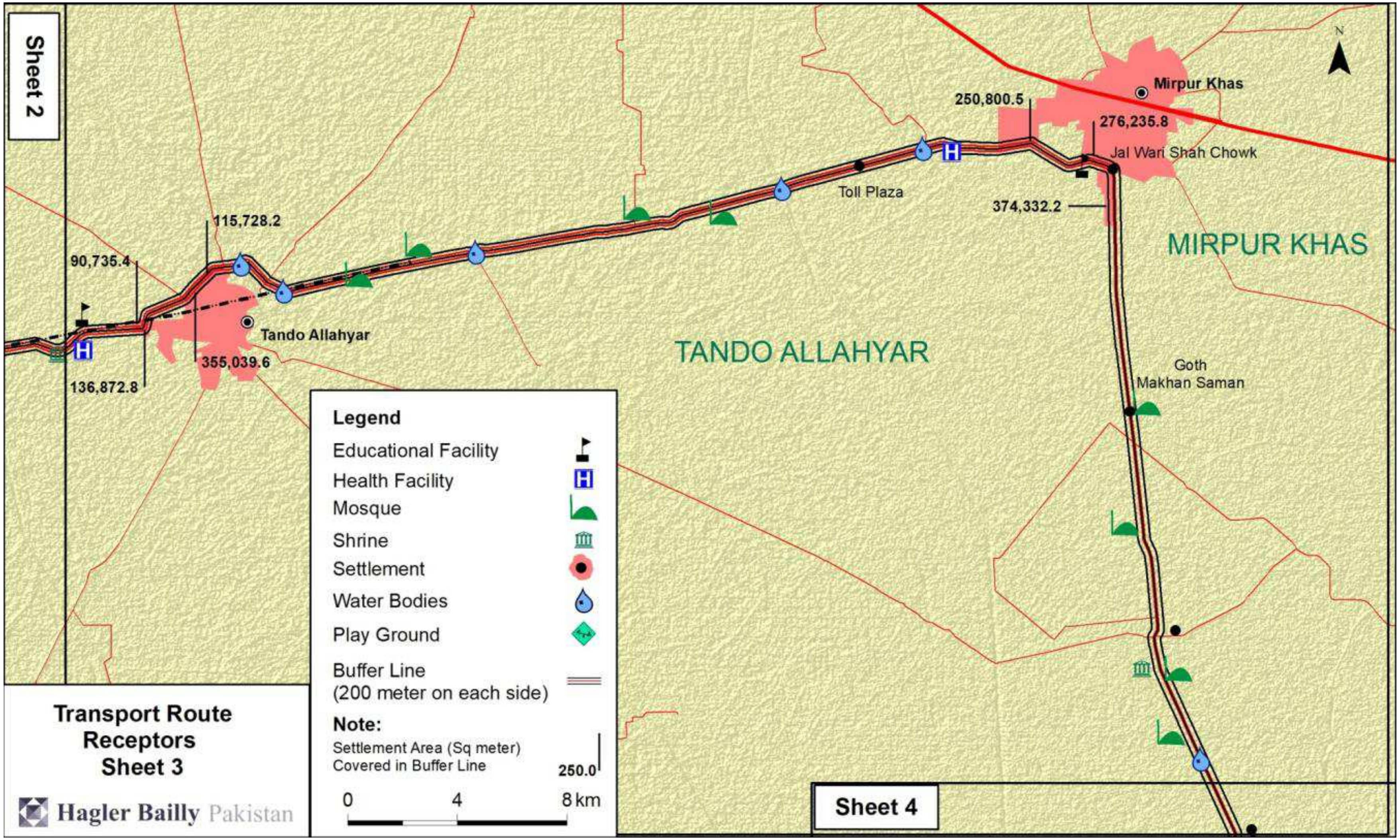
Route Section	*Feature ID*	*Category*	*Feature Name*	*Feature Description*	*Position Type*	*Waypoint*	*Latitude (DD)*	*Longitude (DD)*	*Comments*
11	11-001	Road Infrastructure	Single Road	to Naukot	O	450	24.79085	69.75341667	18 feet wide road
11	11-002	Road Infrastructure	Single Road		O	451	24.79308333	69.74815	18 feet wide road
11	11-003	Road Infrastructure	Single Road		O	452	24.80955	69.70926667	18 feet wide road
11	11-004	Road Infrastructure	Single Road		O	453	24.83896667	69.67266667	18 feet wide road
11	11-005	Mosque	Mosque		L	454	24.83893333	69.60438333	
11	11-006	Settlement	Settlement	Hotel	R	454	24.8283	69.60438333	
11	11-007	Road Infrastructure	Single Road		O	455	24.83805	69.58825	
11	11-008	Mosque	Mosque		R	456	24.83963333	69.54516667	
11	11-009	Settlement	Settlement	Naukot Fort	L	457	24.8479	69.44985	
11	11-010	Mosque	Mosque		R	459	24.83961667	69.4223	
11	11-011	Water Body	Channel	Bridge and narrowed road	O	460	24.84711667	69.41576667	
11	11-012	Settlement	Settlement	Settlement/ Naukot	S	461	24.85316667	69.40633333	
11	11-013	Water Body	Channel	Water Channel	O	462	24.8546	69.40338333	
11	11-014	Settlement	Settlement		S	463	24.85568333	69.4009	
11	11-015	Educational Facility	School	Primary School	L	463	24.861	69.4009	
11	11-016	Mosque	Mosque		L	464	24.8626	69.39805	End of Naukot

Appendix 10: TRAFFIC SITUATION - TRANSPORT ROUTE RECEPTORS ON MAP


Legend
International Boundary
Provincial Boundary
District Boundary
Dual Carriage Road
Single Road
Thar Coal Transport Route
District Headquarter
Main Town
Built-up Area
0 10 20 30 km
Transport Route Receptors (Index Map)
Hagler Bailly Pakistan
Sindh
Lakhra Power Plant
MATIARI
Tando Adam
Matiari
JAMSHORO
Sheet 1
Jamshoro
Hyderabad
Tando Jam
Kotri
Sheet 2
M-9
Thatta
Mirpur Khas
MIRPUR KHAS
SANGHAR
Tando Allahyar
TANDO ALLAHYAR
Sheet 3
Umerkot
UMERKOT
Khathar
Seri
HYDERABAD
Tando Mohammad Khan
Sheet 4
Tando Ghulam Ali
New Dumbaalo
Sheet 5
Digri
N-5
TANDO MUHAMMAD KHAN
Malhan
Tando Jan Muhammad
Rahimabad
Thar Coal Blocks
BADIN
Talhar
Sheet 6
Sheet 7
Naukot
THARPARKAR
Mithi
Islamkot
Indus River
Thatta
THATTA
S-85
Sheet 8
Badin
Sheet 9
Sheet 10
Sheet 11

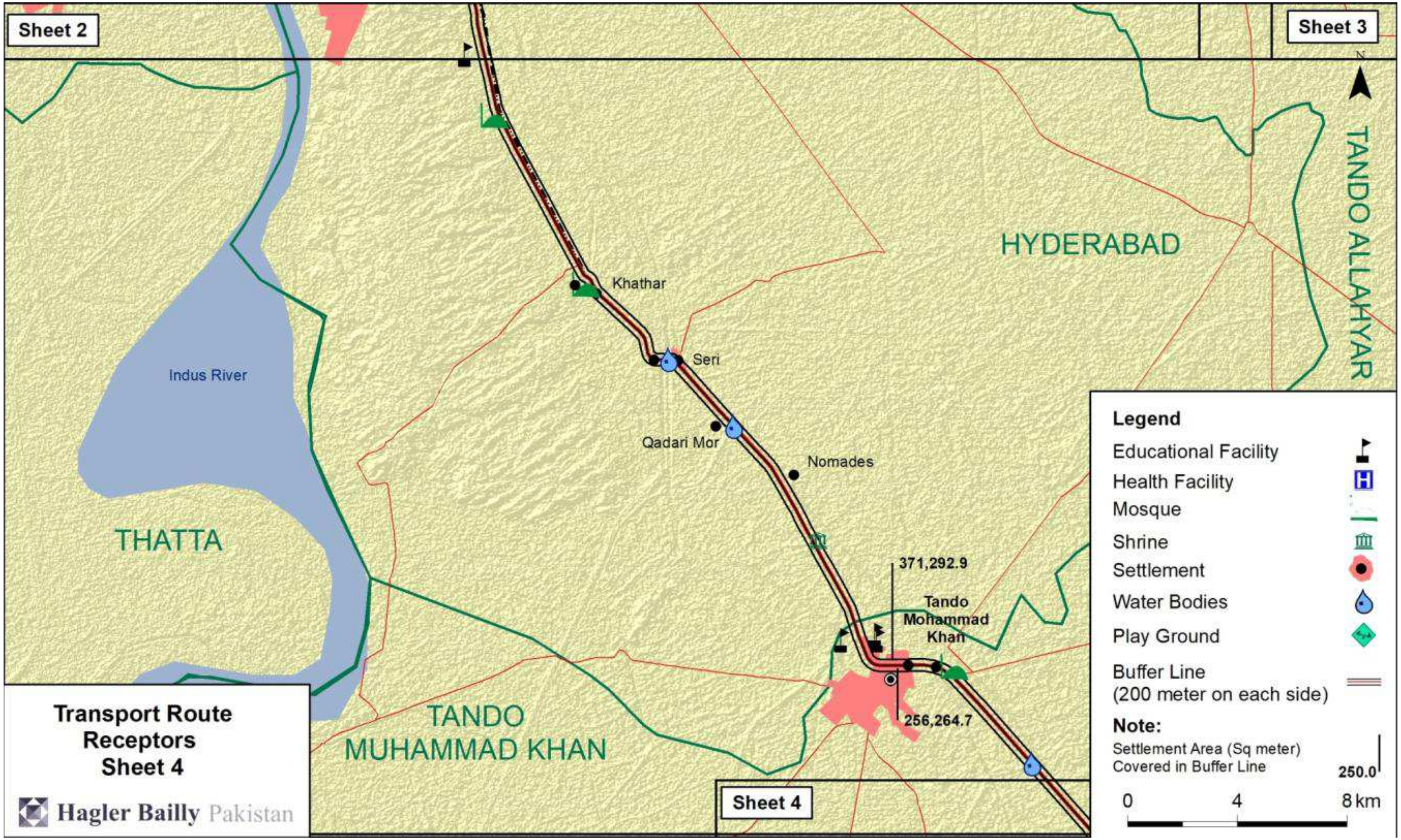

N
JAMSHORO
MATIARI
Lakhra Power Plant
Khanote
Manzoorabad
Indus River
Hala
Khando
Lakhra Plant Colony
888,73.4
133,977.5
Aliabad
Unarpur
Takri
Akro
Matiari
N-55
Legend
Educational Facility
Health Facility
Mosque
Shrine
Settlement
Water Bodies
Play Ground
Buffer Line (200 meter on each side)
Note:
Settlement Area (Sq meter) Covered in Buffer Line
250.0
0
4
8 km
Sheet 2
Transport Route Receptors Sheet 1
Hagler Bailly Pakistan

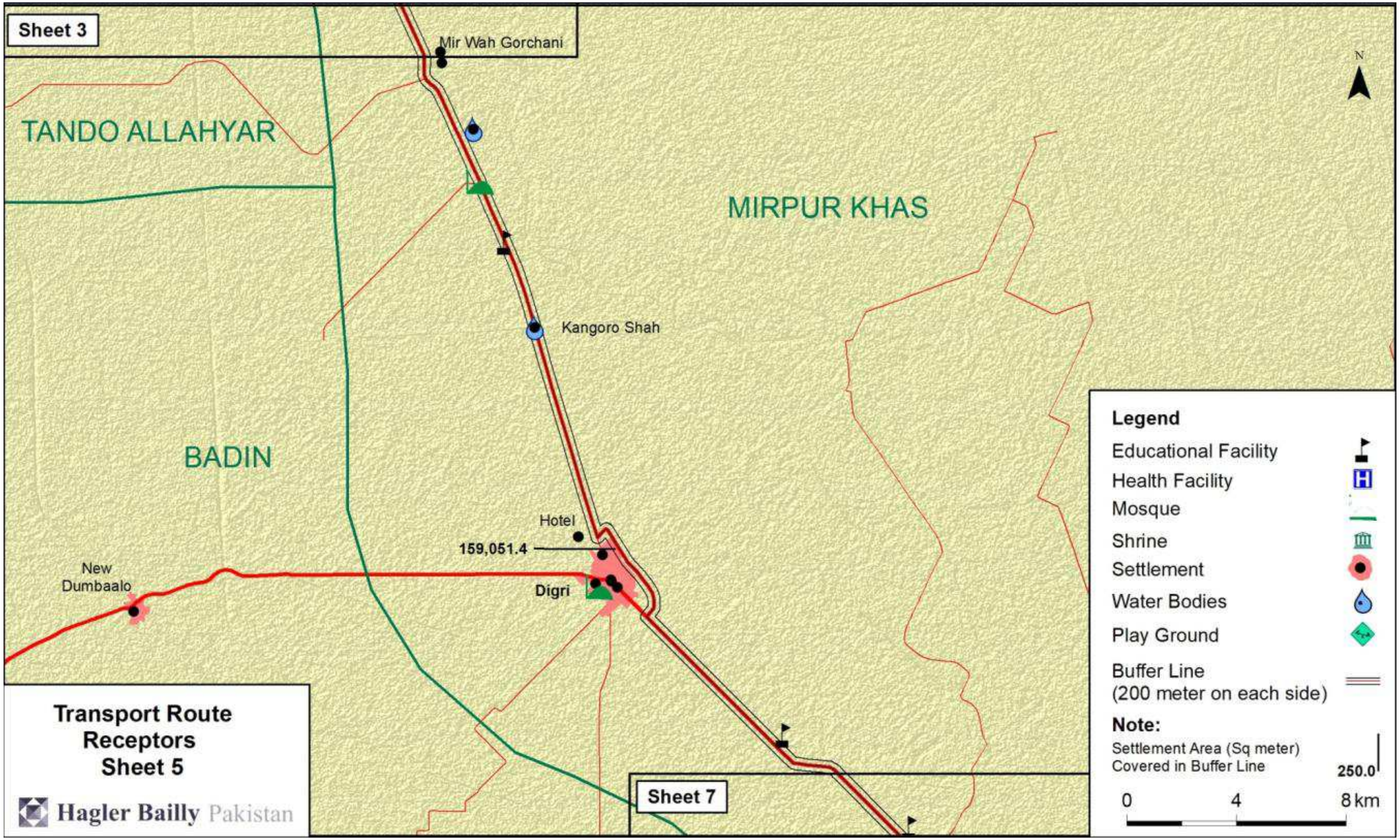

Transport Route Receptors Sheet 2
Hagler Bailly Pakistan
Sheet 3
Sheet 4
N
JAMSHORO
MATIARI
TANDO ALLAHYAR
HYDERABAD
Indus River
Petaro
Jamshoro
Kotri
Hyderabad
Fateh Chowk
Tando Jam
Hisna Mori
874,629.50
1,049,581.09
984,709.85
663,983.36
663,983.36
1,036,734.16
140,486.66
1,092,861.68
1,087,915.52
673,453.24
625,296.27
Note:
Settlement Area (Sq meter) Covered in Buffer Line
250.0
Legend
Educational Facility
Health Facility
Mosque
Shrine
Settlement
Water Bodies
Play Ground
Buffer Line (200 meter on each side)
0
4
8 km



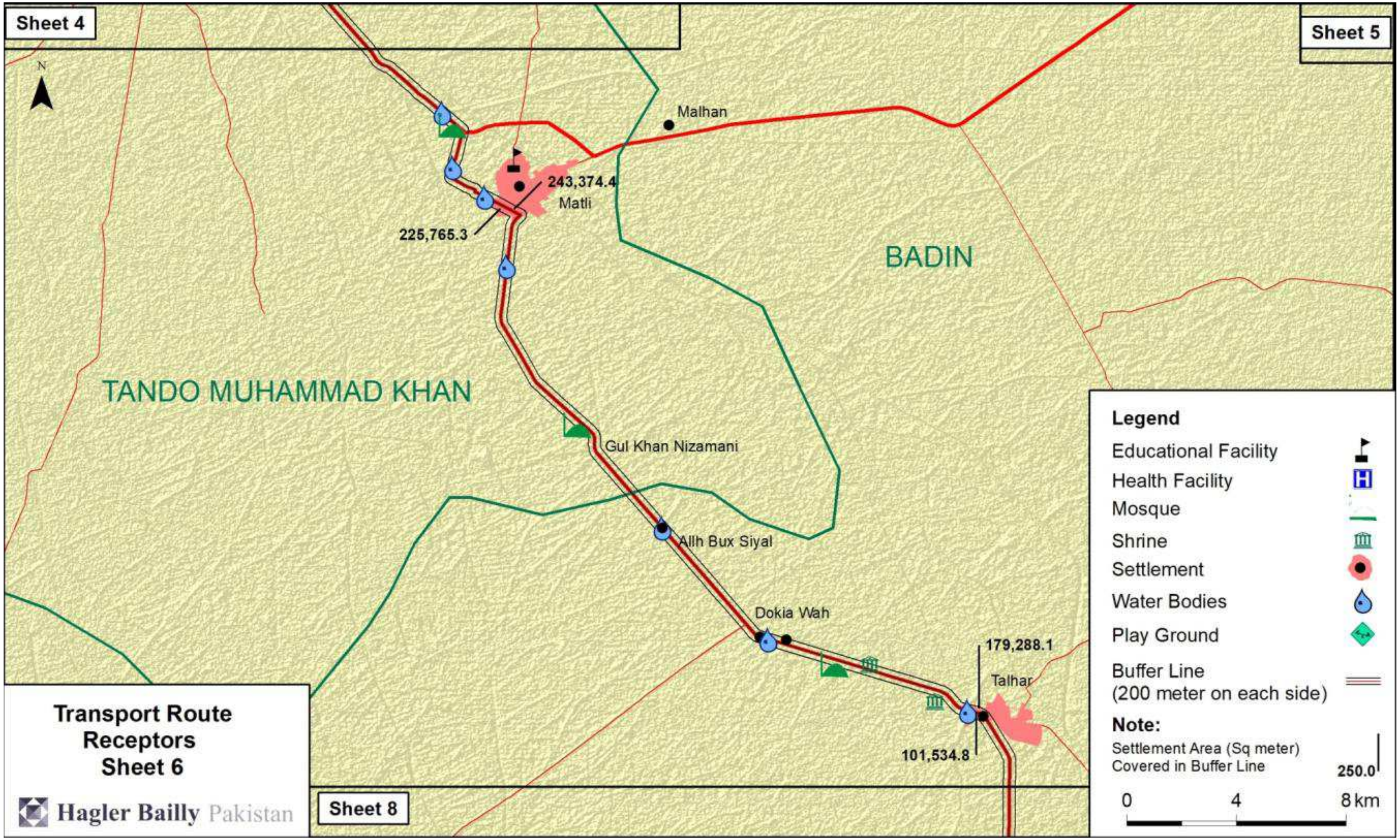
Transport Route Receptors Sheet 3

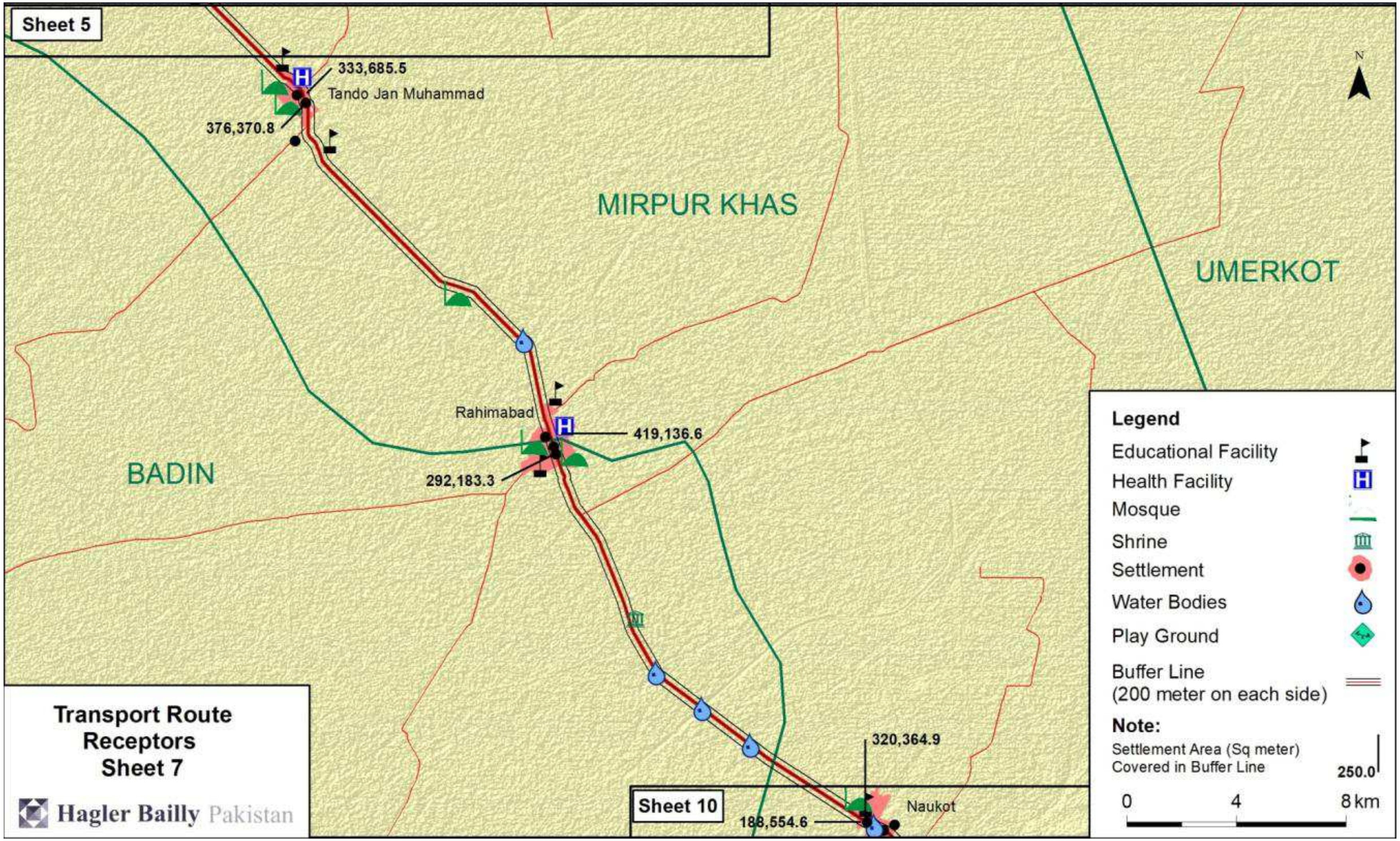
Hagler Bailly Pakistan

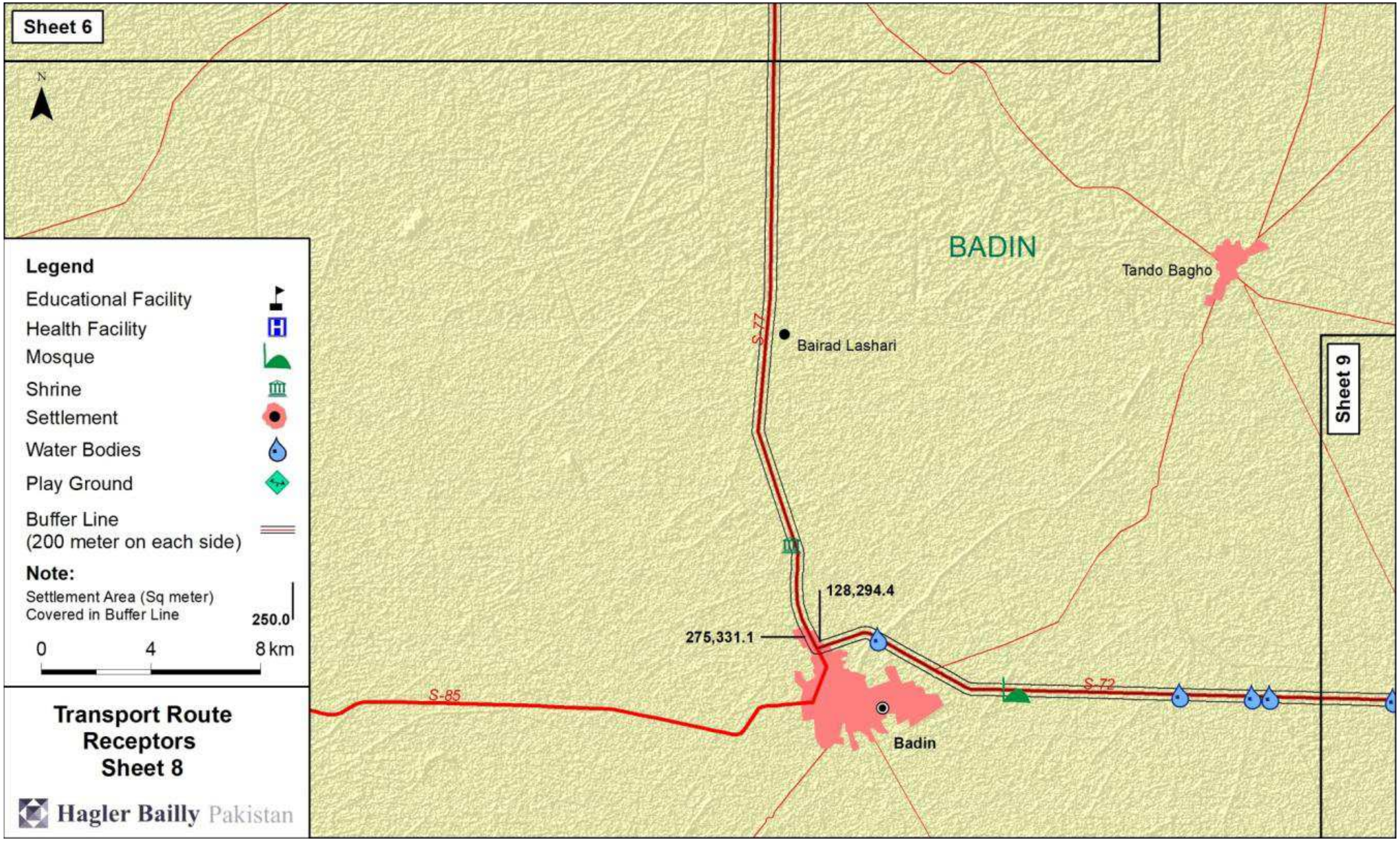

Sheet 2
Sheet 3
Sheet 4
HYDERABAD
TANDO ALLAHYAR
THATTA
TANDO MUHAMMAD KHAN
Indus River
Khathar
Seri
Qadari Mor
Nomades
Tando Mohammad Khan
371,292.9
256,264.7
Legend
Educational Facility
Health Facility
Mosque
Shrine
Settlement
Water Bodies
Play Ground
Buffer Line (200 meter on each side)
Note:
Settlement Area (Sq meter) Covered in Buffer Line
250.0
0
4
8 km
Transport Route Receptors Sheet 4
Hagler Bailly Pakistan



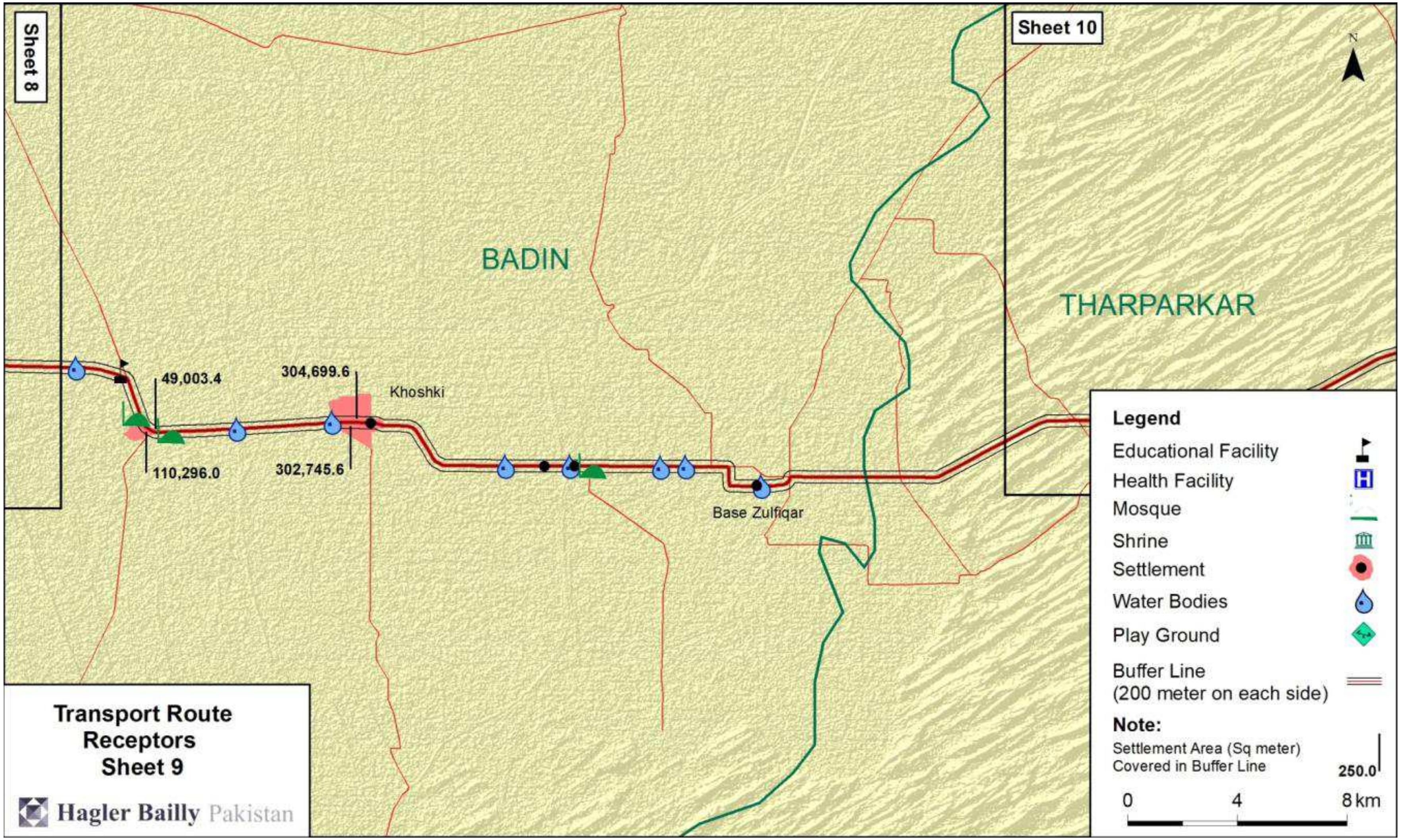
Transport Route Receptors Sheet 5

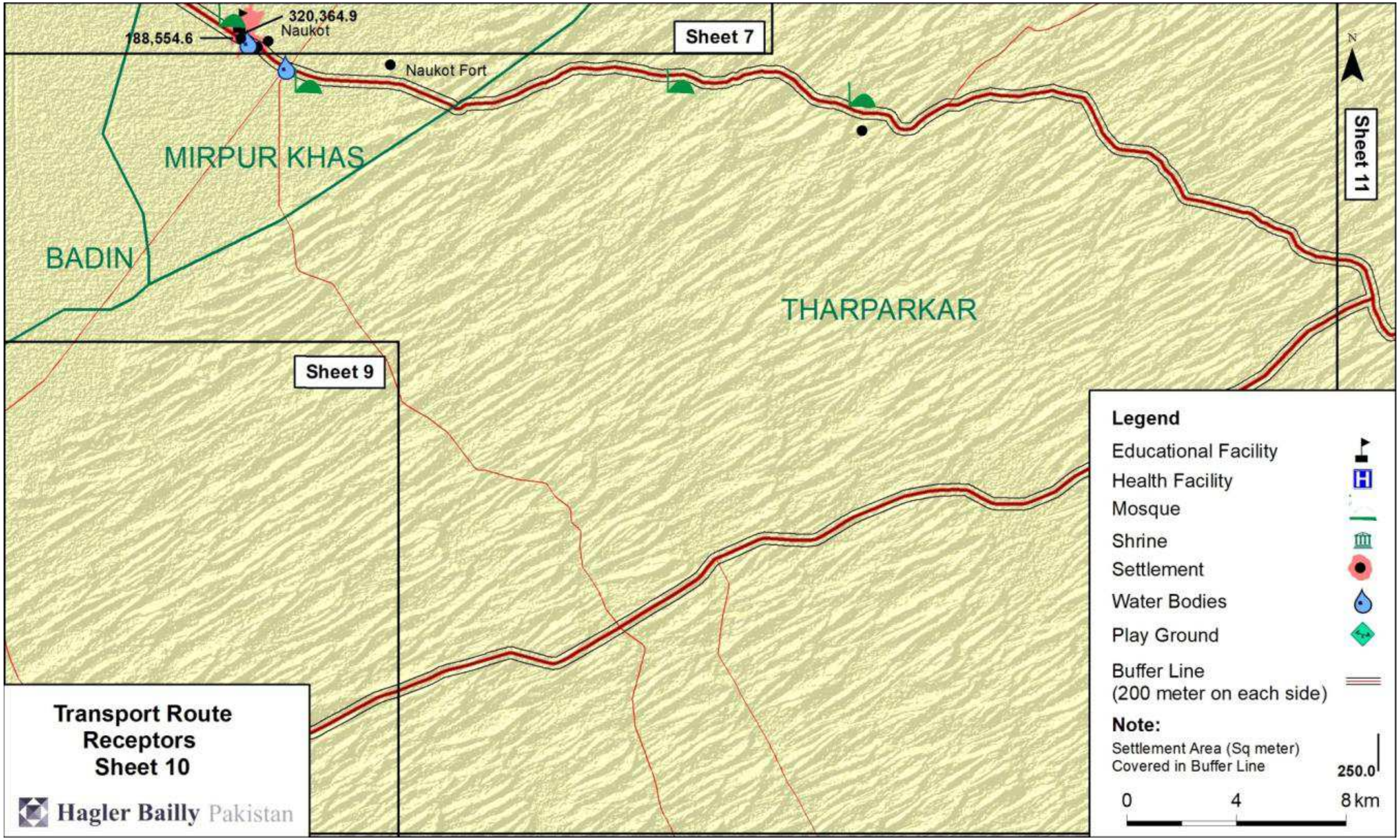

Sheet 4
Sheet 5
N
Malhan
243,374.4
Matli
225,765.3
BADIN
TANDO MUHAMMAD KHAN
Gul Khan Nizamani
Allh Bux Siyal
Dokia Wah
179,288.1
Talhar
101,534.8
Sheet 8
Transport Route Receptors Sheet 6
Hagler Bailly Pakistan
Legend
Educational Facility
Health Facility
Mosque
Shrine
Settlement
Water Bodies
Play Ground
Buffer Line (200 meter on each side)
Note:
Settlement Area (Sq meter) Covered in Buffer Line
250.0
0
4
8 km

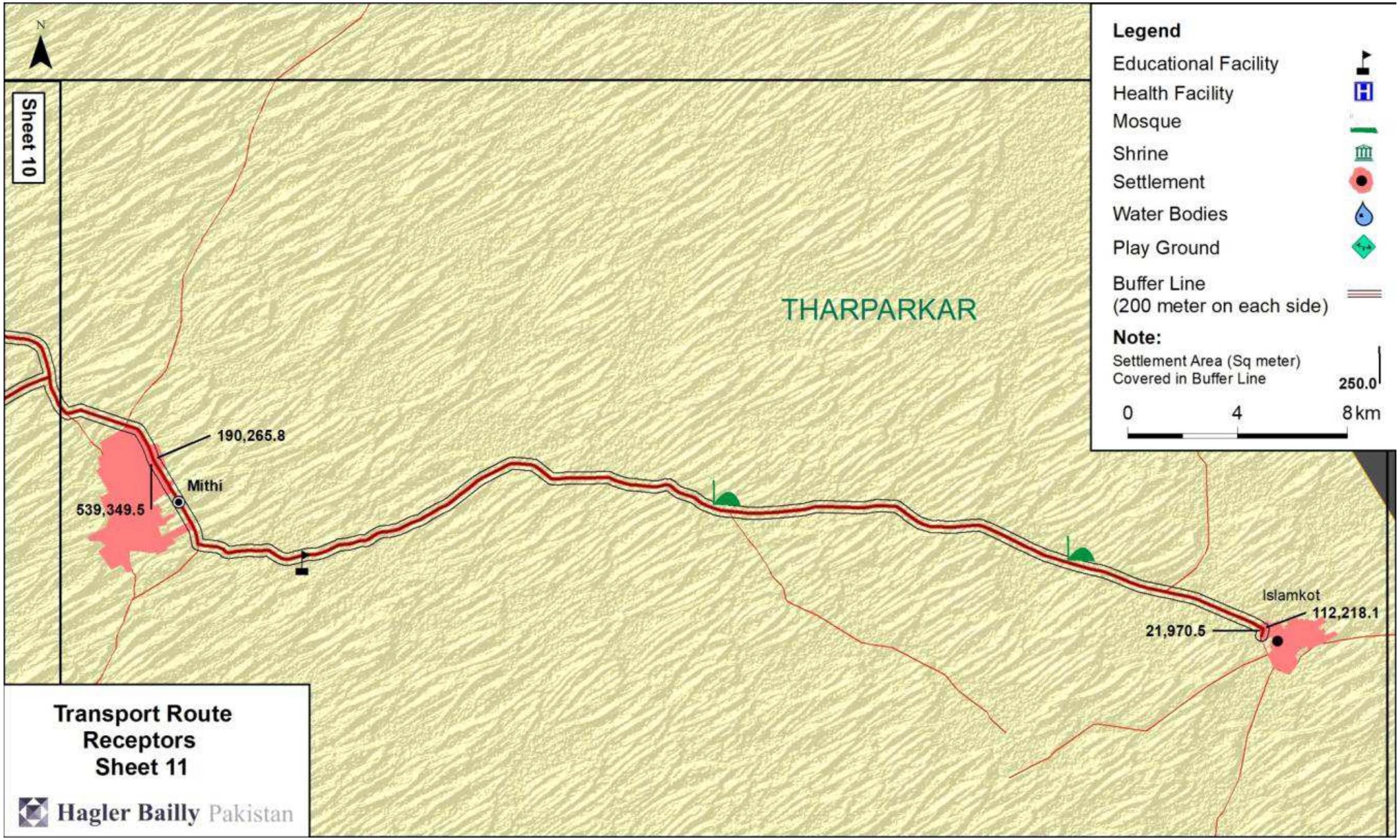

Sheet 5
333,685.5
Tando Jan Muhammad
376,370.8
MIRPUR KHAS
UMERKOT
Rahimabad
419,136.6
292,183.3
BADIN
320,364.9
Naukot
188,554.6
Sheet 10
N
Legend
Educational Facility
Health Facility
Mosque
Shrine
Settlement
Water Bodies
Play Ground
Buffer Line
(200 meter on each side)
Note:
Settlement Area (Sq meter)
Covered in Buffer Line
250.0
0
4
8 km
Transport Route
Receptors
Sheet 7
Hagler Bailly Pakistan



**Transport Route
Receptors
Sheet 8**


Sheet 8
Sheet 10
BADIN
THARPARKAR
49,003.4
304,699.6
110,296.0
302,745.6
Khoshki
Base Zulfiqar
N
Legend
Educational Facility
Health Facility
Mosque
Shrine
Settlement
Water Bodies
Play Ground
Buffer Line
(200 meter on each side)
Note:
Settlement Area (Sq meter)
Covered in Buffer Line
250.0
0
4
8 km
Transport Route
Receptors
Sheet 9
Hagler Bailly Pakistan


320,364.9
Naukot
188,554.6
Sheet 7
Naukot Fort
N
Sheet 11
MIRPUR KHAS
BADIN
THARPARKAR
Sheet 9
Legend
Educational Facility
Health Facility
Mosque
Shrine
Settlement
Water Bodies
Play Ground
Buffer Line
(200 meter on each side)
Note:
Settlement Area (Sq meter)
Covered in Buffer Line
250.0
0
4
8 km
Transport Route
Receptors
Sheet 10
Hagler Bailly Pakistan


N
Sheet 10
Legend
Educational Facility
Health Facility
Mosque
Shrine
Settlement
Water Bodies
Play Ground
Buffer Line
(200 meter on each side)
Note:
Settlement Area (Sq meter)
Covered in Buffer Line
250.0
0
4
8 km
THARPARKAR
190,265.8
Mithi
539,349.5
Islamkot
112,218.1
21,970.5
Transport Route
Receptors
Sheet 11
Hagler Bailly Pakistan

Appendix 11: BACKGROUND INFORMATION DOCUMENT (BID)

February 2014

Background Information Document Environmental Impact Assessment of Lakhra Coal-fired Plant

Introduction

The Government of Japan, under a bilateral agreement with the Government of Pakistan has initiated a feasibility study through Mitsui Consultants and Nippon Koei Company for setting up a 660 MW supercritical coal-fired power plant utilizing imported and Thar coal. The 660 MW coal-fired power plant will be installed within the existing complex of the Lakhra power plant, about 40 km northwest of Hyderabad.

In 2011, the peak generation power in Pakistan was 12,755 MW, while the peak demand was 18,860 MW. This lack of supply capacity is expected to be even severer as the capacity of existing power plants will deteriorate over time and electricity demand, forecasted to grow at an average rate of 5.0% every year, increases. The generated power in Pakistan by energy resource in 2011-12 was 34% oil thermal, 32% hydroelectric, 27% gas, 5% nuclear and only 0.1% coal. The oil thermal generation is the most dependable energy resource, but oil cost remains high and it vulnerable to the market, which means oil thermal, cannot be a stable energy resource.

Mitsui Consultants has acquired the services of Hagler Bailly Pakistan to assist in the environmental study. As a part of the process, consultations are undertaken with communities and institutions that may have interest in the Project or may be affected by the Project (the “Stakeholders”) to record their concerns and to address them in the course of project design and baseline. For informed consultations with the Stakeholder, this Background Information Document (BID) has been prepared to provide information on the project design, its setting and baseline of the proposed project area.

Project Setting

Lakhra power plant is located in Manjhand Taluka, Jamshoro region, about 217 km northwest of Karachi and about 30 km northeast from Jamshoro power plant. It is located on N-55 (Indus Highway) which is one of the main highways that connect Karachi with the rest of the country (**Exhibit 1**).

Existing Lakhra power plant was commissioned in 1995 and is the only coal-fired thermal power plant in Pakistan. The design is an outdated concept and all of the equipment’s being operated manually. The plant originally had three boilers, out of which boiler two and three have been severely deteriorated to the level where their operations have been terminated. Only one unit (Unit no 1) is operating since March, 2007. Lakhra power plant was designed for 150 MW capacity but currently it is generating only 30 MW.

The proposed project site has an area of 77 hectare, which is located in the southwest of the existing power plant. Currently, the land is mostly empty.

The Indus River flows on the east of the project site at a distance of about 4 km. Water requirement of the power plant is met through an inlet pipe connected to the Indus River.

Barren plain of limestone is spread in the western side of Lakhra power plant. The plain has poor vegetation and coal ash from the plant is disposed of here. The limestone is mined and used as a desulfurization material for the existing power plant. The photographs of project area are shown in **Exhibit 2**.

Project Outline

This project includes the construction following infrastructure:

- 660 MW coal fired power plant including ash pond, switch yard, water treatment facilities etc.
- Approximately 2 km of sidetrack from the existing railway
- Coal unloading and transferring station near by the end of sidetrack
- Belt-conveyer from the coal transferring station to the power plant
- Approximately 4.2 km of water intake pipe line from the Indus River to the power plant and pumping station at the river side
- Approximately 4 km of new transmission line from the power plant to the existing transmission line

Water for the project will be obtained from the Indus River. The plant will produce different types of waste water.

- Boiler blow down water - treated and discharged into Indus River
- Boiler wash discharge - treated and discharged into Indus River
- Cooling water - evaporated through a cooling tower.
- Oil contaminated and heavy metal contaminated water - treated and discharged into the Indus River.
- Domestic water from toilet facilities - treated and discharged into the Indus River.

Salient features of the power plant are as follow:

- All components will be installed within the boundary of existing Lakhra power plant
- The plant will be based on super-critical or ultra-super-critical boiler which has a higher efficiency compared to the conventional sub-critical boiler
- Till the development and mining of Thar coal does not take its final shape and reach a stage where it can be fully materialized, the coal requirement of the plant will be fulfilled with 100% imported coal. After ensuring the availability of coal from Thar, a mix of 80% imported and 20% Thar coal will be used to operate the power plant.
- Emission control equipment such as flue gas desulfurization, low NOx burner and particulate matter control will be installed.
- An ash pond will be constructed.

- The imported coal will be unloaded at Port Qasim and transported to power plant by rail, whereas the Thar coal will be transported by road initially and by rail when the rail link is developed.

Exhibit 1: Location of the Project

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Exhibit 2: Photographs of the Project Area

View of the Project Site

Indus River

Water Intake Site

Residential Area

Existing Coal Storage

Approach to the EIA

The study will be undertaken in compliance with relevant national legislation and international guidelines. The major components of the study include:

- comprehensive baseline studies to characterize the existing ecological environment in the project area;
- public consultation process to ensure that project stakeholders are informed of the project development plan and have an opportunity to influence it;
- input to the project planning process to ensure that ecological constraints are considered in project design;
- a comprehensive analysis of the ecological impacts of the project, both negative and positive; and,
- suggested mitigation measures to address the identified impacts.

List of potential environmental and social impacts are presented in **Exhibit 3.** A brief overview of the conceptual components of an EIA process that meets both Pakistan and international standards is given in **Exhibit 4.** A preliminary list of potential environmental and social impacts of the Project and a list of biodiversity issues that will be investigated during the EIA are provided below.

Exhibit 3: Lit of Environmental and Social Impacts

List of potential environmental and social impacts
♦ Provision of employment to people
♦ Construction related impacts such as noise and dust
♦ Reduction in power outages and revival of the affected economies
♦ Increase in traffic due to Project related transportation
♦ Disturbance due to dust, noise, vibration, road congestion, and safety hazard from heavy traffic
♦ Changes to existing social and cultural norms
♦ Pressure on existing infrastructure as a result of influx of job seekers
♦ Contamination of soil

Exhibit 3: Conceptual Components of an EIA Process

Component	*Main purpose*	*Activities related to Stakeholder Consultations*
Scoping	♦ Identify the issues on which the EIA should focus. ♦ Identify project alternatives that should be evaluated during the course of the EIA.	♦ Identify institutional and community stakeholders ♦ Engage stakeholders and record issues raised ♦ Provide feedback to the EIA team to incorporate stakeholders' concern in baseline investigations and impact assessment
Baseline investigations	♦ Collect background information on the environmental and social setting of the project.	♦ Incorporate additional issues raised during the baseline survey
Impact assessment, studies	♦ Define the potential impacts of the project ♦ Undertake specialist investigations to predict changes to environment due to the project ♦ Determine the significance of the potential impacts ♦ Identify measures for the management of the impacts ♦ Determine the residual impacts of the project after incorporation of the management measures. ♦ Evaluate the overall acceptability of the project (from environmental and social perspectives).	♦ Assess issues raised by stakeholders
Mitigation Measures and management plan	♦ Environmental mitigation and monitoring plan will describe the measures proposed to ensure implementation of the mitigation measures identified during the impact assessment. It will include, for example, specific designs and plans, training requirements, resource requirements, monitoring details (sampling locations, methodology, and frequency), review and reporting requirements and budget.	♦ Assess the acceptability and practicability of the proposed mitigation measures
EIA Report Preparation	♦ After the studies, the EIA team will pull together the detailed assessment of impacts and mitigation measures. This may involve liaison with various specialists to ensure correct interpretation of information and compile EIA report.	♦ Provide stakeholders with a feedback on the EIA specifically communicate how the project proponent proposes to address the issues raised by the stakeholders.
EIA submittal to regulatory authorities and decision making	♦ Submittal and review of the EIA report by regulatory authorities and other interested stakeholders. The reviewers will inform about their decision on the acceptability of the Project from environmental and social perspectives and the conditions of approval for the development	♦ Attend the public hearings and respond to the issues raised during the public hearings.

For further information on the study please contact:

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کوئلي واري لاکڙا بجلي گهر جي ماحولياتي اثرن واري اپياس بابت دستاويزي معلومات

تعارف:

جاپاني حکومت، پاکستاني سرکار سان گڏجي ٻه طرفي معاهدي تحت ٿر مان ملندڙ کوئلي توڙي پرڏيهه مان درآمد ٿيندڙ کوئلي تي هلندڙ 660 ميگاواٽ جو هک سپر کرٽکل بجلي گهر لڳائڻ جي حوالي سان مٿسوئي کنسلٽنٽس ۽ نپون کوئي کمپني جي ذريعي هک امکاناتي اپياس جي شروعات کئي آهي، جيکو لاکڙا پاور پلانٽ جي اڳواٽ قائم کامپليکس ۾ ئي نصب کيو ويندو. اهو کامپليکس حيدرآباد کان اتر-اولهه واري پاسي ڏانهن 40 کلوميٽرن جي مفاصلي تي واقع آهي.

2011ع جي انگن اکرن موجب، پاکستان جي وڌ ۾ وڌ بجلي پيداوار 12755 ميگاواٽ هئي، جڏهن ته وڌ ۾ وڌ گهرج ان کان کيئي پيرا وڌيک يعني 18860 ميگاواٽ هئي. پاکستاني بجلي فراهمي واري نظام منجهان حاصل ٿيندڙ کل بجليءَ پيداوار جو اهو انگ گهٽجڻ جو گهڻو امکان موجود آهي، ڇو جو موجوده بجلي گهرن جي بجلي پيدا کرڻ واري صلاحيت ۾ پڻ وقت گذرڻ سان گڏ گهٽتائي اٽر آهي. هوڏانهن ملک ۾ بجلي جي گهرج ۾ پڻ هر سال 5 سيکڙو جي حساب سان واڌ ٿيندي، جيکو صورتحال کي ويتر ڳنڀير بڻائي ڇڏيندو. 2011-2012ع جي انگن اکرن موجب پاکستان ۾ جيکا بجلي جي کل پيداوار هئي، تنهن ۾ ٿرمل بجلي جو حصو 34 سيکڙو، هائيڊرو اليکٽرک جو حصو 32 سيکڙو، گيس مان پيدا ٿيندڙ بجلي جو حصو 27 سيکڙو، جوهري توانائي مان حاصل ٿيندڙ حصو 5 سيکڙو، جڏهن ته کوئلي مان پيدا ٿيڻ واري بجلي جو کل حصو 0.1 سيکڙو رهيو آهي، تيل مان ٺهندڙ بجلي ئي پاکستان ۾ پيدا ٿيندڙ کل بجلي جو وڏي پائيوار آهي، جڏهن ته تيل جا اگهه ڳرا ئي رهن ٿا ۽ اهو وسيلو منڊي ۾ به سدائين لاهن چاڙهن جي ور چڙهيل رهندو آهي. ان جو مطلب اهو وڃي بيهي ٿو ته تيل مان حاصل ٿيندڙ بجلي يا جنهن کي آئل ٿرمل پاور چئجي اهو توانائي جو پاڙڻ جوڳو ذريعو ناهي.

ماحولياتي اپياس واسطي مٿسوئي کنسلٽنٽس پاران هيگلر بيلي پاکستان نالي هک اداري جون خدمتون حاصل کيون ويون آهن. ان سموري عمل جي ئي حصي طور اهڙي مقامي آبادي توڙي اهڙن مقامي ادارن سان لهه وچڙ ۾ اچي انهن سان مشاورت کئي پيئي وڃي جن کي ان منصوبي ۾ دلچسپي هجي يا وري جيکي ان منصوبي کان متاثر ٿيندا هجن (انهن کي ٻين لفظن ۾ پاڳي پائيوار ڌريون چئي سگجهي ٿو). ان مشاورت جو مقصد منصوبي کي حتمي شکل ڏيڻ واري عمل دوران انهيءَ آبادي توڙي انهن ادارن جا اعتراض ختم کري سگهڻ آهي. انهن ئي مشاورتي گڏجاڻين ۾ شريک ٿيندڙن کي منصوبي جي بنيادي ڄاڻ ڏيڻ، منصوبي جي شکل ۽ منصوبي جي تجويز کيل مقام کان آگاهه کرڻ لاءِ هيءُ پس منظر جي ڄاڻ وارو دستاويز تيار کيو ويو آهي.

منصوبي جي جاءِ :

لاکڙا بجلي گهر ڄامشوري جي حدن ۾ مانجهند تعلقي ۾ واقع آهي. هيءُ علائقو کراچي کان اتر-اولهه ڏانهن 217 کلوميٽرن جي مفاصلي تي آهي جڏهن ته ڄامشوري واري بجلي گهر کان اتر-اولهه ڏانهن 30 کن کلوميٽرن جي مفاصلي تي اين-55 (انڊس هاءِ وي) تي واقع آهي، جيکو کراچي کان ملک جي مختلف علائقن سان ڳنڍيندڙ مک روڊن مان هک آهي **(ڏيک نمبر 1)** .

موجود لاکڙا بجلي گهر 1995ع ۾ قائم کيو ويو ۽ اهو ملک جو واحد کوئلي مان بجلي پيدا کندڙ ٿرمل بجلي گهر آهي. ان جي شکل ٻه پراڻن ٽيکنيکل نظرين تي مشتمل آهي ۽ ان ٿرمل گهر جي سموري مشينري کي پڻ هٿن سان هلايو وڃي ٿو. ان بجلي گهر اندر شروعات ۾ ٽي بوائلر هئا، جن مان بوائلر نمبر 2 ۽ 3 ذري گهٽ مکمل طور تي ناکاره ٿي چکا آهن، ايترقدر جو هاڻي انهن کي استعمال به نه ٿو کيو وڃي. فقط هکڙو ئي بوائلر يونٽ، جيکو بوائلر نمبر 1 آهي، مارچ 2007ع کان کتب اچي رهيو آهي. لاکڙا بجلي گهر 150 ميگاواٽ بجلي پيدا کرڻ لاءِ قائم کيو ويو آهي، جڏهن ته موجوده کل پيداوار 30 ميگاواٽ آهي.

تجويز کيل بجلي گهر واري منصوبي جي کل ايراضي 77 هيکٽيئر (يعني 190.19 ايکڙ) هوندي، ۽ اهو موجوده بجلي گهر جي ڏکڻ-اولهه پاسي ڏانهن نصب کيو ويندو. هن وقت تجويز کيل ايراضي خالي زمين ئي آهي.

درياءِ سنڌ به تجويز کيل منصوبي واري مقام کان اندازي موجب 4 کلوميٽرن جي مفاصلي تي وهي ٿو. تجويز کيل بجلي گهر جي پاڻيءَ واري ضرورت درياءِ سنڌ تائين هک پائيپ لائين پهچائڻ سان پوري کري سگهجي ٿي.

چن واري پٽر جو غير آباد پٽ لاکڙا بجلي جي اولهندي پاسي ڏانهن واقع آهي. ان پٽ جي غير زرعي خاصيت سبب بجلي گهر مان نکرندڙ کوئلي جي چار اتي ضايع کئي وجي ٿي. ان پٽ مان ملندڙ چن جو پٽر موجود بجلي گهر لاءِ ڊي سلفرائيزيشن (Desulfurization) کرڻ واري مواد طور استعمال کيو وجي ٿو. ان پٽ جون کجهه تصويرون اوهان کي **ڏيک نبمر 2** ۾ نظر اينديون.

منصوبي جو خاکو:

هن منصوبي ۾ هيٺ ڄاڻايل بنيادي ڍانچي ۾ شامل تعميراتي کم کيا ويندا:

- 660 ميگاواٽ بجلي پيدا کري سگهندڙ کوئلي جي مدد سان هلڻ وارو بجلي گهر، ان لاءِ گهربل چار تلاءُ، سوئچ يارڊ (switch yard) ۽ پاڻي جي ٽريٽمنٽ جي سهولت.
- موجوده ريل پٽڙي کان نکرندڙ هک اندازي موجب 2 کلوميٽرن تائين اضافي پٽڙي.
- انهيءَ پٽڙي جي ڇيڙي تي کوئلو لاهڻ ۽ ان کي بجلي گهر تائين پهچائڻ لاءِ هک اسٽيشن.
- فيکٽرين ۾ استعمال ٿيڻ واري کنهن سامان کي قطار ۾ هک جاءِ کان ٻي جاءِ تائين پهچائڻ وارو خودمختار بيلٽ کنويئر (کوئلي کي اسٽيشن کان بجلي گهر تائين پهچائڻ لاءِ).
- هک اندازي موجب درياءِ سنڌ کان بجلي گهر تائين 4.2 کلوميٽر پکيڙ رکندڙ پاڻي پهچائيندڙ پائيپ لائين ۽ دريا جي کپ تي ان مقصد لاءِ هک پمپنگ اسٽيشن.
- نئين تجويز کيل بجلي گهر کان وٺي موجوده ٽرانسميشن لائين تائين وڃڻ واري هک نئين بجلي پهچائيندڙ لائين، جيکا لڳ ڀڳ 4 کلوميٽر ڊيگهه رکندڙ هوندي.

بجلي گهر جي لاءِ پاڻي درياءِ سنڌ مان حاصل کيو ويندو. بجلي گهر پنهنجي بجلي پيدا کرڻ واري عمل جي نتيجي ۾ فضلو پاڻي پيدا کندو.

- بوائلر جي کم مان پيدا ٿيڻ وارو فضلو پاڻي - ان جي صفائي کري اهو پاڻي ٻيهر دريا ۾ ڇوڙ کرايو ويندو
- بوائلر جي صفائي کانپوءِ نکرندڙ پاڻي - ان جي صفائي کري اهو پاڻي ٻيهر دريا ۾ ڇوڙ کرايو ويندو
- ٿڌ پيدا کرڻ لاءِ استعمال ٿيڻ وارو پاڻي - اهو پاڻي هک کولنگ ٽاور (ٿڌ پيدا کرڻ وارو ٽاور) ذريعي ٻاڦ بڻائي ضايع کيو ويندو
- تيل وسيلي فضلو بڻيل يا وري لوهه وسيلي فضلو بڻيل پاڻي - ان جي صفائي کري اهو پاڻي ٻيهر دريا ۾ ڇوڙ کرايو ويندو
- گهريلو کم کار جيئن ته کاکوس ۽ غسل خاني مان نکرندڙ پاڻي - ان جي صفائي کري اهو پاڻي ٻيهر دريا ۾ ڇوڙ کرايو ويندو

ان بجلي گهر بابت کجهه خاص نقطا:

- بجلي گهر لاءِ گهربل سمورا حصا لاکڙا بجلي جي موجوده حدن اندر ئي نصب کيا ويندا.
- نئين بجلي گهر ۾ پراڻن سب کرٽکل بوائلر جي جاءِ تي سپر کرٽکل يا الٽرا سپر کرٽکل بوائلر استعمال کيا ويندا.
- جيستائين ٿر کوئلي جي ترقي ۽ کوٽائي وارو کم حتمي شکل اختيار نه ٿو کري، تيستائين بجلي گهر جي کوئلي واري گهرج 100 سيکڙو درآمد کيل کوئل مان پوري کئي ويندي. جڏهن ٿر جو کوئلو مکمل طور تي کوئلي پيداوار ڏيڻ واري مقام تائين پهچي ويندو ته بجلي گهر جي کوئلي واري گهرج جو 20 سيکڙو حصو ٿر جي کوئلي مان جڏهن ته باقي 80 سيکڙو حصو درآمد کيل کوئلي مان پورو کيو ويندو.
- اخراج جي ضابطي لاءِ کتب آندي ويندڙ مشينري، جهڙوک فلو گيس ڊي سلفرائيزيشن، هيٺانهون اين او ايکس (NOx) برنر ۽ پارٽيکيوليٽ ميٽر کنٽرول نصب کيو ويندو.
- چار تلاءُ تعمير کيو ويندو
- درآمد کيل کوئلو قاسم بندر تي لاٿو ويندو ۽ ان کي ريل ذريعي بجلي گهر تائين پهچايو ويندو، جڏهن ته ٿر جو کوئلو شروعاتي طور تي روڊ ذريعي بجلي گهر تائين رسايو ويندو ۽ بعد ۾ ريل جو نظام وجود ۾ اچڻ کانپوءِ ان کي به ريل ذريعي ئي بجلي گهر تائين پهچايو ويندو.

شڪل 1: منصوبي جو هنڌ

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

شكل :2 منصوبى جى هنڌ جون تصويرون

منصوبي واري مقام جو ڏيک

پاڻي جي داخلي وارو مقام

سنڌو دريا جو ڏيک

موجوده ڪوئلو ذخيرو ڪرڻ جو هنڌ

رهائشي علائقو

ESIA جو طريقيکار:

اپياس لاڳاپيل قومي قانونسازي جي قدرن ۽ بين الاقوامي رهبري جي اصولن موجب کيو ويندو. اپياس جي مک پاڳن ۾ هيٺيان نقطا شامل هوندا:

- نيادي ڄاڻ حاصل کرڻ لاءِ جامع اپياس جيکو موجوده وقت جي ماحولياتي مسئلن جي سڃاڻپ کرڻ ۾ مدد ڏئي.
- عوام سان مشاورت وارو عمل يقيني بنائڻ، ته جيئن منصوبي جا شراکتدار منصوبي جي ترقياتي کم کان آگاهه به هجن ۽ اهي منصوبي کي پنهنجي مرضيءَ موجب متاثر کري سگهن.
- منصوبابندي جي مختلف مرحلن ۾ ان سموري ڄاڻ جو شامل رکڻ ته جيئن آب هوا جي حوالي سان جن کي نظر ۾ رکڻو آهي، منصوبي کي حتمي شکل ڏيڻ دوران اهي نه اورانگهجن.
- منصوبي جي ماحولياتي اثرن جو هک جامع جائزو جنهن ۾ سڌا توڙي منفي ۽ي اثر نظر هيٺ آندا وڃن.
- جائزي مان جن ماحولياتي اثرن جو پتو پوي تن کي ادراک لاءِ جوڳن قدمن جي صلاح ڏيڻ.

ڏيک نمبر 3 ۾ اوهانجي آڏو اهي ماحولياتي توڙي سماجي مسئلا پيش کيا ويا آهن جن جي درپيش پوڻ جو امکان آهي. اِي آءِ اي جي ان ترکيب بابت کجهه نظرياتي نقطا پڻ ڏيک نمبر 4 ۾ مختصر طور بيان کيا ويا آهن، جيکي پاکستان توڙي بين الاقوامي سطح تي اهڙي کنهن به جائزي لاءِ گهربل طريقي واري معيار تي پورو لهن ٿا. ان سموري جائزي دوران منصوبي جي فعال ٿيڻ جي نتيجي ۾ جن جن امکاني ماحولياتي خطرن ۽ سماجي مسئلن توڙي ماحول ۾ مختلف حياتياتي مسئلن جي ڏار ڏار فهرست جنهن تي اِي آءِ اي دوران نظر آڏو رکيا ويندا سي هن ريت آهن:

شکل 3: ماحولياتي ۽ سماجي اثرن جي هک فهرست

- ماڻهن کي روزگار فراهم کرڻ
- تعميراتي کم سان لاڳاپيل اثر، جهڙوک گوڙ ۽ مٽي
- بجلي جي لوڊشيڊنگ ۾ گهٽتائي اچڻ ۽ متاثر ٿيل معيشتن جو ٻيهر پنهنجن پيرن تي ٿي بيهڻ
- منصوبي سان لاڳاپيل ساز و سامان کي پهچائڻ يا کڻي وڃڻ وغيره جهڙن کمن سبب گاڏين جي اچ وچ ۾ واڌ
- مٽي، گوڙ، لرزڻ، واٽون تنگ ٿيڻ ۽ وڌين گاڏين سبب پيدا ٿيڻ وارا خطرا
- موجوده سماجي ۽ ثقافتي طور طريقن ۾ تبديلي (جي ضرورت)
- روزگار جي تلاش ۾ نئين آباديءَ جي اچڻ سان موجوده انتظامي ڍانچي تي دٻاءُ ۾ اضافو
- زمين جي خرابي

شڪل 4: AISE جو عمل ۽ صلاح مشورا

جز	مقصد	شراڪتدارن جي مشاورت سان لاڳاپيل سرگرمي
سڪوپنگ	• اهڙن مسئلن جي سڃاڻپ ڪرڻ جن تي اِي آءِ اي کي ڌيان ڏيڻ گهرجي • سموري منصوبي جا اهڙا متبادل ڳولڻ جن جو پڻ اِي آءِ اي دوران جائزو ورتو وڃو وڃي ۽ انهن کي پرکيو وڃي	• ادارتي ۽ معاشرتي شراڪتدارن جي سڃاڻپ • شراڪتدارن سان لهه وچڙ ۾ اچڻ ۽ انهن سان ٿيل سموريون ڳالهيون محفوظ ڪرڻ • اِي آءِ اي جي عملي سان ان حوالي سان رايا ونڊڻ ته جيئن اهي پنهنجي بنيادي ڄاڻ واري تحقيقات ۽ اثرن واري جائزي ۾ اهي ڳالهيون به شامل رکن
بنيادي ڄاڻ واري تحقيقات	• منصوبي جي ماحولياتي ۽ سماجي صورتحال بابت تناظر جي حوالي سان ڄاڻ گڏ ڪرڻ	• بنيادي ڄاڻ واري سروي دوران جيڪي اضافي مسئلا ڄاڻايا ويا انهن کي به شامل ڪرڻ
اثرن جي جائزي لاءِ اپياس	• منصوبي جي امڪاناتي اثرن ڪي بيان ڪرڻ • ماهرن جي مدد سان منصوبي جي نتيجي ۾ پيدا ٿيندڙ تبديلين جي تحقيقات ڪرڻ • امڪاني اثرن جي اهميت دريافت ڪرڻ • اثرن جي انتظام بابت طريقو دريافت ڪرڻ • انتظامي طريقي جي شموليت ڪانپوءِ منصوبي جي نتيجي ۾ پوندڙ اثر دريافت ڪرڻ • منصوبي جي سموري قبوليت جو اندازو لڳائڻ (سماجي توڙي ماحولياتي نقطئه نظر ڪان)	• شراڪتدارن پاران ڄاڻ ۾ آندل مسئلن جو جائزو
تخفيف وارا طريقا ۽ انتظام جو منصوبو	• ماحولياتي تخفيف ۽ نگراني وارو منصوبو اثرن جي جائزي دوران دريافت ڪيل تخفيف وارن طريقن جي عمل درآمد ڪي يقيني بنائڻ وارن طريقن ڪي واضح ڪندو. انهيءَ ۾ مخصوص نقشا ۽ منصوبا، تربيتي گهرجون، وسيلن جون گهرجون، نگراني جا تفصيل (مثالي جايون، طريقيڪار ۽ فريڪوئنسي يا گهٽائي)، جائزي ۽ رپورٽنگ جون گهرجون، ۽ بجيٽ شامل هوندا.	• تجويز ڪيل تخفيف وارن طريقن جي قبوليت جو جائزو ۽ ان ڳالهه جو جائزو ته انهن طريقن تي ڪيتريقدر عمل درآمد ڪري سگهجي ٿو.
اِي آءِ اي رپورٽ جي تياري	• اپياسن ڪانپوءِ اِي آءِ اي جو عملو منصوبي جي اثرن ۽ ان جي تخفيف جي طريقن بابت سمورا تفصيل هڪ جاءِ گڏ ڪندو. ان ۾ امڪاني طور تي مختلف ماهرن سان صلاح مشورو شامل ٿي سگهي ٿو ته جيئن حاصل ٿيڻ واري ڄاڻ جي درست نموني پيشڪش ڪري سگهجي ۽ اِي آءِ اي واري ترتيب ڏئي سگهجي.	• شراڪتدارن ڪي اِي آءِ اي جي حوالي سان راين ڪان آگاهه ڪرڻ. خاص طور تي انهن ڪي اهو ٻڌائڻ ته منصوبو هلائڻ وارا انهن شراڪتدارن پاران ڄاڻايل مسئلن ڪي حل ڪرڻ لاءِ ڪهڙيون تجويزون ڏين ٿا.
اِي آءِ اي پاران لاڳاپيل اختيارين تائين ڄاڻ پهچائڻ ۽ فيصلا سازي	• اِي آءِ اي پاران پنهنجي رپورٽ لاڳاپيل اختيارين ڪي جمع ڪرائڻ ۽ اختيارين توڙي دلچسپي رکندڙ شراڪتدارن پاران رپورٽ جو جائزو. ان ڪانپوءِ رپورٽ جو جائزو وٺندڙ ڌريون منصوبي جي ماحولياتي ۽ سماجي نقطئه نظر ڪان قبوليت بابت پنهنجو فيصلو ٻڌائيندين ۽ منصوبي جي منظوري جي حوالي سان پنهنجا شرط پڻ آڏو رکنديون.	• عوامي گڏجاڻين ۾ شرڪت ڪرڻ ۽ انهن گڏجاڻين دوران اٿاريل سوالن جا جواب ڏيڻ

منصوبيجي باري ۾ وڌيڪ معلومات لاءِ رابطو ڪريو:

هدايت حسن
هيگلر بيلِي پاڪستان
39، گلِي نمبر 15، اي 7 ، اسلام آباد
فون :0200 261 51 92+
فيڪس :0208 261 51 92+
اِي ميل: hhasan@haglerbaily.com.pk

راشد خان
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39، گلِي نمبر 15، اي 7 ، اسلام آباد
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فيڪس:0208 261 51 92+
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Appendix 12: THE DETAILED LOG OF SCOPING CONSULTATIONS

Baseline Survey of Lakhra Coal-fired Thermal Power Plant
JICA Survey Team

Record of the Consultation Meeting

Stakeholder:	World Wide Fund for Nature (WWF), Islamabad
Date:	February 19, 2014
Time:	10:15 am
Meeting Venue:	WWF office, Islamabad
Attended by:	Project Coordinator Coordinator, Government and Aid Agencies
Conducted by:	HH, Hagler Bailly Pakistan (HBP) IK, JICA Survey Team (JST) HS, JICA Survey Team (JST) RK, Hagler Bailly Pakistan (HBP)
Recorded by:	RK, HBP HS, MCC
Language:	English
Preamble:	The discussion started with the introduction of the public consultation team. IK verbally briefed about the purpose of the meeting and gave a comprehensive description of the project and the related activities. At the end of the informative session, he invited the participants to express or share their concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	The Indus River is very important from ecological point of view. The wastewater discharge in the Indus River will cause environmental changes and be critical for aquatic life, especially fresh water turtle and Indus Blind Dolphin. . 34 Indus Blind Dolphins had been observed upstream of Kotri Barrage.	WWF	The wastewater will be treated before discharge in Indus River. Thermal discharge will be evaporated through cooling tower and not discharged into the Indus River.
2.	The area is a corridor for migratory birds. The impacts on these migratory birds as well as residential birds should therefore be assessed and measures should be taken to minimize the effects.	WWF	Concern noted.
3.	Wastewater generated from the plant should be properly managed.	WWF	The wastewater will be treated before discharge in Indus River.
4.	From where will you take water for the proposed project?	WWF	Water for the project will be obtained from the Indus River

No.	*Issues Raised*	*By*	*Response Provided*
5.	Any change in the environment may result in a loss of biodiversity of the area. Measures should be taken to avoid any loss of flora and fauna in the area.	WWF	Concern noted.
6.	What would the process to intake water from Indus River?	WWF	The water will be taken from the Indus River deep waters through suction pump.
7.	is there any water discharge from coal yard and coal storage facilities?	WWF	The waste water generated from these facilities will be treated and reused for the same purpose (coal yard sprinkling) and for dust suppression during coal transport and handling.
8.	What measures will be taken to control emissions from the plant so that the communities in the surrounding areas would not be adversely affected?	WWF	Emission control equipment such as Flue Gas Desulfurization (FGD) to remove SO_2 from the emissions and Electrostatic Precipitator (EP) for particulate matter control will be installed.
9.	What would be the water intake from the Indus River in low flow season?	WWF	The lowest flow in Indus River is in the month of December. The average flow in this month during drought season is about 30 cumec. The water intake will be less than 2% of the flow.
10.	During winter season, due to considerable temperature difference, even little addition of discharged water will affect the ecology of the Indus River.	WWF	Cooling towers will be installed to evaporate the thermal discharge so that no thermal discharge would be discharged into the Indus River. The small amount of waste water such as domestic water and boiler blow-down will be discharged after treatment.
11.	The impacts on the air quality should be considered in the study.	WWF	Air quality monitoring is under process. The baseline data will help develop a design for the power plant, stacks and emission control system that ensure that the emissions comply with National Environmental Quality Standards and IFC standards.
12.	The project proponent should conduct the ecological survey in all seasons to cover all the indigenous species round the year. It should be noted that Indus Blind Dolphin can only be seen during March and April. While fresh water turtles can only been observed in summer. Therefore, the sampling should be taken seasonally.	WWF	Concern noted.

No.	Issues Raised	By	Response Provided
13.	Is there any negative impact on water use of community?	WWF	The field survey is not implemented so far. This will be determined after the field survey.
14.	Air quality standards for humans also provide protection to the birds. Minimize the negative affect of the project on migratory and resident birds. In Pakistan, it is hardly possible to implement and follow all standards.	WWF	The project activities will be undertaken in compliance with relevant national legislations and international guidelines.
15.	Are there any negative health impacts of this project?	WWF	The project is in scoping phase. The impacts can be determined after baseline survey.
16.	The baseline data should be shared with WWF so that more concerns or suggestions can be shared with the project proponent.	WWF	Concern noted.
17.	There would be negative impacts on the local people during construction phase.	WWF	Measures should be taken to mitigate or minimize the negative impacts during the construction phase.
18.	WWF has to check, if the project area falls in the Biosphere reserve forest.	WWF	Concern noted.
19.	The collected data for baseline of Indus Dolphin, Turtles and birds should be shared with WWF.	WWF	Concern noted.

Other Comments

1. JST requested WWF to share the mangroves data around Port Qasim.

Record of the Consultation Meeting

Stakeholder:	International Union for Conservation of Nature (IUCN), Islamabad
Date:	February 19, 2014
Time:	3:10 pm
Meeting Venue:	IUCN office, Islamabad
Attended by:	Project Manager, National Impact Assessment Program,
Conducted by:	IK, JICA Survey Team (JST) HS, JICA Survey Team (JST) RK, Hagler Bailly Pakistan (HBP)
Recorded by:	RK, HBP HS, JST
Language:	English
Preamble:	The discussion started with the introduction of the public consultation team. IK verbally briefed about the purpose of the meeting and gave a comprehensive description of the project and the related activities. At the end of the informative session, IK invited IUCN to express or share his concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Upstream of Kotri barrage is a habitat to the Blind Dolphin. The consultant and the project proponent should consult IUCN, Karachi office for more concerns regarding aquatic species.	IUCN	Concern noted
2.	Where the wastewater will be discharged?	IUCN	The waste water will be treated before its discharge in the Indus River. Most of waste water is thermal discharge and will be evaporated through cooling tower.
3.	From where the coal will be imported?	IUCN	It is not decided yet.

No.	Issues Raised	By	Response Provided
4.	What are the mitigation measures to minimize the negative impact of air emission?	IUCN	The project activities will be undertaken in compliance with relevant national legislation and international guidelines. Emissions control equipment such as Flue Gas Desulfurization (FGD) to remove SO_2 from the exhaust, Electrostatic Precipitator (EP) for particulate matter control and Low NOx burner will be installed.
5.	How much water will be required for the plant?	IUCN	The requirement of water will be 0.5 m^3/sec.
6.	What would be the stack height?	IUCN	The stack height will be more than 200 meters.
7.	If the stack height is more than 200 meters, then the area for air dispersion should be more than five kilo meters.	IUCN	Concern noted. Area of dispersion not only depends upon stack height, other factors like wind speed, wind direction, particle size and humidity also play their part.
8.	Ambient air should be monitored in this project	IUCN	Concern noted.
9.	Are there any community consultations for this project?	IUCN	The community consultation is an important part of EIA. The consultations will be conducted in coming couple of weeks to record the concerns of the local communities.
10.	If the project proponent is using superior technology, then the negative impacts would not be high. All the plants use latest technology/equipment, but due to bad maintenance of this technology/equipment, it creates problems.	IUCN	Concern noted.
11.	The maintenance of the project should be monitored on regular basis to avoid negative impacts of the equipment.	IUCN	Concern noted.
12.	The project proponent should implement technology/equipment in the proposed project that can easily be managed and available in Pakistan.	IUCN	Concern noted.
13.	The consultants and project proponents should consult IUCN Karachi office, PAK-EPA and Sindh-EPA for more concerns and suggestion.	IUCN	Concern noted.

Other Comments

1. IUCN requested to share the ecological data of the region with them.

Record of the Consultation Meeting

Stakeholder:	Pakistan Museum of Natural History (PMNH), Islamabad
Date:	February 19, 2014
Time:	11:45 am
Meeting Venue:	PMNH office, Islamabad
Attended by:	Director of Zoological Department Research Associate
Conducted by:	IK, JICA Survey Team (JST) HS, JICA Survey Team (JST) RK, Hagler Bailly Pakistan (HBP)
Recorded by:	RK, HBP HS, JST
Language:	English
Preamble:	The discussion started with the introduction of the public consultation team. IK verbally briefed about the purpose of the meeting and gave a comprehensive description of the project and the related activities. At the end of the informative session, IK invited the participants to express or share their concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Selection of Lakhra for the proposed project is good as the area has not much biodiversity. The impacts on the plants and agriculture land will be less due to the areas lower environmental value. In comparison, Karachi port site has much higher biodiversity including mangroves.	PMNH	Noted
2.	The Lakhra area is divided into two ecological characteristics by the Indus Highway. Eastern side composes richer wildlife in riparian and aquatic environment, while western side is low biodiversity due to arid plain	PMNH	Noted

No.	*Issues Raised*	*By*	*Response Provided*
3.	The only species of concern is Blind Indus Dolphin from the Indus River. Overall its population is very low but it has some high density population between Guddu and Kotri barrage. Other than dolphins, fresh water turtles and frogs shall be considered as they are very sensitive species. Brown-roof Turtles is most sensitive species inhabiting there.	PMNH	Noted
4.	Biodiversity is low in Lakhra. The area is a replica of Jamshoro in terms of plant species. Muddy banks are the only available habitats for fresh water turtles.	PMNH	Noted
5.	Twenty five species of fish are commercially utilized. Downstream of Kotri barrage is a popular fishing area. Local people are mostly involved in fishing. The fishery status is most likely the same in Lakhra site.	PMNH	Noted
6.	Experts are hopeful to encounter some unique species in summer season, especially reptiles.	PMNH	Noted
7.	The proposed project is not likely to cause any threat to the indigenous species via hunting. It may change some diversity but that impact seems to be low due to low biodiversity of the area. The only mammals to consider are the Indus Blind Dolphins.	PMNH	Noted
8.	The agricultural land is the feeding grounds for the birds. The emissions from the plant may impact the resident and migratory birds.	PMNH	To avoid any such issues, mitigations measures like emissions control systems; Flue Gas Desulfurization (FGD) and Electrostatic Precipitator (ESP), will be employed to ensure that emissions levels stay within the prescribed standards.
9.	Aquatic ecology of the Indus river can be affected which will impact the local community as their income largely depends on fishing.	PMNH	Waste water from the plant will be treated before its discharge in the Indus River. It will be ensured that no effluent from the power plant adversely impacts any indigenous species, local community, physical environment of the region.

No.	*Issues Raised*	*By*	*Response Provided*
10.	To cover maximum species in the ecological survey, another survey is recommended in summer season. For this purpose, June and July are suitable for studying fish and early May for reptiles.	PMNH	Noted
11.	What is appropriate season to study and collect data on Indus Blind Dolphin?	IK	Response by PMNH: Post flood season and low water season, when the river is calm, mostly August and September are the appropriate season to conduct ecological survey for Indus Blind Dolphin. WWF has a sufficient information and knowledge on these dolphins. They should be consulted for further comments and suggestions.
12.	There has not been any study on the Indus Blind Dolphin and their response to the water pollution.	PMNH	Noted
13.	During winters canals are closed in December and January. Water level also reaches its minimum level. In these two months dolphins shift in shallow water bodies. There have been cases reporting dolphins found dead near river shores. There is a rescue center in Sukkur for dolphins.	PMNH	Noted
14.	Baseline studies should highlight the issues like illegal net size during fishing that catches turtles and result in their permanent loss.	PMNH	Noted
15.	How many times you visit the area for survey and observing Indus blind Dolphin and how do you observe them?	HS	Response by PMNH: There are random and nocturnal surveys with standardized methodology in different seasons round the year. There is another team with binoculars and cameras to observe them.

No.	*Issues Raised*	*By*	*Response Provided*
16.	Do you heard about Biosphere Reserve?	HS	Response by PMNH : PMNH proposed "Establishment of Indus Blind Dolphin Biosphere Reserve in Pakistan" to the UNESCO Man and the Biosphere (MAB) Program September 2013. The proposed reserve range is from Jinnah Barrage to Kotri Barrage (Punjab, Khyber Pukhtunkhawa Sindh) and this includes this project area. The objective of MAB establishment is to protect the habitat of Dolphins, to involve public, to make ecological management program etc. The PMNH expect the result in 2014.

Other Comments

1. It was a kind of discussion with the experts who have knowledge and information about the project area. They did not raise any major concerns and issues. The meeting was very productive in terms of the knowledge that experts have shared with the project proponents and consultants.
2. PMNH also informed about the survey process that there are day and nocturnal surveys with standardized methodology in different seasons round the year.
3. PMNH will provide information about fishery at Port Qasim by e-mail.

Record of the Consultation Meeting

Stakeholder:	Lakhra Coal Development Company (LCDC), Lakhra
Date:	February 24, 2014
Time:	10:40 am
Meeting Venue:	LCDC office, Lakhra
Attended by:	Senior Mining Engineer (LCDC) Senior Mining Engineer (Jamil and Company)
Conducted by:	HH, Hagler Bailly Pakistan (HBP) RK, Hagler Bailly Pakistan (HBP) IK, JICA Survey Team (JST) HS, JICA Survey Team (JST)
Recorded by:	RK, HBP HS, JST
Language:	English
Preamble:	The discussion started with the introduction of the public consultation team. IK verbally briefed about the purpose of the meeting and gave a comprehensive description of the project and the related activities. At the end of the informative session, senior engineer of LCDC shared the information about the LCDC. The information shared are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Coal washing facility belongs to Shehzad International.	LCDC	Noted.
2.	There are 2 public companies (LCDC and PLDC) and more than 32 private coal companies working in this area.	LCDC	Noted.
3.	Three coal layers, Dhanwari, Lalian and Kach are found in this area. All three layers settled in same geological period, five million years ago	LCDC	Noted.
4.	Lalian is the middle seam with 80-90 meters depth and 1-4 meter thickness.	LCDC	Noted.
5.	Due to non-availability of latest technology/machinery, coal mining is operating on very low scale.	LCDC	Noted.

No.	*Issues Raised*	*By*	*Response Provided*
6.	If machinery is used for mining and conveying, the coal dust generated will be an issue.	LCDC	Noted.
7.	Currently no suitable power plant exists in the area to consume coal. Brick kilns consume the largest proportion of the coal extracted.	LCDC	Noted.
8.	If latest machinery is used, it will lead to an increased cost of production.	LCDC	Noted.
9.	LCDC has 60 operated coal mines.	LCDC	Noted.
10.	For the financial survival of LCDC, permission is granted to sell small amount of coal to the local market.	LCDC	Noted.
11.	All Lakhra coal fields are producing 2.3 million metric tons of coal per year.	LCDC	Noted.
12.	LCDC is producing 800 tons per day and almost all (800 tons per day) is supplied to the Lakhra Power Station. Only 100 tons or less are sold to the open market.	LCDC	Noted.
13.	Who are the main consumer of the coal produced by LCDC and which sector is utilizing the largest proportion?	IK	LCDC replied: Two power plants, Cement factories, Brick kilns and, Sugar mill factories are utilizing coal produced by LCDC.. One of the power plant is the Lakhra and the other is in Thatta owned by KESC. Among the private consumers, the brick kilns are utilizes most of the coal while cement industries use coal only for blending and mixing.
14.	Who is the largest producer of coal in the area?	HH	LCDC replied: Hussain mining company is the largest producer of coal and they produce according to their customer demands. Private companies do not store coal as stock piling of coal increases 70% chance of spontaneous ignition within two weeks and burns the entire stock. Only LCDC stores the coal stock.
15.	Local stocks are kept by LCDC under the commitment with the Lakhra Power Plant (LPP). However, lignite coal could easily catch fire due to interaction with oxygen. Sprinkling water does not help avoiding spontaneous ignition; it would rather encourage the ignition.	LCDC	Concerns noted.

No.	*Issues Raised*	*By*	*Response Provided*
16.	Are there any labors from local community?	HS	LCDC replied: Majority labor working in LCDC belongs to Northern areas (Swabi, Mangora). Labor from the Northern areas is normally hired on contracts for 6 months. During the winter season and migrates back to their areas in summer.. This is a common practice is the Lakhra coal field. Only two (2) private companies hire people from local communities.
17.	How many times has fire incidents occurred?	IK	LCDC replied: Six incidents have occurred in the area in last 2 years. Fire ignites at the bottom and burns the entire stock. Approximately, four mines have lost their entire stock due to spontaneous fires. Each mine loss approximately 10,000 tons of coal stock.
18.	From where do you get water?	IK	LCDC replied: There is no ground water here. LCDC extracts water from Indus River through water tankers.
19.	Do you treat coal in a coal washing plant before supplying it t to the Lakhra Power Station?	IK	LCDC replied: No, the washed coal is only supplied to cement factories. The technology for the coal washing is "de-ashing" which means reducing organic sulphur by bacteria.
20.	How many labors work in LCDC?	IK	LCDC replied: There are more than 1,500 coal cutting (underground) labor, whereas 600 workers are also employed for other jobs. The working hours are normally from 7:00 am – 3:00 pm. Each mine is operated by 12-30 underground laborers
21.	Do you monitor underground temperature?	HH	LCDC replied: No, we do not have any temperature monitoring equipment. The only personal protective equipment used is a helmet.
22.	Is there any medical facility in the vicinity?	LCDC	LCDC replied: Every company has its own small l dispensary which provides first aid. In severe cases, the affected is shifted to the hospital; in Hyderabad.
23.	Why you do not do open mining?	IK	LCDC replied: It will increase the production cost. Machinery mining could increase the market price from $3 to $6 per ton according to a study conducted by China. LCDC has conducted a pre-feasibility to lease the half of the mine for semi-mechanized mining to increase production volume within feasible cost.

No.	*Issues Raised*	*By*	*Response Provided*
24.	Do you have any data on age structure of the LCDC's labor?	HS	LCDC replied: We do not have any specific classification of labor. We have some record of labor which can be shared.
25.	What is the average salary of a labor?	HS	The average salary is approximately PKR 15,000 (USD 150)/month.
26.	Does LCDC have any selection criteria for labor (education, experience)?	HS	LCDC replied: No, there are no such criteria. However, it is preferred to have some mining experience for underground labor. Education requirement is only mandatory for the surveyor or supervisor.
27.	What are the education and literacy levels of the labors?	HS	LCDC replied: The education level of the labor is more or less than primary education. In Pakistan, education status is very poor and up in the North, the situation is even worse. Not much labor is able to read and write.
28.	Since your company is strongly relied on the Lakhra power station, have you discussed any future plan of both companies? What if the existing Lakhra power station is closed, will you have a significant damage in your business?	HS	Closing of the existing Lakhra Power Station will be a huge damage for the LCDC since they are the major consumer of the coal. Lakhra Power Station was specially designed for the Lakhra coal.
29.	In future, when latest equipment and machinery will be used, there might be some environmental issues.	LCDC	Noted

Baseline Survey of Lakhra Coal-fired Thermal Power Plant

JICA Survey Team

Record of the Consultation Meeting

Stakeholder:	Sindh Wildlife Department, Hyderabad
Date:	February 25, 2014
Time:	11:00 am
Meeting Venue:	Sindh Wildlife Department (SWD), Hyderabad
Attended by:	Deputy Conservator Assistant Conservator
Conducted by:	HH, Hagler Bailly Pakistan (HBP) IK, JICA Survey Team (JST) HS, JICA Survey Team (JST) RK, Hagler Bailly Pakistan (HBP)
Recorded by:	RK, HBP HS, JST
Language:	English
Preamble:	The discussion started with the introduction of the public consultation team. IK briefed about the purpose of the meeting and gave a comprehensive description of the project and the related activities with the help of maps. At the end of the informative session, IK invited the participants to express or share their concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	From where will you get coal to operate the power plant?	SWD	Initially the coal requirement of the power plant will be fulfilled by imported coal. After the availability of Thar coal, a mix of 80% import and 20%Thar coal will be used to operate the power plant
2.	This area is riverine area that is important and sensitive for soil and water point of view. Due to ash from existing plant operation, water and soil have been contaminated.	SWD	Emission control equipment such as Flue Gas Desulfurization (FGD), low NOx burner and particulate matter control will be installed.
3.	Ibex, Urial and Chinkara are found in this area. Ash from chimneys of the existing plant is spread in 20-25 km radius.	SWD	In the proposed power plant latest equipment and technologies will be used to treat, dispose and control ash from the power plant.
4.	Do you have any data on wildlife?	SWD	We are not authorized to share data. For the latest data, you have to contact Wildlife, Karachi office.

No.	*Issues Raised*	*By*	*Response Provided*
5.	Hog deer, Partridge, Jackal, Civet jackal, Wild boar, Jungle cat, Desert cat, Otter, Indus dolphin and Monitor lizard are the protected species found in this area.	SWD	Noted.
6.	Main concerns are that; 1- The ash disposal from existing plant contaminates the soil and water quality. 2 - New power plant creates environmental changes. 3 - Water availability in the Indus River is limited. 4 - Water discharge from the plants will change the water quality especially in operational phase. 5 - Coal transportation by trucks increase traffic and cause various environmental issues.	SWD	Noted.
7.	From where will you get water for the power plant?	SWD	The water will be taken from Indus River.
8.	What is the quantity of water to be taken from the Indus River for the project?	SWD	The volume of intake water would be 0.5 cubic/sec.
9.	Where the project's wastewater will be discharge? If the wastewater will be discharged into the Indus River, it will degrade the quality of river water and create problems for aquatic species and for the people who are using Indus River water for their domestic need.	SWD	Cooling towers will be installed to treat the thermal discharge so that no thermal water would be discharged into the Indus River. The wastewater such as domestic water, boiler blow-down water, boiler wash discharge and oil contaminated and heavy metal contaminated water will be discharged after treatment.
10.	Three technologies are being used for power plant, water cooling, air cooling, and oil cooling. We will suggest using air cooling or oil cooling method so that no water will be required. .	SWD	Noted.
11.	Baseline study and environmental monitoring during the construction phase are recommended to avoid any negative impact of the project activities. If the results of monitoring study and draft EIA report are shared with the Wildlife Department, we can assist you by giving advice to mitigate the identified issues in more eco-friendly manner.	SWD	Noted

No.	*Issues Raised*	*By*	*Response Provided*
12.	Transportation route is very important. If the project proponent put all its traffic on the existing roads, it will create problems. We will suggest thinking about the rail for the coal transportation to avoid congestion of traffic on roads.	SWD	Noted.
13.	How many staff does the wildlife department have in Hyderabad division?	IK	SWD replied: There are more than 300 staff members in the wildlife department. In which, 151 personnel are s for Jamshoro district as Kirthar National Park falls in Jamshoro District. This means that this region hold a high environmental value and importance.
14.	You should visit the Kirthar National Park and riverine area to understand the wildlife and natural resources.	SWD	Noted.
15.	What would be the dumping procedure of ash?	SWD	The ash will be deposited in the ash pond until the settlement with cement industry.
16.	Why did you select these candidate sites? GENCO can install this project in Thatta or any other area?	SWD	This site is selected for three reasons. Availability of existing transmission line, railway line and water.

Record of the Consultation Meeting

Stakeholder:	Sindh Forest Department, Hyderabad
Date:	February 25, 2014
Time:	3:00 pm
Meeting Venue:	Sindh Forest Department (SFD), Hyderabad
Attended by:	Chief Conservator Conservator
Conducted by:	HH, Hagler Bailly Pakistan (HBP) IK, JICA Survey Team (JST) HS, JICA Survey Team (JST) RK, Hagler Bailly Pakistan (HBP)
Recorded by:	RK, HBP HS, JST
Language:	English
Preamble:	The discussion started with the introduction of the public consultation team. IK briefed about the purpose of the meeting and gave a comprehensive description of the project and the related activities with the help of maps. At the end of the informative session, IK invited the participants to express or share their concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Where the project waste will be disposed?	SFD	Coal ash will be generated and disposed within the project area.
2.	Do you think that the project activities may impact on reserved forests?	IK	SFD replied: The reserved forest is about five kilometers far from the project area, so there would be no direct impact though non-direct impact may be a concern
3.	The air pollution as one of the indirect impact can impact the biodiversity and forest.	SFD	Baseline survey is in process. Environmental impacts can be predicted after the data analysis.
4.	Could you please share the boundary of reserved forests as some agriculture land also exists within the boundary of reserved forests according to the survey of Pakistan (SOP) sheets. Please share the super impose map with GPS coordinates, if you have.	HH	SFD replied: We will share the required maps, if available. Please request it in writing and then data can be shared via email.

No.	*Issues Raised*	*By*	*Response Provided*
5.	What is the status of reserved forests?	HS	SFD replied: A reserved forest is a one where the species are protected in their natural habitat and no human interference is allowed or any kind of human activity is strictly prohibited without any special permission. A copy of Forest Act is also shared with JST.

Record of the Consultation Meeting

Stakeholder:	Deputy Commissioner (DC), Jamshoro
Date:	February 25, 2014
Time:	1:30 pm
Meeting Venue:	DC office, Jamshoro
Attended by:	DC officer
Conducted by:	HH, Hagler Bailly Pakistan (HBP) IK, JICA Survey Team (JST) HS, JICA Survey Team (JST) RK, Hagler Bailly Pakistan (HBP)
Recorded by:	RK, HBP HS, JST
Language:	English
Preamble:	The discussion started with the introduction of the public consultation team. HS briefed about the purpose of the meeting and gave a comprehensive description of the project and the related activities with the help of maps. At the end of the informative session, DC gave information about the Land Acquisition and express or share his concerns. The discussion and concerns raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Who is financing this project?	DC	Government of Japan in assistance with Government of Pakistan is working on the preparatory survey and GENCO is the executing agency.
2.	Firstly, you have to specify the location of transmission line, railway and water pipeline and submit the drawing on a map at Taluka level.	DC	Noted.
3.	We will depute a person called Tapadar to accompany you to the field and support in identifying the government and private and surveyed and un-surveyed land.	DC	Noted.
4.	The project proponent has to finalize the drawing and send a letter to the Deputy Commissioner.	DC	Noted.

No.	*Issues Raised*	*By*	*Response Provided*
5.	If the required land is government owned, the land will be granted without undertaking any procedure after Section 4. The land will be granted within three months.	DC	Noted.
6.	If the private land is involved, the Deputy Commissioner will depute the Land Revenue Office (which is under the Jamshoro Coordination Office) to announce a preliminary notification in official gazette under Section 4. Then, the land will be physically marked out, surveyed and evaluated.	DC	Noted.
7.	How long will it take to complete evaluation of the land after the Section 4 starts?	HS	It will take about one month to complete the land measurement and evaluate tentative land budget (tentative award / compensation under Section 6).
8.	How much land is required for this project?	DC	At this stage, we are not sure how much land is required for the project but design and location of transmission line, water pipeline, railway line will be specified on government land as much as possible and try to avoid purchasing the private land.
9.	For the land acquisition, and all other project related activities, we will comply with relevant national legislation and World Bank guidelines.	HS	DC replied: There is no conflict in national law and World Bank guidelines. Our field staff will help you.

Others:

1. The Deputy Commissioner (DC) provided the latest population data of Manzurabad in 2013.
2. HS submitted a questionnaire #001 to the DC. The DC will share the requested statistic data via email if there are any data available.
3. The DC will also send a presentation of Land Acquisition Act procedure on 25th or 26th of February 2014 to HS.

Record of the Consultation Meeting

Stakeholder:	Mehran University of Engineering and Technology (MUET), Jamshoro
Date:	February 26, 2014
Time:	11:00 am
Meeting Venue:	Mehran University of Engineering and Technology, Jamshoro
Attended by:	Director Institute of Environmental Engineering Co-Director
Conducted by:	HH, Hagler Bailly Pakistan (HBP) IK, JICA Survey Team (JST) HS, JICA Survey Team (JST) RK, Hagler Bailly Pakistan (HBP)
Recorded by:	RK, HBP HS, JST
Language:	English
Preamble:	The discussion started with the introduction of the public consultation team. IK briefed about the purpose of the meeting and gave a comprehensive description of the project and the related activities with the help of maps. At the end of the informative session, IK invited the participants to express or share their concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	We appreciate your site selection. During the consultation of Jamshoro Power Plant (JPP), we raised several issues but nobody paid attention on any of those issues.	MUET	Noted.
2.	The location of the JPP is very sensitive as there are 3 universities and hospitals near JPP site. When wind comes from north, particulates are dispersed and settle around and in these settlements. Therefore we suggested shifting it to another location but no results.	MUET	Noted.
3.	We want coal power but the location of JPP should have been somewhere else. Lakhra site is very suitable for the coal power plant with fewer impacts.	MUET	Noted.

No.	*Issues Raised*	*By*	*Response Provided*
4.	In many EIAs, consultants states that projects provide job opportunities to local people but never happened. The project should provide some internship opportunities to the university students.	MUET	Noted.
5.	The Indus River is the source of drinking water for the people. What is the procedure of wastewater discharge?	MUET	There will be no thermal discharge from the power plant in the Indus River, as cooling towers will be installed to evaporate the thermal discharge. The wastewater such as domestic water, boiler blow-down water, boiler wash discharge and oil contaminated and heavy metal contaminated water will be discharged after treatment.
6.	What is the consumption of coal per day for the proposed power plant?	MUET	The coal consumption would be 4000 ton/day
7.	What is the transportation method of coal to the power plant?	MUET	The imported coal will be unloaded at Port Qasim and transported to power plant by rail, whereas the Thar coal will be transported by road initially and by train when the rail link will be developed.
8.	Mehran university has the lab facility and we can analyse, water, NOx, SOx. We can do this job on charge basis.	MUET	Noted.
9.	In Jamshoro area, due the JPP operation, air quality has been ruined. What are the precautionary measures you plan to taken to mitigate or minimize these impacts?	MUET	Emission control equipment such as Flue Gas Desulfurization (FGD) to remove SO_2 from the emissions and Electrostatic Precipitator (EP) for particulate matter control will be installed.
10.	Do you have any study on ash quality?	HS	Some students have done the study on quality of ash from the existing LPP, washed ash, utilization of coal ash (particles) and biomass to create briquettes.
11.	There is only one coal washing company in the area.	MUET	Noted.

Other Comments:

1. MUET requested to provide the internship to the university students in the project, so they can learn new things.
2. MUET also requested to provide any lab analysis work to the university. The university students and management are ready to help and support the project proponent.
3. The thesis studied on quality of ash from the existing LPP will be shared with JST and sent via email.

Baseline Survey of Lakhra Coal-fired Thermal Power Plant
JICA Survey Team

Record of the Consultation Meeting

Stakeholder:	Department of Livestock and Fisheries (DLF), Hyderabad
Date:	February 26, 2014
Time:	12:30 pm
Meeting Venue:	Office of Department of Livestock and Fisheries, Hyderabad
Attended by:	Deputy Director
Conducted by:	HH, Hagler Bailly Pakistan (HBP) IK, JICA Survey Team (JST) HS, JICA Survey Team (JST) RK, Hagler Bailly Pakistan (HBP)
Recorded by:	RK, HBP HS, JST
Language:	English
Preamble:	The discussion started with the introduction of the public consultation team. HS briefed about the purpose of the meeting and gave a comprehensive description of the project and the related activities with the help of maps. At the end of the informative session, HS invited DLF to express or share their concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	What is the function of the Fishery Department? Is there any permit for fishing in certain areas and what is the system of permit?	HS	DLF replied: Fisheries department controls the district offices of the entire Sindh. The concerned district officer issues an annual license for fishing in a specific area for Rp.12,000/person/boat. If there are more fishermen on a boat, then the license cost differs. They can fish only in the vicinity of the allotted area which is normally within the stretch of the river or a water body within the district. But illegal fishing activities are common in the area.
2.	Is there any key person for the fishing activities?	HS	DLF replied: District officer is the key person for local fisheries.
3.	Are there any social conflicts among the local fisherman's groups?	HS	DLF replied: Yes, there are conflicts among unequal or illegal capture in sense of volume, size/mesh size, area.

No.	*Issues Raised*	*By*	*Response Provided*
4.	How the volume of fish catch is determined or how much fish can fishermen catch?	HS	DLF replied: Volume is not an issue. The real issue is net size. The fishermen are allowed 2 inches net. In breeding season (Jun – Aug), fishing activities are banned.
5.	What age groups are normally involved in fishing activities?	HS	DLF replied: The age groups cannot be defined. Different age groups are involved in fishing activities.
6.	Are females involved in the fishing activities?	HS	DLF replied: Only 1-2% are involved in fishing activities.
7.	Are there any fishermen communities in Jamshoro?	HS	DLF replied: There are fishermen communities (village of fishing folks) in Badin, Sanghar and Thatta. But in other area, fishermen are not united and work on individual basis.
8.	Where are the major markets of fish products?	HS	DLF replied: The fishermen sell their catch in local market. Jamshoro is the main market. Others are Sawan and Bhan areas.
9.	Are there any middle men involved in selling fish to the market?	HS	DLF replied: No, there are not any middle men. They directly sell their catch to the shops or the market.
10.	Any estimates of total catch fish in Nawabshah, Jamshoro, Hyderabad and Matiari area?	HH	DLF replied: We will share the data, if available
11.	Concern is if the wastewater discharge will harm the quality of the Indus River and create problems for aquatic life. Because the livelihood of fishermen are totally dependent on fishery.	AL	The wastewater will be treated before discharged to avoid any adverse impact pm aquatic life. Intake and discharge pipelines will be constructed in the Indus River. It requires piling works during construction phase and limits fishing activities in small area where the piling works will be undertaken. However, the fishing activities can continuously conducted.
12.	The discharge water from the existing power plant is not treated and polluting water quality.	AL	Wastewater treatment equipment of the existing power plant is not functional. As a part of the preparatory survey, rehabilitation of the existing power plant would be recommended.
13.	During construction phase, is there any chemical contamination?	AL	There will be an increase in turbidity.
14.	What is the average monthly income and expenditure per household of fishermen?	HS	The fishermen do not share their income and expenditure data with anyone.

No.	*Issues Raised*	*By*	*Response Provided*
15.	What are the general education level and literacy levels of fishermen?	HS	As an assumption, 65% of fishermen have only primary and 35% have secondary education. Literacy level is very low. Some of them can read Sindhi language.
16.	Is there any association of fishermen in the area?	HS	No.
17.	How do you control illegal fishing?	HS	DLF replied: We have field officers who usually monitor the activities of fishermen. If someone is found involved in any illegal activity, they penalized them with fine

Others:

1. In Karachi coastal area, the area from coastal line up to 200 m off-shore is called ‘The Exclusive Economic Zone (EEZ)’ and regulated by the Federal Government. The area from the coastal line up to 20 nautical miles are called ‘Territorial Water’ and regulated by the Provincial Government. In the Territorial Water, deep sea fishing is conducted.
2. Data on estimates of total catch fish in Nawabshah, Jamshoro, Hyderabad and Matiari.
3. Data on number of registered fishermen and total amount of the catch fish in Karachi.
4. Detail answers on the Questionnaire (JST-Fishery Department 001).

Record of the Consultation Meeting

Stakeholder:	Liaquat University of Medical Sciences (LUMHS), Jamshoro
Date:	February 26, 2014
Time:	2:30 pm
Meeting Venue:	Office of the Registrar, LUMHS
Attended by:	Registrar
Conducted by:	HH, Hagler Bailly Pakistan IK, JICA Survey Team (JST) HS, JICA Survey Team (JST) RK, Hagler Bailly Pakistan (HBP)
Recorded by:	RK, HBP HS, JST
Language:	English
Preamble:	The discussion started with the introduction of the public consultation team. HS briefed about the purpose of the meeting and gave a comprehensive description of the project and the related activities with the help of maps. At the end of the informative session, HS invited the participants to express or share his concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	I cannot comment on the issues raised from the LPP, as we are far away from existing LPP. I can only comment on Jamshoro Power Plant (JPP) as we are residing in the vicinity of JPP.	LUMHS	Noted.
2.	All the agricultural lands are ruined due to the discharge of wastewater from JPP in the Indus River.	LUMHS	In this project, there will be no thermal discharge from the power plant into the Indus River, as cooling towers will be installed to evaporate the thermal discharge. The wastewater such as domestic water, boiler blow-down water, boiler wash discharge and oil contaminated and heavy metal contaminated water will be discharged after treatment.

No.	*Issues Raised*	*By*	*Response Provided*
3.	The consultant should consult the communities residing in the vicinity of the existing LPP.	LUMHS	As a part of the process, consultations are undertaken with institutions and communities that may have any interest in the Project or may be affected by the project. The communities residing in the vicinity of the LPP will also be consulted.
4.	What measures are taken to minimize the negative impacts from the project?	LUMHS	The soil, water and air samples are being collected for analysis. The impacts will be identified and we will try to minimize the negative impacts of the project.
5.	A survey should also be carried out to know the diseases in the vicinity of existing LPP.	LUMHS	Noted.
6.	Do you have any plan to minimize the impact of air pollution?	LUMHS	There are certain international standards and limits that power plant will adhere to. The plant will install appropriate environmental measures to meet these standards.
7.	The consultant should also have a meeting with community representative and provincial assembly member, Dr Sikandar Ali Shoro, belongs to Kotri.	LUMHS	Noted.
8.	Do you know any NGO, who provides health status of local communities?	HS	LUMHS replied: There are many NGOs in Pakistan, working on health.
9.	Is there any government institute who deals with community health?	HS	LUMHS replied: There must be some institutions.

Record of the Consultation Meeting

Stakeholder:	Lakhra Coal Development Company (LCDC), Karachi
Date:	February 24, 2014
Time:	10:40 am
Meeting Venue:	LCDC office, Karachi
Attended by:	Managing Director
Conducted by:	HH, Hagler Bailly Pakistan (HBP) IK, JICA Survey Team (JST) HS, JICA Survey Team (JST) RK, Hagler Bailly Pakistan (HBP)
Recorded by:	RK, HBP HS, JST
Language:	English
Preamble:	The discussion started with the introduction of the public consultation team. IK verbally briefed about the purpose of the meeting and gave a comprehensive description of the project and the related activities. At the end of the informative session, LCDC, shared the information about the LCDC and raised some questions about the proposed project. The information shared are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	At what price LCDC sell coal to LPP?	IK	LCDC replied: The selling price of coal to Lakhra power plant is PKR 3,962/ton, including transportation and taxes. The increase in coal price is on yearly basis. The rate of other companies who sell coal in open market is PKR 4,300/ton exclusive of transportation and taxes. The coal prices fluctuate in open market on bimonthly basis.
2.	At what price LCDC sell coal to Market?	HH	LCDC replied: The selling price of coal to the market is PKR 4,300/ton, including transportation and taxes. The price varies every 15 days.

No.	*Issues Raised*	*By*	*Response Provided*
3.	Is there any coal washing facility?	IK	LCDC replied: Yes, there is one coal washing facility, which is not functional. The facility is on partnership basis. The other partners of coal washing facility belong to South Africa and UK. LCDC is trying to establish its own coal washing plant at Lakhra.
4.	What is the quantity of lime and coal supplied to LCDC in last 3-4 years?	HH	LCDC replied: During 2008-09, 100,000 ton coal supplied to Lakhra power plant, while the quantity of lime is only 6,383 ton during 2008-2013. Which is only 2% of the entire combustion?
5.	Who are the major customers of your coal and how much do you sell each?	IK	LCDC replied: LCDC supplies coal only to Lakhra power plant on demand basis. LCDC sells coal to the market in a small quantity. If any party wants to install coal power plant, LCDC can provide them coal as well after the agreement. There are three shareholders in LCDC, i.e Ministry of Petroleum and Natural Resources, WAPDA, Government of Sindh
6.	How much volume of coals do you mine annually?	HS	LCDC produce coal according to the demand of WAPDA. Currently, LCDC is producing 800 ton/day as per requirement.
7.	From where do you buy coal for the proposed project?	LCDC	Initially, the coal requirement of the plant will be fulfilled with 100% imported coal. After ensuring the availability of coal from Thar, a mix of 80% imported and 20% Thar coal will be used to operate the power plant.
8.	What is the transportation method of coal to the power plant?	LCDC	The imported coal will be unloaded at Port Qasim and transported to power plant by rail, whereas the Thar coal will be transported by road initially and by train when the rail link is developed.
9.	Why you are not considering Lakhra coal for your project?	LCDC	In Lakhra coal, the content of Sulphur is very high.
10.	What is the daily requirement of coal for proposed power plant?	LCDC	The daily requirement of coal would be approximately 1,500 ton/day.

No.	*Issues Raised*	*By*	*Response Provided*
11.	We suggest you to use Lakhra coal as it would be cost effective. We also propose to install a single boiler in your power plant specific for Lakhra coal.	LCDC	Noted.
12.	LCDC is also planning to establish a coal power plant of 25 MW.	LCDC	Noted.
13.	What is the employment ratio of local people?	HH	Local people from Lakhra area work only on surface and are about 15% whereas rest are mostly from northern areas. There are also some people from Thar area. Some people from Thar work even during off season (after May).
14.	Why the local people work on surface not underground?	HH	The local people do not have the capacity to work underground. The people belongs from northern areas are hard and can work under extreme conditions thus are fit for underground work.
15.	Is there any difference in wages of underground labor and surface labor?	IK	LCDC replied: LCDC does not hire labor directory. The contractor hires the labor and decides the wages. The average salary of the labor is PKR 600/day. There are 30-35 contractors, who work for LCDC. The labor works 6 days a week.

Others:

1. JST and HBP obtained following information.
2. A data on limestone sale to Lakhra Power Plant.
3. A list of projects and programs for development of indigenous coal by LCDC.

Baseline Survey of Lakhra Coal-fired Power Plant

JICA Survey Team

Record of the Consultation Meeting

Stakeholder:	International Union For Conservation of Nature (IUCN), Karachi
Date:	March 04, 2014
Time:	1:45 pm
Meeting Venue:	Avari Hotel Karachi
Attended by:	Senior Adviser (IUCN)
Conducted by:	HI, JICA Survey Team (JST) HS, JICA Survey Team (JST) SR, Assistant Surveyor
Recorded by:	SR, Assistant Surveyor HS, JST
Language:	English
Preamble:	The discussion started with the introduction of the public consultation team members. HS along with IK briefed about the purpose of the meeting and gave a comprehensive description of the project to be Implemented and the related activities with the help of maps. At the end of the informative session, IK and HS opened the session for questions and concerns of participants, especially in marine environment in Karachi coastal area. The issues raised and responses provided by IUCN are discussed below:

No.	*Issues Raised*	*By*	*Response Provided*
1.	Development projects in Pakistan do not follow the international and national rules and regulation.	IUCN	Noted.
2.	In Karachi Port area, thermal discharge from existing power plant, factories like Pak steel mills and Toyota are affecting seedlings and saplings of mangroves and flies and laves of fish.	IUCN	Noted.
3.	The 350 - 370 million gallon of non-treated industrial and urban waste water containing solid waste is discharged into Korangi Creek daily and is resulting in eutrophication. The high nutrition in water encourages growth of mature mangroves but the sludge has adverse impacts on seedlings.	IUCN	Noted. .

No.	*Issues Raised*	*By*	*Response Provided*
4.	Do the factories, companies and plants follow the National Environmental Quality Standard (NEQS)?	HS	IUCN replied: The regulations are not being followed and there is no inspection by the Government.
5.	What is the system of waste drainage from factories and plants to Korangi creek?	HI	IUCN replied: There are two natural routes/spillways which bring solid wastes as well as waste water towards the Korangi creek.
6.	What magnitude of impact will be caused as a result of removing mangroves?	HS	IUCN replied: Mangroves are one of the important components of tropical ocean ecosystems in the world. Removing mangroves could affect the coastal environment in certain ways. The level of adverse impact depends upon the quantity.
7.	How many mangrove trees will be needed for off-setting?	HI	IUCN replied: Removing one mature mangrove will require planting at least 5 fresh mangroves. The restoration will take minimum 8-10 years.
8.	Are there any orders/notifications for the offsetting plants issued by the Government of Pakistan?	HI	IUCN replied: Former president did not issue any such notifications. The PIBT project will result in a loss of 25 hectares of mangroves. The CEO of PIBT announced in a public meeting that they will plant 500 hectares of mangroves.
9.	What kind of issues and concerns will arise in the Karachi coastal line from our project?	HS	IUCN replied: It will adversely affect mangrove especially seedlings and saplings. It will also affect eggs, larva and adult fish and crabs etc. Mobile creatures such as shrimps and fish colonies will migrate from project location but they will eventually come back
10.	According to the NEQS, the outlet of thermal discharge must be kept at the specific distance (more than 10 miles) from the creek?	HS	The minimum offset distance is about 10 miles from the mangroves, but its practical implementation is seldom seen.
11.	Do the industrial activities and urbanization influence the Ramsar site "Indus Delta" which is situated about 50-60 km southeast?	HS	IUCN replied: Actually, the Karachi coastal line is the passive delta of the Indus Delta. The southeast side of the river mouth is the active delta. The water contamination in the passive delta will not affect the Indus Delta.
12.	How many creeks cover the Sindh coastal belt?	HI	IUCN replied: There are a total of 17 creeks in Sindh coast as a part of Indus Delta.

No.	*Issues Raised*	*By*	*Response Provided*
13.	How often the sea mammals can be seen along with the coastal line?	HI	IUCN replied: The mammals can be seen alongside the coastal line of Karachi coast, but sightings are not very common. Dolphins are often seen at Gharo Creek etc. Young of wild boars were also seen on mangrove land. Mammals are more common on the Baluchistan coast.
14.	Are there any coral reefs in the Karachi coast?	HI	IUCN replied: No, Coral reefs are sensitive to turbidity and the Karachi port is geologically formed by alluvial deposition.

Others:

1. IUCN will conduct environmental monitoring for the PIBT project as a third party.
2. Environmental awareness among the local people has significantly improved during the last five years. People now know the value of a mature mangrove and are hesitant to cut it down.

Record of the Consultation Meeting

Stakeholder:	Manzurabad (Men)
Date:	April 09, 2014
Time:	10:20 am
Meeting Venue:	Autaq[1] of a villager
Attended by:	34 attendees
Conducted by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Language:	Urdu, Sindhi
Preamble:	The discussion started with the introduction of the public consultation team members. RK briefed about the purpose of the meeting by using the Background Information Document for the Project (BID) and gave a comprehensive description of the project to be Implemented and the related activities. Copies of the BID translated in Sindhi had been circulated to the participants. At the end of the informative session, RK invited the participants to share their comments and concerns, which have been documented below. The community was assured that their concerns would be communicated to the Project proponent for their consideration and action. Where possible, the response was given from the Project BID.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Employment was not provided to the locals as promised by the existing plant management in the past.	Attendee	Concern noted.
2.	Locals should be given due share in the projects’ employment opportunities.	Attendee	Concern noted.

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[1] Autaqs are guest rooms or places where men gather to mingle and discuss community matters.

No.	*Issues Raised*	*By*	*Response Provided*
3.	Wastewater generated from the plant should be properly managed. So It can be used for agriculture fields.	Attendee	In this project, there will be no thermal discharge from the power plant into the Indus River, as cooling towers will be installed to evaporate the thermal discharge. The wastewater such as domestic water, boiler blow-down water, boiler wash discharge and oil contaminated and heavy metal contaminated water will be discharged after treatment.
4.	The project proponent should provide the facility of drinkable water for the community.	Attendee	Concern noted.
5.	I got employment in the existing LPP in 1988 as a daily wage labor but fired in 2000 without any reason. Permanent jobs should be provided to the local people of the area.	Attendee	Concern noted.

Others:

1. The community appreciated the project and hope that the project will cater for the electricity shortage in the country.

Record of the Consultation Meeting

Stakeholder:	Manzurabad (Women)
Date:	April 09, 2014
Time:	10:20 am
Meeting Venue:	Residence of a villager
Attended by:	18 attendees
Conducted by:	SR, Public Consultation Consultant, HBP FD, Public Consultation Consultant, HBP
Recorded by:	FD
Language:	Sindhi, Urdu
Information Provided:	The discussion started with the introduction of the public consultation team from Hagler Bailly Pakistan (HBP) who briefed on the EIA of the Lakhra Coal Fired Power Plant. SR briefed the participants about the purpose of the meeting and gave a comprehensive description of the project. The main points of the BID were verbally explained in Sindhi and Urdu. At the end of the informative session, an attendee invited the participants to express or share their concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	The exiting LPP has caused air and river water pollution in the area. Community is dependent on Indus River water for water uses. Care should be taken on these accounts, while establishing the proposed plant.	Attendee	The project activities will be undertaken in compliance with relevant national legislation and international guidelines. Emissions control equipment will be installed to control the negative impact of emissions. The wastewater will be treated before discharge in Indus River.
2.	Livestock will be negatively affected by the project as they are dependent on river water for drinking purposes.	Attendee	The wastewater will be treated before discharge in Indus River
3.	Community should be given first preference in terms of employment.	Attendee	Concern noted.
4.	Training and vocational institutes for women should be established to help enable them to earn decent livelihood alongside men.	Attendee	Concern noted.

No.	*Issues Raised*	*By*	*Response Provided*
5	Educational institutions should be provided, especially for women in the village.	Attendee	Concern noted.

Others:

1. The women were generally content with the establishment of the power plant and were hopeful that the plant will bring economic and social development to their area. Unemployment, lack of education and water shortage were identified by women as the main issues in the community.

Record of the Consultation Meeting

Stakeholder:	Zimi (Men)
Date:	April 09, 2014
Time:	12:00 pm
Meeting Venue:	Autaq of a villager
Attended by:	25 attendees
Conducted by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Language:	Urdu, Sindhi
Preamble:	The discussion started with the introduction of the public consultation team members. RK briefed about the purpose of the meeting by using the Background Information Document for the Project (BID) and gave a comprehensive description of the project to be Implemented and the related activities. Copies of the BID translated in Sindhi had been circulated to the participants. At the end of the informative session, RK invited the participants to share their comments and concerns, which have been documented below. The community was assured that their concerns would be communicated to the Project proponent for their consideration and action. Where possible, the response was given from the Project BID.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Employment for the locals in the in the project should be ensured. There are only two persons employed from the community in the existing LPP.	3 attendees	Concern noted.
2.	Contractors looking for workers, hire people for jobs from their area. Employment opportunities should be provided to nearby communities.	Attendee	Concern noted.
3.	The project proponent should provide the facility of drinkable water for the community.	Attendee	Concern noted.

No.	*Issues Raised*	*By*	*Response Provided*
4.	The villagers are dependent on rain for their agriculture fields. If the discharge water from the plant is properly treated then the farmers can use the discharge water for their agriculture fields.	Attendee	Waste water from the plant will be treated before its discharge in the Indus River. It will be ensured that no effluent from the power plant adversely impacts any community and physical environment of the region.
5.	Employment contractor should be of the local area so the local people can get employment in the power plant.	Attendee	Concern noted.

Others:

1. The community hopes that after the completion of new power plant project, duration of load shedding will be reduced.

Record of the Consultation Meeting

Stakeholder:	Zimi (Women)
Date:	April 09, 2014
Time:	12:00 pm
Meeting Venue:	Residence of a villager
Attended by:	9 attendees
Conducted by:	SR, Public Consultation Consultant, HBP FD, Public Consultation Consultant, HBP
Recorded by:	FD
Language:	Sindhi, Urdu
Information Provided:	The discussion started with the introduction of the public consultation team from Hagler Bailly Pakistan (HBP) who briefed on the EIA of the Lakhra Coal Fired Power Plant. SR briefed the participants about the purpose of the meeting and gave a comprehensive description of the project. The main points of the BID were verbally explained in Sindhi and Urdu. At the end of the informative session, SR invited the participants to express or share their concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Indus River water is very polluted and unfit for domestic use. However, community is dependent on this water despite the high levels of pollution. Something should be done to address this situation.	Attendee	Waste water from the plant will be treated before its discharge in the Indus River. It will be ensured that no effluent from the power plant adversely impacts any community and physical environment of the region.
2.	Pipelines or filter plants may be provided to the village community for good quality drinking water.	Attendee	Concern noted.
3.	Agricultural land is barren as there is not irrigation channel or water available.	Attendee	Concern noted.
4.	Electricity is not available to everyone and there is no gas connection to the village. It is urgently needed by the community.	Attendee	Concern noted.
5	Elderly women go to fetch water and wood from distant places. Drinking water facility should be	Attendee	Concern noted.

No.	Issues Raised	By	Response Provided
	provided by the project proponent.		
6	There is no proper education available and teachers are absent from schools all year long. The project proponent should help the community in improving their education.	Attendee	Concern noted.
7	Basic commodities such as health units, transportation system, educational institutes and marketplaces are not available locally.	Attendee	Concern noted.

Other Comments

1. The women were hopeful that the project will bring socioeconomic development to their area and cater for the needs. Most important issues highlighted by the women included water scarcity, unemployment and resultant poverty in the community.

Record of the Consultation Meeting

Stakeholder:	Imdad Ali Khoso (Men)
Date:	April 10, 2014
Time:	10:30 am
Meeting Venue:	Autaq of Village
Attended by:	23 attendees
Conducted by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Language:	Urdu, Sindhi
Preamble:	The discussion started with the introduction of the public consultation team members. RK briefed about the purpose of the meeting by using the Background Information Document for the Project (BID) and gave a comprehensive description of the project to be Implemented and the related activities. Copies of the BID translated in Sindhi had been circulated to the participants. At the end of the informative session, RK invited the participants to share their comments and concerns, which have been documented below. The community was assured that their concerns would be communicated to the Project proponent for their consideration and action. Where possible, the response was given from the Project BID.

No.	*Issues Raised*	*By*	*Response Provided*
6.	The inhabitants of the village suffer from numerous diseases such as respiratory illnesses and eyes problems due to the air emissions from existing LPP.	Attendee	The project activities will be undertaken in compliance with relevant national legislation and international guidelines. Emissions control equipment to remove SO_2 from the exhaust, Electrostatic Precipitator (EP) for particulate matter control will be installed.
7.	Existing Power Station is not beneficial for the community because employment and electricity is not provided to the locals.	Attendee	Concern noted.
8.	Locals are deprived of employment in the power station. They should be given preference for job opportunities over the outsiders.	Attendee	Concern noted.

No.	*Issues Raised*	*By*	*Response Provided*
9.	Employment was not provided to the locals as promised by the existing power plant management.	Attendee	Concern noted.
10.	Drinking water should be provided to the villagers.	Attendee	Concern noted.
11.	I worked in existing power plant for six years on daily wages but was fired without any reason and the plant management hired someone else on permanent basis.	Attendee	Concern noted.

Other Comments

1. The community appreciated the new project and hoped that after the completion of new power plant project, they will get employment and other basic necessities of life.

Record of the Consultation Meeting

Stakeholder:	Imdad Ali Khoso (Women)
Date:	April 10, 2014
Time:	10:30 am
Meeting Venue:	Residence of a villager
Attended by:	26 attendees
Conducted by:	SR, Public Consultation Consultant, HBP FD, Public Consultation Consultant, HBP
Recorded by:	FD
Language:	Sindhi, Urdu
Information Provided:	The discussion started with the introduction of the public consultation team from Hagler Bailly Pakistan (HBP) who briefed on the EIA of the Lakhra Coal Fired Power Plant. SR briefed the participants about the purpose of the meeting and gave a comprehensive description of the project. The main points of the BID were verbally explained in Sindhi and Urdu. At the end of the informative session, SR invited the participants to express or share their concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Employment is needed by the village community.	Attendee	Concern noted.
2.	Women want to work and learn skills that can be used to generate livelihood.	Attendee	Concern noted.
3.	Education is lacking, especially in case of women. More schools should be built in the area.	Attendee	Concern noted.
4.	Water shortage is acute. Water is brought from Indus River and has poor quality that makes village community ill.	Attendee	In the new power plant, the wastewater will be treated before discharge in Indus River.
5	There is no gas and electricity supply.	Attendee	Concern noted.
6	There is no conveniently located health facility.	Attendee	Concern noted.
7	The existing plant smoke suffocates village residents. It makes children ill.	Attendee	In the new power project, the project activities will be undertaken in compliance with relevant national legislation and international

No.	Issues Raised	By	Response Provided
			guidelines. Emissions control equipment will be installed to control the negative impact of emissions.

Other Comments

1. The women looked forward to the construction of the coal fired power plant and expressed desire to earn employment through the project. Some complaints regarding the existing plant were noted by local women however, they were assured that the proposed plant will have mitigation measures in place to minimize any such negative impacts.

Record of the Consultation Meeting

Stakeholder:	Shuja Muhammad Khoso (Men)
Date:	April 10, 2014
Time:	12:15 pm
Meeting Venue:	Autaq of Village
Attended by:	14 attendees
Conducted by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Language:	Urdu, Sindhi
Preamble:	The discussion started with the introduction of the public consultation team members. RK briefed about the purpose of the meeting by using the Background Information Document for the Project (BID) and gave a comprehensive description of the project to be Implemented and the related activities. Copies of the BID translated in Sindhi had been circulated to the participants. At the end of the informative session, RK invited the participants to share their comments and concerns, which have been documented below. The community was assured that their concerns would be communicated to the Project proponent for their consideration and action. Where possible, the response was given from the Project BID.

No.	*Issues Raised*	*By*	*Response Provided*
1.	To save fuel and earn money from locals, the truck drivers of LPP illegally fill excavated areas with ash, near residential areas within settlements. This creates problems for villagers because ash blown by the wind causes eye irritation and breathing problems.	Attendee	Concern noted.
2.	Ash trucks transporting ash from LPP to dumping site are not covered properly, which causes the ash to spread in the area and cause health problems.	Attendee	Concern noted.
3.	Drinkable water and health facilities should be provided by the project proponent.	Attendee	Concern noted.

No.	*Issues Raised*	*By*	*Response Provided*
4.	In the new power plant, employment opportunities for the locals should be ensured.	Attendee	Concern noted.

Others:

1. The community is in the favour of new power plant but basic facilities such as drinkable water, health facilities and employment should be provided to the local people of the area.

Record of the Consultation Meeting

Stakeholder:	Shuja Muhammad Khoso (Women)
Date:	April 10, 2014
Time:	12:15 pm
Meeting Venue:	Residence of a villager
Attended by:	10 attendees
Conducted by:	SR, Public Consultation Consultant, HBP FD, Public Consultation Consultant, HBP
Recorded by:	FD
Language:	Sindhi, Urdu
Information Provided:	The discussion started with the introduction of the public consultation team from Hagler Bailly Pakistan (HBP) who briefed on the EIA of the Lakhra Coal Fired Power Plant. SR briefed the participants about the purpose of the meeting and gave a comprehensive description of the project. The main points of the BID were verbally explained in Sindhi and Urdu. At the end of the informative session, SR invited the participants to express or share their concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Water transport system is expensive and most people cannot afford it. Drinking water facility should be provided to the community.	Attendee	Concern noted.
2.	Teachers are absent from government schools. Measures should be taken by the project proponent to improve the education system in the community.	Attendee	Concern noted.
3.	Village women can sew the traditional ‘Gagha’ (balochi women dress) and other embroidery. This skill can be used to generate livelihood if opportunity is provided through this proposed project.	Attendee	Concern noted.
4.	The health care system is non-existent and illnesses and deaths have occurred in the recent past due to wrong medicine or treatment by inefficient health care workers.	Attendee	Concern noted.

Others:

1. The women did not show any reservations regarding construction of the Power plant in their area and hoped it would improve the socioeconomic conditions in the region by generating employment.

Record of the Consultation Meeting

Stakeholder:	Bhuro Khan Rind (Men)
Date:	April 10, 2014
Time:	2:15 pm
Meeting Venue:	Autaq of a villager
Attended by:	24 attendees
Conducted by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Language:	Urdu, Sindhi
Preamble:	The discussion started with the introduction of the public consultation team members. RK briefed about the purpose of the meeting by using the Background Information Document for the Project (BID) and gave a comprehensive description of the project to be Implemented and the related activities. Copies of the BID translated in Sindhi had been circulated to the participants. At the end of the informative session, RK invited the participants to share their comments and concerns, which have been documented below. The community was assured that their concerns would be communicated to the Project proponent for their consideration and action. Where possible, the response was given from the Project BID.

No.	*Issues Raised*	*By*	*Response Provided*
1.	The ash from the LPP is dumped near the settlements. In the rainy days, the water comes with the ash, dumped near the settlements and ruined the agricultural fields. Resultantly, agricultural fields gradually lose fertility.	Attendee	Concern noted.
2.	The management of existing power plant did not fulfill its promise of employment. The community hope in the new power plant that they will get the employment according to their skills.	Attendee	Concern noted.
3.	I am working in the existing power plant since 1993 but still working on daily wages and not getting any benefit.	Attendee	Concern noted.

No.	*Issues Raised*	*By*	*Response Provided*
4.	The people are not happy with the existing power plant and its management. The existing power plant is not beneficial but causing eyes and breathing problems from its emissions.	Attendee	Concern noted.
5.	The labor working in LPP does not have access to Personal protective equipment (PPEs), which causes health problems in the laborers.	Attendee	Concern noted.
6.	Drinkable water should be provided by the project proponent.	Attendee	Concern noted.
7.	Ash trucks transporting ash from LPP to dumping site are not covered properly, which causes the ash to spread in the area and cause health problems in locals.	Attendee	Concern noted.

Record of the Consultation Meeting

Stakeholder:	Bhuro Khan Rind (Women)
Date:	April 10, 2014
Time:	2:15 pm
Meeting Venue:	Residence of a villager
Attended by:	16 attendees
Conducted by:	SR, Public Consultation Consultant, HBP FD, Public Consultation Consultant, HBP
Recorded by:	FD
Language:	Sindhi, Urdu
Information Provided:	The discussion started with the introduction of the public consultation team from Hagler Bailly Pakistan (HBP) who briefed on the EIA of the Lakhra Coal Fired Power Plant. SR briefed the participants about the purpose of the meeting and gave a comprehensive description of the project. The main points of the BID were verbally explained in Sindhi and Urdu. At the end of the informative session, SR invited the participants to express or share their concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Unemployment is the greatest problem in the village.	Attendee	Concern noted.
2.	There is no school for women in the village. School facility for girls should be provided to the community.	Attendee	Concern noted.
3.	Mosquitoes and other disease vectors cause Dengue, Malaria and related diseases in the village. Health facility should be provided by the project proponent.	Attendee	Concern noted.
4.	Existing LPP is throwing dust and harmful fumes in the air, Indus River and community lands. This causes diseases and severe health problems among locals.	Attendee	Concern noted.

Others:

1. The women observed that if the plant had appropriate mitigation measures in place, there should not be a problem and they supported the construction of the power plant. However, basic needs of the community including employment, clean drinking water and education should be met by the project team.

Record of the Consultation Meeting

Stakeholder:	Jan Muhammad Khoso (Men)
Date:	April 11, 2014
Time:	10:15 am
Meeting Venue:	Autaq of Village
Attended by:	13 attendees
Conducted by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Language:	Urdu, Sindhi
Preamble:	The discussion started with the introduction of the public consultation team members. RM briefed about the purpose of the meeting by using the Background Information Document for the Project (BID) and gave a comprehensive description of the project to be Implemented and the related activities. Copies of the BID translated in Sindhi had been circulated to the participants. At the end of the informative session, RM invited the participants to share their comments and concerns, which have been documented below. The community was assured that their concerns would be communicated to the Project proponent for their consideration and action. Where possible, the response was given from the Project BID.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Employment was not provided to the locals as promised by the LPP management. The villagers are concerned whether or not the locals will get employment in the new power plant.	Attendee	Concern noted.
2.	Educational and health facilities should be provided by the project proponent.	Attendee	Concern noted.
3.	Drinking water contamination due to LPP effluents in the Indus River is affecting the health of the locals.	Attendee	Waste water from the new power plant will be treated before its discharge in the Indus River.
4.	The trucks transporting ash from LPP to dumping site are not covered properly, which causes the ash to spread in the area and cause health problems in the surrounding areas.	Attendee	Concern noted.

No.	*Issues Raised*	*By*	*Response Provided*
5.	In the rainy days, the water comes with the ash, dumped near the settlements and ruined the agricultural fields.	Attendee	Concern noted.

Record of the Consultation Meeting

Stakeholder:	Jan Muhammad Khoso (Women)
Date:	April 11, 2014
Time:	10:15 am
Meeting Venue:	Residence of a villager
Attended by:	12 attendees
Conducted by:	SR, Public Consultation Consultant, HBP FD, Public Consultation Consultant, HBP
Recorded by:	FD
Language:	Sindhi, Urdu
Information Provided:	The discussion started with the introduction of the public consultation team from Hagler Bailly Pakistan (HBP) who briefed on the EIA of the Lakhra Coal Fired Power Plant. SR briefed the participants about the purpose of the meeting and gave a comprehensive description of the project. The main points of the BID were verbally explained in Sindhi and Urdu. At the end of the informative session, SR invited the participants to express or share their concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Water is not available and where available, it has poor quality causing Diarrhea, Hepatitis C, Stomach illnesses and other water related diseases. Drinking water should be provided by the project proponent.	Attendee	Concern noted.
2.	Health infrastructure in the village is lacking.	Attendee	Concern noted.
3.	If locals are not given employment in the Power Plant, community protests and disputes are likely to happen.	Attendee	Concern noted.

Others:

1. The women did not show any reservations against the power plant project however, they noted that if locals are not given employment and left out (as in case of the existing LPP), there will be protests.
2. Women education is lacking in the village.

Record of the Consultation Meeting

Stakeholder:	Khanot (Men)
Date:	April 11, 2014
Time:	1:30 pm
Meeting Venue:	Residence of a villager
Attended by:	15 attendees
Conducted by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Language:	Urdu, Sindhi
Preamble:	The discussion started with the introduction of the public consultation team members. RK briefed about the purpose of the meeting by using the Background Information Document for the Project (BID) and gave a comprehensive description of the project to be Implemented and the related activities. Copies of the BID translated in Sindhi had been circulated to the participants. At the end of the informative session, RK invited the participants to share their comments and concerns, which have been documented below. The community was assured that their concerns would be communicated to the Project proponent for their consideration and action. Where possible, the response was given from the Project BID.

No.	*Issues Raised*	*By*	*Response Provided*
1.	The inhabitants of the village facing numerous diseases such as respiratory illnesses and eyes problems due to the emissions of the existing LPP.	Attendee	The project activities will be undertaken in compliance with relevant national legislation and international guidelines. Emissions control equipment will be installed to control the negative impact of emissions.
2.	The discharge water from the existing LPP is not treated and polluting water quality and creates problems for the people who are using Indus River water for their domestic need. Inhabitants, suffer from Hepatitis B and C due to the low quality of Indus River.	Attendee	Cooling towers will be installed to evaporate the thermal discharge so that no thermal discharge would be discharged into the Indus River. The small amount of waste water such as domestic water and boiler blow-down will be discharged after treatment.

No.	*Issues Raised*	*By*	*Response Provided*
3.	Filtered water should be provide by the project proponent.	Attendee	Concern noted.
4.	Employment was not provided to the locals in the past as promised by the LPP management. We being the locals of the area want employment opportunities in the new power plant.	2 attendees	Concern noted.
5.	Educational and health facilities should be provided by the project proponent.	Attendee	Concern noted.

Record of the Consultation Meeting

Stakeholder:	Khanot (Women)
Date:	April 11, 2014
Time:	1:30 pm
Meeting Venue:	Indus Resource Center (IRC) Girls Elementary School
Attended by:	16 attendees
Conducted by:	SR, Public Consultation Consultant, HBP FD, Public Consultation Consultant, HBP
Recorded by:	FD
Language:	Sindhi, Urdu
Information Provided:	The discussion started with the introduction of the public consultation team from Hagler Bailly Pakistan (HBP) who briefed on the EIA of the Lakhra Coal Fired Power Plant. SR briefed the participants about the purpose of the meeting and gave a comprehensive description of the project. The main points of the BID were verbally explained in Sindhi and Urdu. At the end of the informative session, SR invited the participants to express or share their concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	The new power plant will cause air pollution resulting in eye irritation and breathing problems.	Attendee	The project activities will be undertaken in compliance with relevant national legislation and international guidelines. Emissions control equipment will be installed to control the negative impact of emissions.
2.	Coal labor is the major source of employment in the village and this employment source should not be affected in any way.	Attendee	Concern noted.
3.	Gas connection should be given to the locals.	Attendee	Concern noted.
4.	Electricity theft and unfair arrears in the electricity bill are creating problems for the poor people.	Attendee	Concern noted.
5.	Water tankers that villagers use because of discontinued government water pipeline supply scheme, sometimes smell of oil. This indicates poor quality of water. Drinkable water facility	Attendee	Concern noted.

No.	Issues Raised	By	Response Provided
	should be provided by the project proponent.		
6.	Government filter is not functional. It should be made functional again.	Attendee	Concern noted.
7.	Education is not available at higher levels and where available, it is unaffordable for the poorer community. Education facilities should be provided by the project proponent.	Attendee	Concern noted.
8.	Local boys are well educated and deserve employment in the LPP and proposed power plant.	Attendee	Concern noted.

Others:

1. The women noted that education, gas and water supply were the major problems of the village and efforts should be made to help village community with these issues if the project has to be efficiently implemented in the area.

Record of the Consultation Meeting

Stakeholder:	Paryo Khan Dia Dano (Men)
Date:	April 12, 2014
Time:	10:30 am
Meeting Venue:	Residence of a villager
Attended by:	17 attendees
Conducted by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Language:	Urdu, Sindhi
Preamble:	The discussion started with the introduction of the public consultation team members. RK briefed about the purpose of the meeting by using the Background Information Document for the Project (BID) and gave a comprehensive description of the project to be Implemented and the related activities. Copies of the BID translated in Sindhi had been circulated to the participants. At the end of the informative session, RK invited the participants to share their comments and concerns, which have been documented below. The community was assured that their concerns would be communicated to the Project proponent for their consideration and action. Where possible, the response was given from the Project BID.

No.	*Issues Raised*	*By*	*Response Provided*
1.	The ash from the LPP is dumped near the settlements. In the rainy days, the water comes with the ash, dumped near the settlements and ruined the agricultural fields. Resultantly, agricultural fields gradually lose fertility. The coal ash should be properly landfilled away from the settlements.	Attendee	Concern noted.
2.	Locals of the area should be preferred over outsiders for employment opportunities in the new power plant. The resident engineer (RE) outsiders for employment instead of local people.	2 attendees	Concern noted,

No.	*Issues Raised*	*By*	*Response Provided*
3.	The project proponent should provide the facility of drinkable water for the community. The inhabitants are bound to buy water tanker and cannot afford.	Attendee	Concern noted.
4.	To save fuel, the truck drivers of LPP illegally dump the ash, near residential areas instead of allotted ash dump site. This creates problems for villagers because ash blown by the wind causes eye irritation and breathing problems.	Attendee	Concern noted.

Record of the Consultation Meeting

Stakeholder:	Paryo Khan Dai Dano (Women)
Date:	April 12, 2014
Time:	10:30 am
Meeting Venue:	Residence of a villager
Attended by:	16 attendees
Conducted by:	SR, Public Consultation Consultant, HBP FD, Public Consultation Consultant, HBP
Recorded by:	FD
Language:	Sindhi, Urdu
Information Provided:	The discussion started with the introduction of the public consultation team from Hagler Bailly Pakistan (HBP) who briefed on the EIA of the Lakhra Coal Fired Power Plant. SR briefed the participants about the purpose of the meeting and gave a comprehensive description of the project. The main points of the BID were verbally explained in Sindhi and Urdu. At the end of the informative session, SR invited the participants to express or share their concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Ash and dust from coal dumping site near the village causes breathing and eye irritation problems among village community.	Attendee	Concern noted.
2.	No PPEs are provided to workers in the LPP, which causes them to suffer from breathing problems, eye and skin irritation.	Attendee	
3.	Drinking water is a major problem in the village. Tankers are too expensive and unaffordable for the inhabitants.	Attendee	Concern noted.
4.	Naked electricity wires are lying around in the village. During rain and other weather extremes, electricity poles tend to fall and cause fire accidents.	Attendee	Concern noted.
5.	There is no opportunity for female education in the village. Project proponent should provide such opportunities to village women. Sindh Education Foundation (SEF) School is closed as there are no available funds to run the school.	Attendee	Concern noted.

No.	*Issues Raised*	*By*	*Response Provided*
6.	There is no maternity health care facility available in the village. Health care facility should be provided by the project proponent.	Attendee	Concern noted.

Others:

1. The women community supports the project.
2. The women were content with the construction of the project and wished that the project will improve their socioeconomic conditions, especially in terms of water facility and women education.

Record of the Consultation Meeting

Stakeholder:	Koreja (Men)
Date:	April 12, 2014
Time:	1:30 pm
Meeting Venue:	Residence of a villager
Attended by:	17 attendees
Conducted by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Language:	Urdu, Sindhi
Preamble:	The discussion started with the introduction of the public consultation team members. RK briefed about the purpose of the meeting by using the Background Information Document for the Project (BID) and gave a comprehensive description of the project to be Implemented and the related activities. Copies of the BID translated in Sindhi had been circulated to the participants. At the end of the informative session, RK invited the participants to share their comments and concerns, which have been documented below. The community was assured that their concerns would be communicated to the Project proponent for their consideration and action. Where possible, the response was given from the Project BID.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Birds are affected by the release of the pollutant air emissions from the existing LPP.	Attendee	The project activities will be undertaken in compliance with relevant national legislations and international guidelines. The Emissions control to remove SO_2 from the exhaust, Electrostatic Precipitator (EP) and Low NOx burner will be installed.
2.	The agricultural land is the feeding grounds for the birds. The emissions from the existing LPP have a negative impact on the birds.	Attendee	The project activities will be undertaken in compliance with relevant national legislations and international guidelines. The Emissions control to remove SO_2 from the exhaust, Electrostatic Precipitator (EP) and Low NOx burner will be installed.

No.	*Issues Raised*	*By*	*Response Provided*
3.	Pollutants discharge of existing LPP into the irrigation canal and Indus River is impacting an adverse effect on fish breeding and decreasing fish population.	Attendee	In the new power plant, there will be no thermal discharge from the power plant into the Indus River, as cooling towers will be installed to evaporate the thermal discharge. The wastewater such as domestic water, boiler blow-down water, boiler wash discharge and oil contaminated and heavy metal contaminated water will be discharged after treatment.
4.	Due to air emissions and fly ash of existing LPP, the trees and agricultural fields are damaged.	Attendee	The new project activities will be undertaken in compliance with relevant national legislations and international guidelines. The Emissions control to remove SO_2 from the exhaust, Electrostatic Precipitator (EP) and Low NOx burner will be installed.
5.	The baseline data of ecology should be shared with the educated inhabitants of the community.	Attendee	Concern noted.
6.	Employment was not provided to the locals as promised by the existing LPP management in the past. The locals are hopeless that in the new power plant they will get employment or any other facility.	Attendee	Concern noted.
7.	The inhabitants of the community facing numerous diseases such as respiratory illnesses and eyes problems due to the emissions from existing LPP.	Attendee	The new project activities will be undertaken in compliance with relevant national legislations and international guidelines. The Emissions control to remove SO_2 from the exhaust, Electrostatic Precipitator (EP) and Low NOx burner will be installed.
8.	Waste water effluents and air emissions has affected the health of the local people. It has caused an increase in germs, skin allergies.	Attendee	In the new power plant, there will be no thermal discharge from the power plant into the Indus River, as cooling towers will be installed to evaporate the thermal discharge. The wastewater such as domestic water, boiler blow-down water, boiler wash discharge and oil contaminated and heavy metal contaminated water will be discharged after treatment.

No.	*Issues Raised*	*By*	*Response Provided*
9.	Air emissions are affecting the health of the local wildlife and causing a decrease in their population.	Attendee	The new project activities will be undertaken in compliance with relevant national legislations and international guidelines. The Emissions control to remove SO_2 from the exhaust, Electrostatic Precipitator (EP) and Low NOx burner will be installed.
10.	The smoke from the existing LPP creates nuisance for the locality during winds.	Attendee	The new project activities will be undertaken in compliance with relevant national legislations and international guidelines. The Emissions control to remove SO_2 from the exhaust, Electrostatic Precipitator (EP) and Low NOx burner will be installed.
11.	When wind comes from West, particulates are dispersed and settle around and in these settlements. We want coal power but the location of new power plant should have been somewhere else.	Attendee	The new project activities will be undertaken in compliance with relevant national legislations and international guidelines. The Emissions control to remove SO_2 from the exhaust, Electrostatic Precipitator (EP) and Low NOx burner will be installed.

Others:

1. The inhabitants are not in a favour of new coal power plant at any cost. If it is constructed the community will protest against the new power plant.
2. An attendee wants to meet the project proponent directly so that he can communicate the problems from existing LPP to them.

Record of the Consultation Meeting

Stakeholder:	Koreja (Women)
Date:	April 12, 2014
Time:	1:30 pm
Meeting Venue:	Residence of a villager
Attended by:	10 attendees
Conducted by:	SR, Public Consultation Consultant, HBP FD, Public Consultation Consultant, HBP
Recorded by:	FD
Language:	Sindhi, Urdu
Information Provided:	The discussion started with the introduction of the public consultation team from Hagler Bailly Pakistan (HBP) who briefed on the EIA of the Lakhra Coal Fired Power Plant. SR briefed the participants about the purpose of the meeting and gave a comprehensive description of the project. The main points of the BID were verbally explained in Sindhi and Urdu. At the end of the informative session, SR invited the participants to express or share their concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	People suffer from eye infection due to the coal ash being dumped near the settlement.	Attendee	Concern noted.
2.	Vegetation is negatively affected. There is no plant growth in areas where coal ash is dumped or deposited of the existing power plant.	Attendee	Concern noted.
3.	Drinking water is a major problem in the village. It is lacking in terms of both quality and quantity.	Attendee	Concern noted.
4.	There is only one primary school for women. As women cannot travel to far off places for higher education, therefore despite desire, they usually do not pursue higher education.	Attendee	Concern noted.
5.	If a new power plant is going to be established in this area, appropriate measures to control coal ash and its dumping must be taken.	Attendee	Concern noted.

Others:

1. The women were content with the construction of the project and wished that the project will improve their socioeconomic conditions, especially in terms of water facility and women education.

Record of the Consultation Meeting

Stakeholder:	Thehbo (Men)
Date:	April 12, 2014
Time:	2:00 pm
Meeting Venue:	Residence of a villager
Attended by:	50 attendees
Conducted by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Language:	Urdu, Sindhi
Preamble:	The discussion started with the introduction of the public consultation team members. RK briefed about the purpose of the meeting by using the Background Information Document for the Project (BID) and gave a comprehensive description of the project to be Implemented and the related activities. Copies of the BID translated in Sindhi had been circulated to the participants. At the end of the informative session, RK invited the participants to share their comments and concerns, which have been documented below. The community was assured that their concerns would be communicated to the Project proponent for their consideration and action. Where possible, the response was given from the Project BID.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Employment opportunities should be provided to the local people of the area.	Attendee	Concern noted.
2.	There is lack of educational facilities in the settlement. Health facilities should be provided to the community.	Attendee	Concern noted.
3.	The existing power station is not beneficial for the community because it does not supply electricity to the settlement. The inhabitants hope that after the completion of new power plant, electricity will be provided to the community.	2 attendees	Concern noted

No.	*Issues Raised*	*By*	*Response Provided*
4.	Project management should ensure that health effects on local inhabitants should be minimized and health facilities should be provided to the community.	2 attendees	Concern noted.

Record of the Consultation Meeting

Stakeholder:	Thehbo (Women)
Date:	April 12, 2014
Time:	2:00 pm
Meeting Venue:	Residence of a villagers
Attended by:	25 attendees
Conducted by:	SR, Public Consultation Consultant, HBP FD, Public Consultation Consultant, HBP
Recorded by:	FD
Language:	Sindhi, Urdu
Information Provided:	The discussion started with the introduction of the public consultation team from Hagler Bailly Pakistan (HBP) who briefed on the EIA of the Lakhra Coal Fired Power Plant. SR briefed the participants about the purpose of the meeting and gave a comprehensive description of the project. The main points of the BID were verbally explained in Sindhi and Urdu. At the end of the informative session, SR invited the participants to express or share their concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	The community is content with the construction of the project and look forward to socioeconomic development of the area.	Attendee	Concern noted.
2.	Electricity and gas supply are the major requirements of the village community.	Attendee	Concern noted.
3.	There is no school in the village. Education facility should be provided by the project proponent.	Attendee	Concern noted.
4.	Government supplies tap water to the village but it is not usable. Drinking water facility should be provided by the project proponent.	Attendee	Concern noted.
5.	Women want sewing machines, so they can work and generate money to support family. The project proponent should support them by providing them the sewing machines.	Attendee	Concern noted.

Others:

1. The women were content with the construction of the project and wished that the project will improve their socioeconomic conditions.

Record of the Consultation Meeting

Stakeholder:	Allah Dino Baricho (Men)
Date:	April 13, 2014
Time:	11:00 am
Meeting Venue:	Hotel at Habibullah Mor
Attended by:	25 attendees
Conducted by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Language:	Urdu, Sindhi
Preamble:	The discussion started with the introduction of the public consultation team members. RK briefed about the purpose of the meeting by using the Background Information Document for the Project (BID) and gave a comprehensive description of the project to be Implemented and the related activities. Copies of the BID translated in Sindhi had been circulated to the participants. At the end of the informative session, RK invited the participants to share their comments and concerns, which have been documented below. The community was assured that their concerns would be communicated to the Project proponent for their consideration and action. Where possible, the response was given from the Project BID.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Outsiders are employed in the LPP while the local communities are ignored.	Attendee	Concern noted.
2.	To save fuel, the truck drivers of LPP illegally dump coal waste near residential area. This creates problems for villagers because ash blown by the wind causes eye irritation and breathing problems.	Attendee	Concern noted.
3.	In the rainy days, the water comes with the ash, dumped near the settlements and ruined the agricultural fields.	Attendee	Concern noted.
4.	The coal ash should be away from the settlements.	Attendee	Concern noted.

No.	*Issues Raised*	*By*	*Response Provided*
5.	Water facility should be provided by the project proponent.	Attendee	Concern noted.
6.	We have dug well in the village but the water is not sweat. The project proponent should provide reverse osmosis facility to the community.	Attendee	Concern noted.
7.	Education facility and teacher should be provided by the project proponent.	Attendee	Concern noted.

Record of the Consultation Meeting

Stakeholder:	Allah Dino Baricho (Women)
Date:	April 13, 2014
Time:	11:00 am
Meeting Venue:	Residence of a villager
Attended by:	19 attendees
Conducted by:	SR, Public Consultation Consultant, HBP FD, Public Consultation Consultant, HBP
Recorded by:	FD
Language:	Sindhi, Urdu
Information Provided:	The discussion started with the introduction of the public consultation team from Hagler Bailly Pakistan (HBP) who briefed on the EIA of the Lakhra Coal Fired Power Plant. SR briefed the participants about the purpose of the meeting and gave a comprehensive description of the project. The main points of the BID were verbally explained in Sindhi and Urdu. At the end of the informative session, SR invited the participants to express or share their concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	The project team is requested to upgrade existing women education situation in the village by providing an educational institute for women. The government school is closed due to absence of teachers.	Attendee	Concern noted.
2.	Employment opportunities should be provided in the proposed power plant.	Attendee	Concern noted.
3.	Infrastructure is poor due to lack of financial resources and is subject to the mercy of weather. In case of extreme events such as the 2010 flood and monsoon rains, houses tend to fall and there is no money to rebuild them.	Attendee	Concern noted.
4.	Project team should provide a housing scheme within the settlement.	Attendee	Concern noted.

Others:

1. The women of the community support the establishment of this project in the area.
2. The women expressed concern regarding lack of employment opportunities in the LPP, which was against the promise made by the project contractors. They

wanted an equal share in employment along with other socioeconomic reforms including educational opportunities and accommodation infrastructure.

Record of the Consultation Meeting

Stakeholder:	Esab Khan Khoso (Men)
Date:	April 13, 2014
Time:	1:00 pm
Meeting Venue:	Autaq of a villager
Attended by:	6 attendees
Conducted by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Language:	Urdu, Sindhi
Preamble:	The discussion started with the introduction of the public consultation team members. RK briefed about the purpose of the meeting by using the Background Information Document for the Project (BID) and gave a comprehensive description of the project to be Implemented and the related activities. Copies of the BID translated in Sindhi had been circulated to the participants. At the end of the informative session, RK invited the participants to share their comments and concerns, which have been documented below. The community was assured that their concerns would be communicated to the Project proponent for their consideration and action. Where possible, the response was given from the Project BID.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Employment was not provided to the locals in the existing LPP.	Attendee	Concern noted.
2.	Ash trucks transporting ash from LPP to dumping site are not covered properly, which causes the ash to spread in the area and cause health problems.	Attendee	Concern noted.
3.	The ash from the LPP is dumped near the settlements. This creates problems for villagers because ash blown by the wind causes eye irritation and respiratory problems.	Attendee	Concern noted.
4.	Health and educational facilities should be provided by the project proponent.	Attendee	Concern noted.

Record of the Consultation Meeting

Stakeholder:	Esab Khan Khoso (Women)
Date:	April 13, 2014
Time:	1:00 pm
Meeting Venue:	Residence of a villager
Attended by:	12 attendees
Conducted by:	SR, Public Consultation Consultant, HBP FD, Public Consultation Consultant, HBP
Recorded by:	FD
Language:	Sindhi, Urdu
Information Provided:	The discussion started with the introduction of the public consultation team from Hagler Bailly Pakistan (HBP) who briefed on the EIA of the Lakhra Coal Fired Power Plant. SR briefed the participants about the purpose of the meeting and gave a comprehensive description of the project. The main points of the BID were verbally explained in Sindhi and Urdu. At the end of the informative session, SR invited the participants to express or share their concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	The coal ash and other harmful emissions will cause health problems in the village. However, village community supports the project if it betters the socioeconomic condition of the area.	Attendee	The project activities will be undertaken in compliance with relevant national legislation and international guidelines. Emissions control equipment will be installed to control the negative impact of emissions.
2.	Drinking water facility and employment opportunities are the need of the hour.	Attendee	Concern noted.
3.	Women have the skill of making rilleys (traditional cloth work) and handmade traditional dresses. They should be provided opportunity to cash this skill.	Attendee	Concern noted.
4.	The project will only be appreciated and supported if something is done for the village community.	Attendee	Concern noted.
5.	Project team should hear the voice of the poor people and address their concerns instead of consulting the rich and powerful	Attendee	We are here to hear your voice. You can raise any issue related to existing LPP and give

No.	*Issues Raised*	*By*	*Response Provided*
	class alone.		suggestions for new power plant.

Others:

1. The women wanted an improvement in the socioeconomic conditions of the settlement. Employment was identified as the major need of the settlement. Women expressed desire to be given an outlet to cash their skills in the market.

Record of the Consultation Meeting

Stakeholder:	Murid Khan Rind (Men)
Date:	April 14, 2014
Time:	10:15 am
Meeting Venue:	In open air
Attended by:	55 attendees
Conducted by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Language:	Urdu, Sindhi
Preamble:	The discussion started with the introduction of the public consultation team members. RK briefed about the purpose of the meeting by using the Background Information Document for the Project (BID) and gave a comprehensive description of the project to be Implemented and the related activities. Copies of the BID translated in Sindhi had been circulated to the participants. At the end of the informative session, RK invited the participants to share their comments and concerns, which have been documented below. The community was assured that their concerns would be communicated to the Project proponent for their consideration and action. Where possible, the response was given from the Project BID.

No.	*Issues Raised*	*By*	*Response Provided*
1.	We being the locals of the area want employment opportunities in the project. Employment opportunities in the project should be provided to the local inhabitants.	2 attendees	Concern noted.
2.	The water provided by the LPP is not of good quality. Drinkable water should be provided by the project proponent.	Attendee	Concern noted.
3.	Ash trucks transporting ash from LPP to dumping site are not covered properly, which causes the ash to spread in the area and cause health problems.	Attendee	Concern noted.

No.	*Issues Raised*	*By*	*Response Provided*
4.	The educational and health facilities (dispensary) are available in Wapda colony but the inhabitants of the community are not allowed to get the benefits from them. Educational and health facilities should be provided by the project proponent.	2 attendees	Concern noted.
5.	The ash from the LPP is dumped near the settlements. This creates problems for villagers because ash blown by the wind causes eye irritation and breathing problems.	Attendee	Concern noted.

Record of the Consultation Meeting

Stakeholder:	Murid Khan Rind (Women)
Date:	April 14, 2014
Time:	10:15 am
Meeting Venue:	Residence of a villager
Attended by:	27 attendees
Conducted by:	SR, Public Consultation Consultant, HBP FD, Public Consultation Consultant, HBP
Recorded by:	FD
Language:	Sindhi, Urdu
Information Provided:	The discussion started with the introduction of the public consultation team from Hagler Bailly Pakistan (HBP) who briefed on the EIA of the Lakhra Coal Fired Power Plant. SR briefed the participants about the purpose of the meeting and gave a comprehensive description of the project. The main points of the BID were verbally explained in Sindhi and Urdu. At the end of the informative session, SR invited the participants to express or share their concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	The power plant construction is supported by the village community because there is hope this project will bring prosperity to the village.	Attendee	Concern noted.
2.	Educational infrastructure is present however; there are no teachers who can teach in schools.	Attendee	Concern noted.
3.	If a female school is established, only women teachers should teach there.	Attendee	Concern noted.
4.	Women and children collect wood therefore do not get time to get education. Gas facility should be provided to the community.	Attendee	Concern noted.

Others:

1. The women showed support for the project in return for improvement in the socioeconomic conditions of the area.

Record of the Consultation Meeting

Stakeholder:	Abdul Ghani Bandwani (Men)
Date:	April 14, 2014
Time:	12:00 pm
Meeting Venue:	Autaq of a villager
Attended by:	12 attendees
Conducted by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Language:	Urdu, Sindhi
Preamble:	The discussion started with the introduction of the public consultation team members. RK briefed about the purpose of the meeting by using the Background Information Document for the Project (BID) and gave a comprehensive description of the project to be Implemented and the related activities. Copies of the BID translated in Sindhi had been circulated to the participants. At the end of the informative session, RK invited the participants to share their comments and concerns, which have been documented below. The community was assured that their concerns would be communicated to the Project proponent for their consideration and action. Where possible, the response was given from the Project BID.

No.	*Issues Raised*	*By*	*Response Provided*
1.	The existing LPP is not beneficial for the community. The management of the LPP did not provide any facility to the community.	Attendee	Concern noted.
2.	Outsiders are employed in the existing LPP while the local communities are ignored in the past.	Attendee	Concern noted.
3.	The inhabitants of the village suffer from numerous diseases such as respiratory illnesses and eyes problems due to the air emissions from existing LPP.	Attendee	Concern noted.
4.	In the new power plant, water effluents and air emissions discharged from the power station should be mitigated and minimized.	Attendee	Concern noted.

No.	*Issues Raised*	*By*	*Response Provided*
5.	The water is not available in the community. The inhabitants purchase water from water tankers for their domestic use. The inhabitants are very poor and do not afford water. Drinking water should be provided by the project proponent.	Attendee	Concern noted.

Record of the Consultation Meeting

Stakeholder:	Abdul Ghani Bandwani (Women)
Date:	April 14, 2014
Time:	12:00 pm
Meeting Venue:	Residence of a villager
Attended by:	16 attendees
Conducted by:	SR, Public Consultation Consultant, HBP FD, Public Consultation Consultant, HBP
Recorded by:	FD
Language:	Sindhi, Urdu
Information Provided:	The discussion started with the introduction of the public consultation team from Hagler Bailly Pakistan (HBP) who briefed on the EIA of the Lakhra Coal Fired Power Plant. SR briefed the participants about the purpose of the meeting and gave a comprehensive description of the project. The main points of the BID were verbally explained in Sindhi and Urdu. At the end of the informative session, SR invited the participants to express or share their concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Agricultural fields will be destroyed by the project activities (especially waste dumping).	Attendee	The ash will be dumped at the allocated site.
2.	To compensate the losses to our fields, water and health, the project should provide drinking water and employment to the village community.	Attendee	Concern noted.
3.	Accommodation infrastructure should be provided to the village people.	Attendee	Concern noted.
4.	Almost all women in the village are uneducated as there is no conveniently located educational facility.	Attendee	Concern noted.

Others:

1. The community noted that ash dust and power plant waste may be a problem to the agricultural fields. They requested project team to provide water and employment to the village locals.

Record of the Consultation Meeting

Stakeholder:	Dodo Mithano (Men)
Date:	April 14, 2014
Time:	1:30 pm
Meeting Venue:	Government Primary School
Attended by:	7 attendees
Conducted by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Language:	Urdu, Sindhi
Preamble:	The discussion started with the introduction of the public consultation team members. RK briefed about the purpose of the meeting by using the Background Information Document for the Project (BID) and gave a comprehensive description of the project to be Implemented and the related activities. Copies of the BID translated in Sindhi had been circulated to the participants. At the end of the informative session, RK invited the participants to share their comments and concerns, which have been documented below. The community was assured that their concerns would be communicated to the Project proponent for their consideration and action. Where possible, the response was given from the Project BID.

No.	*Issues Raised*	*By*	*Response Provided*
1.	The ash should be dumped at the allocated site and water should be sprinkled on the dumped ash.	Attendee	Concern noted.
2.	Air emissions of the existing LPP have led to respiratory and skin allergies. It has also caused irritation in the eyes of the local inhabitants.	Attendee	The project activities will be undertaken in compliance with relevant national legislation and international guidelines. Emissions control equipment will be installed to control the negative impact of emissions.
3.	Employment opportunities are not provided in the existing LPP. Employment should be given to the local people.	Attendee	Concern noted.
4.	Health and educational facilities should be provided by the project proponent.	2 attendees	Concern noted.

Record of the Consultation Meeting

Stakeholder:	Dodo Mithano (Women)
Date:	April 14, 2014
Time:	1:30 pm
Meeting Venue:	Residence of a villager
Attended by:	10 attendees
Conducted by:	SR, Public Consultation Consultant, HBP FD, Public Consultation Consultant, HBP
Recorded by:	FD
Language:	Sindhi, Urdu
Information Provided:	The discussion started with the introduction of the public consultation team from Hagler Bailly Pakistan (HBP) who briefed on the EIA of the Lakhra Coal Fired Power Plant. SR briefed the participants about the purpose of the meeting and gave a comprehensive description of the project. The main points of the BID were verbally explained in Sindhi and Urdu. At the end of the informative session, SR invited the participants to express or share their concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Ash is thrown immediately adjacent to our settlement which causes health hazards especially among children.	Attendee	In the new power project, the ash will be deposited at the allocated site.
2.	Our village atmosphere and meager water resources may be destroyed by the project activities.	Attendee	In the new power project, the project activities will be undertaken in compliance with relevant national legislation and international guidelines. Emissions control equipment will be installed to control the negative impact of emissions, whereas The wastewater will be treated before discharge in Indus River.
3.	Employment should be provided to the locals in the proposed power plant. Mistakes made by the LPP must not be repeated in this project.	Attendee	Concern noted.

Others:

1. Employment was identified as the prime requirement of the village community. Some women noted concerns that the project may pollute existing environment of the village.

Record of the Consultation Meeting

Stakeholder:	WAPDA Colony (Men)
Date:	April 15, 2014
Time:	11:00
Meeting Venue:	Wapda Colony
Attended by:	16 attendees
Conducted by:	RK, Public Consultation Consultant, HBP SR, Public Consultation Consultant, HBP FD, Public Consultation Consultant, HBP
Recorded by:	SR, Public Consultation Consultant, HBP
Language:	Urdu
Preamble:	The discussion started with the introduction of the public consultation team members. RK briefed about the purpose of the meeting by using the Background Information Document for the Project (BID) and gave a comprehensive description of the project to be implemented and the related activities. Copies of the BID had been circulated to the participants. At the end of the informative session, RK invited the participants to share their comments and concerns, which have been documented below. The participants were assured that their concerns would be communicated to the Project proponent for their consideration and action. Where possible, the response was given from the Project BID.

No.	*Issues Raised*	*By*	*Response Provided*
1.	From where the coal will be imported?	Attendee	It is not decided yet.
2.	Why you are not considering Lakhra coal for your project?	Attendee	Due to high content of Sulphur, we are not considering Lakhra coal.
3.	Water quantity is decreasing with time. How will you manage with water scarcity for the new power plant in future?	Attendee	Concern noted.

No.	*Issues Raised*	*By*	*Response Provided*
4.	Due to the air emissions from existing LPP, the inhabitants suffer from respiratory illnesses.	2 attendees	In the new power plant, the project activities will be undertaken in compliance with relevant national legislation and international guidelines. Emissions control equipment such as Flue Gas Desulfurization (FGD) to remove SO_2 from the exhaust, Electrostatic Precipitator (EP) for particulate matter control and Low NOx burner will be installed.
5.	Due to the bad quality of the Wapda colony, the inhabitants suffer from diarrhea and stomach problems. People are poor and cannot afford water filters at home. Reverse osmosis or filtration plant should be provided by the management of power plant.	4 attendees	Concern noted.
6.	Infrastructure maintenance in new power plant colony should be on regular basis as in the existing colony there is not maintenance of houses.	Attendee	Concern noted.
7.	There is not water storage tank for the market of the Wapda colony. The management of the LPP should provide the water storage tank for the market.	Attendee	Concern noted.

Record of the Consultation Meeting

Stakeholder:	Wapda Colony (Women)
Date:	April 14, 2014
Time:	11:00
Meeting Venue:	Wapda Colony
Attended by:	18 attendees
Conducted by:	SR, Public Consultation Consultant, HBP FD, Public Consultation Consultant, HBP
Recorded by:	FD
Language:	Sindhi, Urdu
Information Provided:	The discussion started with the introduction of the public consultation team from Hagler Bailly Pakistan (HBP) who briefed on the EIA of the Lakhra Coal Fired Power Plant. SR briefed the participants about the purpose of the meeting and gave a comprehensive description of the project. The main points of the BID were verbally explained in Sindhi. At the end of the informative session, SR invited the participants to express or share their concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	LPP is ruining the water quality of the Indus River and other water sources by adding ash and waste chemicals to it.	Attendee	Waste water from the new power plant will be treated before its discharge in the Indus River. It will be ensured that no effluent from the power plant adversely impacts any community and physical environment of the region.
2.	A water filter should be provided within the colony.	Attendee	Concern noted.
3.	Load shedding and gas problems must be addressed.	Attendee	Concern noted.
4.	Speed up the construction project. The area urgently needs socioeconomic reforms expected from the project.	Attendee	Concern noted.
5.	Water supply becomes scarce during winter months and cause problems.	Attendee	Concern noted.

No.	*Issues Raised*	*By*	*Response Provided*
6.	Employment is needed by the educated men and women in the colony.	Attendee	Concern noted.
7.	Higher education situation in the colony is grim. The project proponent must address this issue urgently.	Attendee	Concern noted.
8.	There are no recreational facilities, especially for women in the area.	Attendee	Concern noted.

Others:

1. There is excitement in the colony about the new project and people have high hopes from the project.

Record of the Consultation Meeting

Stakeholder:	Mir Dost Khoso (Men)
Date:	April 15, 2014
Time:	1:30 pm
Meeting Venue:	Autaq of a villager
Attended by:	5 attendees
Conducted by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Recorded by:	AN, Local Assistant Public Consultation Consultant, HBP
Language:	Urdu,
Preamble:	The discussion started with the introduction of the public consultation team members. RK briefed about the purpose of the meeting by using the Background Information Document for the Project (BID) and gave a comprehensive description of the project to be Implemented and the related activities. Copies of the BID translated in Sindhi had been circulated to the participants. At the end of the informative session, RK invited the participants to share their comments and concerns, which have been documented below. The community was assured that their concerns would be communicated to the Project proponent for their consideration and action. Where possible, the response was given from the Project BID.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Employment was not provided to the locals as promised by the existing LPP management in the past. Employment opportunities should be provided to the people residing in the vicinity of the power plant.	Attendee	Concern noted.
2.	Air emissions are affecting the health of the local inhabitants and causing health problems.	Attendee	The new project activities will be undertaken in compliance with relevant national legislations and international guidelines. The emissions will be controlled by using latest equipment in the stack.

Record of the Consultation Meeting

Stakeholder:	Mir Dost Khoso (Women)
Date:	April 15, 2014
Time:	1:30 pm
Meeting Venue:	Residence of a villager
Attended by:	13 attendees
Conducted by:	SR, Public Consultation Consultant, HBP FD, Public Consultation Consultant, HBP
Recorded by:	FD
Language:	Sindhi, Urdu
Information Provided:	The discussion started with the introduction of the public consultation team from Hagler Bailly Pakistan (HBP) who briefed on the EIA of the Lakhra Coal Fired Power Plant. SR briefed the participants about the purpose of the meeting and gave a comprehensive description of the project. The main points of the BID were verbally explained in Sindhi and Urdu. At the end of the informative session, SR invited the participants to express or share their concerns. The issues raised are discussed below with responses given by concerned persons.

No.	*Issues Raised*	*By*	*Response Provided*
1.	There is no female education in the village.	Attendee	Concern noted.
2.	Project will be supported if village community is given employment and water facilities.	Attendee	Concern noted.
3.	There have been allergies in some people within the village due to the coal ash in water and air.	Attendee	Concern noted.

Others:

1. Women education and employment were the major issues raised by women community. Generally, the women did not raise any objection to the establishment of the project and were hopeful of improvement in the existing socioeconomic conditions of their settlement.

Record of the Consultation Meeting

Stakeholder:	Traders of Habibullah Mor (Men)
Date:	April 15, 2014
Time:	3:00 pm
Meeting Venue:	Autaq of a villager
Attended by:	8 attendees
Conducted by:	RK, Public Consultation Consultant, HBP AN, Local Assistant Public Consultation Consultant, HBP
Recorded by:	AN, Local Assistant Public Consultation Consultant, HBP
Language:	Urdu,
Preamble:	The discussion started with the introduction of the public consultation team members. RK briefed about the purpose of the meeting by using the Background Information Document for the Project (BID) and gave a comprehensive description of the project to be Implemented and the related activities. Copies of the BID translated in Sindhi had been circulated to the participants. At the end of the informative session, RK invited the participants to share their comments and concerns, which have been documented below. The community was assured that their concerns would be communicated to the Project proponent for their consideration and action. Where possible, the response was given from the Project BID.

No.	*Issues Raised*	*By*	*Response Provided*
1.	The truck drivers of LPP illegally dump coal waste near Habibullah Mor. This creates problems for villagers because ash blown by the wind causes eye irritation and breathing problems.	Attendee	Concern noted.
2.	The ash dump should be away from the residential area and Habibullah Mor.	Attendee	Concern noted.
3.	Proper measures should be taken to avoid air emission. All the agricultural lands are ruined due to the air emissions from existing LPP.	Attendee	The new project activities will be undertaken in compliance with relevant national legislations and international guidelines. The emissions will be controlled by using latest equipment in the stack.

No.	*Issues Raised*	*By*	*Response Provided*
4.	The people of the area are no so hopeful that they will get employment in the new power plant. In the past, the management of existing LPP did not provide jobs to locals.	Attendee	Concern noted.
5.	Water scarcity is the biggest problem of the area. Drinkable water should be provided by the project proponent.	Attendee	Concern noted.

Appendix 13: THE DETAILED LOG OF FEEDBACK CONSULTATIONS

Baseline Survey of Lakhra Coal-fired Thermal Power Plant

JICA Survey Team

Record of the Consultation Meeting

Stakeholder:	Department of Livestock and Fisheries(DoLF), Hyderabad
Date:	Sep 8, 2014
Time:	11:00 am
Meeting Venue:	DoLF Office, Hyderabad
Attended by:	Deputy Director
Conducted by:	RK, Hagler Bailly Pakistan (HBP) MY, LPGCL Representative
Recorded by:	Rashid Khan, HBP
Language:	Urdu
Preamble:	RKstarted the discussion by introducing himself. RK briefed Mr Latif about the purpose of the meeting and provided information about the updated design and current status of the project. RKinformed how the issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, RK invited DoLF to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. Copy of relevant sections such as fisheries, aqua culture and water chemistry should be shared by email with DoLF. DoLF hopes that the effluent from the power plant will be treated by effluent treatment facility in order to meet the NEQS.

Record of the Consultation Meeting

Stakeholder:	Sindh Wildlife Department(SWD), Hyderabad
Date:	Sep 08, 2014
Time:	12:00 pm
Meeting Venue:	SWD Office, Hyderabad
Attended by:	Deputy Conservator Assistant Conservator
Conducted by:	RK, Hagler Bailly Pakistan (HBP) MY, LPGCL Representative
Recorded by:	RK, HBP
Language:	Urdu
Preamble:	RKstarted the discussion by introducing himself. RK briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. RK informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, RK invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

No.	*Issues Raised*	*By*	*Response Provided*
1.	There should be audit and monitoring of the proposed mitigation measures for discharged wastewater and air emissions on yearly basis.	SWD	Concern noted.
2.	There should be plantation along the proposed transportation road and in the vicinity of the power plant.	SWD	Concern noted.

Baseline Survey of Lakhra Coal-fired Thermal Power Plant

JICA Survey Team

Record of the Consultation Meeting

Stakeholder:	Liaquat University of Medical Sciences (LUMHS), Jamshoro
Date:	Sep 8, 2014
Time:	1:20 pm
Meeting Venue:	Office of the Registrar, LUMHS
Attended by:	Registrar
Conducted by:	RK, Hagler Bailly Pakistan (HBP) MY, LPGCL Representative
Recorded by:	RK, HBP
Language:	Urdu
Preamble:	RKstarted the discussion by introducing himself. RK briefed SRabout the purpose of the meeting and provided information about the updated design and current status of the project. RK informed how the issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, RK invited LUMHS to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. LUMHS appreciated the proposed mitigation measures to reduce the negative impact of air emissions and discharged wastewater.
2. LUMHS suggested, it would be good, if the treated wastewater can be provided to the communities for their agricultural fields.

Baseline Survey of Lakhra Coal-fired Thermal Power Plant

JICA Survey Team

Record of the Consultation Meeting

Stakeholder:	Mehran University of Engineering and Technology(MUET), Jamshoro
Date:	February 26, 2014
Time:	2:45 pm
Meeting Venue:	MUET, Jamshoro
Attended by:	Director Institute of Environmental Engineering
Conducted by:	RK, Hagler Bailly Pakistan (HBP) MY, LPGCL Representative
Recorded by:	RK, HBP
Language:	Urdu
Preamble:	RKstarted the discussion by introducing himself. RKbriefed MK about the purpose of the meeting and provided information about the updated design and current status of the project. RKinformed how the issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, RK invited MUET to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. MUET appreciated the mitigation measures and hopes that mitigation measures will be applied as communicated.
2. The responses of raised issues/concerns should also be shared with us by email.

Record of the Consultation Meeting

Stakeholder:	Additional Deputy Commissioner (ADC), Jamshoro
Date:	February 25, 2014
Time:	1:30 pm
Meeting Venue:	ADC office, Jamshoro
Attended by:	ADC
Conducted by:	RK, Hagler Bailly Pakistan (HBP) MY, LPGCL Representative
Recorded by:	RK, HBP
Language:	Urdu
Preamble:	RK started the discussion by introducing himself. RK briefed ADCabout the purpose of the meeting and provided information about the updated design and current status of the project. RK briefly informed him how the issues/concerns, raised by the communities and institutions during the scoping consultation are addressed in EIA. At the end of the informative session, RK invited ADC to share their views/comments, if any. The views/comments have been documented below.

Views/Comments

1. ADC appreciated the mitigation measures and hopes that mitigation measures will be applied as communicated.
2. ADC assured of their support and said that the project proponent should let them know in advance whenever they need their help.

Record of the Feedback Consultation Meeting

Stakeholder:	Imdad Ali Khoso (Men)
Date:	Sep 05, 2014
Time:	4:45 pm
Meeting Venue:	Autaq[1] of Village
Attended by:	9 attendees
Conducted by:	RK, Public Consultation Consultant, HBPMA, Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP
Language:	Urdu
Preamble:	RK started the discussion by introducing himself. RK briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. RK informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, RK invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. The community appreciated the project design and hope that in the new power plant, they will get employment and other facilities, proposed in the social augmentation plan.
2. No further issues/concerns raised.

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[1] Autaqs are guest rooms or places where men gather to mingle and discuss community matters.

Record of the Feedback Consultation Meeting

Stakeholder:	Imdad Ali Khoso (Women)
Date:	Sep 05, 2014
Time:	4:45 pm
Meeting Venue:	Residence of a villager
Attended by:	8 attendees
Conducted by:	FD, Public Consultation Consultant, HBPQA, Public Consultation Consultant, HBP
Recorded by:	FD, Public Consultation Consultant, HBP
Language:	Sindhi
Information Provided:	FD started the discussion by introducing herself. FD briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. FD informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, FD invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. The women were happy to know about the mitigation measures to minimize the impact of air emissions and the wastewater discharge. The women expressed desire to earn employment through the project.

Record of the Feedback Consultation Meeting

Stakeholder:	Manzurabad (Men)
Date:	Sep 05, 2014
Time:	5:50 pm
Meeting Venue:	Autaq of Village
Attended by:	15 attendees
Conducted by:	RK, Public Consultation Consultant, HBPMS, Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP
Language:	Urdu
Preamble:	RK started the discussion by introducing himself. RK briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. RK informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, RK invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

No.	*Issues Raised*	*By*	*Response Provided*
1.	There should be a monitoring officer for monitoring and evaluation the social augmentation plan.	Attendee	Concern noted.
2.	In past projects, the project proponent deals with *waderas*[2] and poor people were ignored.	Attendee	Concern noted.

Views/Comments

1. The community appreciated the proposed mitigation plans and hope that the project proponent fulfills their commitments.

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[2] Influential or notable of the village.

Record of the Consultation Meeting

Stakeholder:	Manzurabad (Women)
Date:	Sep 5, 2014
Time:	5:45 pm
Meeting Venue:	Residence of a villager
Attended by:	6 attendees
Conducted by:	FD, Public Consultation Consultant, HBP QU, Public Consultation Consultant, HBP
Recorded by:	FD, Public Consultation Consultant, HBP
Language:	Sindhi
Information Provided:	FD started the discussion by introducing herself. FD briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. FD informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, FD invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

No.	*Issues Raised*	*By*	*Response Provided*
1.	It would be good for the community, if the project proponent can provide gas facility to the villagers.	Attendee	Concern noted.

Views/Comments

1. The women were happy and appreciated the proposed mitigation plans to minimize the negative impact of air emissions and discharged water.

Baseline Survey of Lakhra Coal-fired Power Plant

JICA Survey Team

Record of the Consultation Meeting

Stakeholder:	Zimi (Men)
Date:	Sep 05, 2014
Time:	6:40 pm
Meeting Venue:	Autaq of Village
Attended by:	11 attendees
Conducted by:	RK, Public Consultation Consultant, HBPMS, Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP
Language:	Urdu
Preamble:	RK started the discussion by introducing himself. RK briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. RK informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, RK invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. The community appreciated the proposed mitigation plans to minimize the negative impact of air emissions and discharged water.

Record of the Consultation Meeting

Stakeholder:	Zimi (Women)
Date:	Sep 5, 2014
Time:	6:45 pm
Meeting Venue:	Residence of a villager
Attended by:	9 attendees
Conducted by:	FD, Public Consultation Consultant, HBPQU, Public Consultation Consultant, HBP
Recorded by:	FD, Public Consultation Consultant, HBP
Language:	Sindhi
Information Provided:	FD started the discussion by introducing herself. FD briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. FD informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, FD invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. The women would be happy if the project provides employment and drinkable water as planned.

Baseline Survey of Lakhra Coal-fired Power Plant

JICA Survey Team

Record of the Consultation Meeting

Stakeholder:	Esab Khan Khoso (Men)
Date:	Sep 6, 2014
Time:	10:30 am
Meeting Venue:	Autaq of Village
Attended by:	8 attendees
Conducted by:	RK, Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP
Language:	Urdu
Preamble:	RK started the discussion by introducing himself. RK briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. RK informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, RK invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

No.	*Issues Raised*	*By*	*Response Provided*
1.	The community has the facility of water supply scheme but does not have any mechanism to store the water such as water storage tanks. The project proponent should construct or provide water tank so the water can be stored in it.	Attendee	Concern noted.

Views/Comments

1. The community appreciated the proposed mitigation plans to minimize the negative impact of air emissions and discharged water. The community also appreciated the social augmentation plan.

Record of the Consultation Meeting

Stakeholder:	Esab Khan Khoso (Women)
Date:	Sep 6, 2014
Time:	10:20 am
Meeting Venue:	Residence of a villager
Attended by:	13 attendees
Conducted by:	FD, Public Consultation Consultant, HBP
Recorded by:	FD, Public Consultation Consultant, HBP
Language:	Sindhi
Information Provided:	FD started the discussion by introducing herself. FD briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. FD informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, FD invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. The women were happy to know about the social augmentation plan and appreciated the project.

Baseline Survey of Lakhra Coal-fired Power Plant

JICA Survey Team

Record of the Consultation Meeting

Stakeholder:	Bhuro Khan Rind (Men)
Date:	Sep 6, 2014
Time:	10:30 am
Meeting Venue:	Autaq of Village
Attended by:	12 attendees
Conducted by:	MS, Public Consultation Consultant, HBP
Recorded by:	MS, Public Consultation Consultant, HBP
Language:	Urdu
Preamble:	MS started the discussion by introducing himself. MS briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. MS informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, MS invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. The community appreciated the social augmentation plan and proposed mitigation plans to minimize the negative impact of air emissions and discharged water.

Baseline Survey of Lakhra Coal-fired Power Plant

JICA Survey Team

Record of the Consultation Meeting

Stakeholder:	Bhuro Khan Rind (Women)
Date:	Sep 6, 2014
Time:	10:30 am
Meeting Venue:	Residence of a villager
Attended by:	9 attendees
Conducted by:	QU, Public Consultation Consultant, HBP
Recorded by:	QU, Public Consultation Consultant, HBP
Language:	Sindhi
Information Provided:	QU started the discussion by introducing herself. QU briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. QU informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, QU invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. The women would be happy, if employment and water problems are resolved.

Record of the Consultation Meeting

Stakeholder:	Shuja Muhammad Khoso (Men)
Date:	Sep 6, 2014
Time:	11:30 am
Meeting Venue:	Autaq of Village
Attended by:	8 attendees
Conducted by:	MS, Public Consultation Consultant, HBP
Recorded by:	MS, Public Consultation Consultant, HBP
Language:	Urdu
Preamble:	MS started the discussion by introducing himself. MS briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. MS informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, MS invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. The community appreciated the social augmentation plan and proposed mitigation plans to minimize the negative impact of air emissions and discharged water.

JICA Survey Team

Record of the Consultation Meeting

Stakeholder:	Shuja Muhammad Khoso (Women)
Date:	Sep 6, 2014
Time:	11:25 am
Meeting Venue:	Residence of a villager
Attended by:	11 attendees
Conducted by:	QU, Public Consultation Consultant, HBP
Recorded by:	QU, Public Consultation Consultant, HBP
Language:	Sindhi
Information Provided:	QU started the discussion by introducing herself. QU briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. QU informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, QU invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. The women would be happy, if employment and skills training are provided.

Record of the Consultation Meeting

Stakeholder:	Allah Dino Baricho (Men)
Date:	Sep 6, 2014
Time:	11:20 am
Meeting Venue:	Hotel at Habibullah Mor
Attended by:	6 attendees
Conducted by:	RK, Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP
Language:	Urdu
Preamble:	RK started the discussion by introducing himself. RK briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. RK informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, RK invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

No.	*Issues Raised*	*By*	*Response Provided*
1.	School building is present but there is no proper education available and teachers are absent from school all year long. Furthermore, the school building needs to be renovated. The project proponent should help the community in renovation the school building and improving their education.	Attendee	Concern noted.

Views/Comments

1. The community appreciated the proposed mitigation plans to minimize the negative impact of air emissions and discharged water. The community also appreciated the social augmentation plan.

Record of the Consultation Meeting

Stakeholder:	Allah Dino Baricho (Women)
Date:	Sep 6, 2014
Time:	11:25 am
Meeting Venue:	Residence of a villager
Attended by:	16 attendees
Conducted by:	FD, Public Consultation Consultant, HBP
Recorded by:	FD, Public Consultation Consultant, HBP
Language:	Sindhi
Information Provided:	FD started the discussion by introducing herself. FD briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. FD informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, FD invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

No.	*Issues Raised*	*By*	*Response Provided*
1.	School building is present however; there are no teachers since last seven years who can teach in school. The project proponent should provide teacher or help the villagers in this regard.	Attendee	Concern noted.

Views/Comments

1. The women appreciated the project and social augmentation plant.

Record of the Consultation Meeting

Stakeholder:	Koreja (Men)
Date:	Sep 6, 2014
Time:	12:35 pm
Meeting Venue:	Residence of a villager
Attended by:	11 attendees
Conducted by:	MS, Public Consultation Consultant, HBP
Recorded by:	MS, Public Consultation Consultant, HBP
Language:	Urdu
Preamble:	MS started the discussion by introducing himself. MS briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. MS informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, MS invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. One of attendees said that the community is not in a favor of coal power plant at any cost due to the air emissions and ash from existing power plant. Also, the pollutants discharge of existing power plant in Indus River is impacting an adverse effect on fish breeding and decreasing fish population.
2. The community will not compromise on cheap power generation from coal fuel.
3. The community has already shared their issues during scoping consultations with HBP team.
4. Any change in the environment may result in a loss of biodiversity of the area. Measures should be taken to avoid any loss of flora and fauna in the area.
5. The community will protest, if the new plant is constructed in the vicinity of Koreja Village.

Record of the Consultation Meeting

Stakeholder:	Koreja (Women)
Date:	Sep 6, 2014
Time:	12:30 pm
Meeting Venue:	Residence of a villager
Attended by:	12 attendees
Conducted by:	QU, Public Consultation Consultant, HBP
Recorded by:	QU, Public Consultation Consultant, HBP
Language:	Sindhi
Information Provided:	QU started the discussion by introducing herself. QU briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. QU informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, QU invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Drinking water and health are major problem in the village. It is lacking in terms of both quality and quantity.	Attendee	Concern noted.

Views/Comments

1. The women would be happy, if gas connections are provided.

Baseline Survey of Lakhra Coal-fired Power Plant

JICA Survey Team

Record of the Consultation Meeting

Stakeholder:	Murid Khan Rind (Men)
Date:	Sep 6, 2014
Time:	12:30 pm
Meeting Venue:	In open air
Attended by:	22 attendees
Conducted by:	RK, Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP
Language:	Urdu
Preamble:	RK started the discussion by introducing himself. RK briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. RK informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, RK invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. The community appreciated the proposed mitigation plans to minimize the negative impact of air emissions and discharged water. The community also appreciated the social augmentation plan.

Record of the Consultation Meeting

Stakeholder:	Murid Khan Rind (Women)
Date:	Sep 6, 2014
Time:	12:35 pm
Meeting Venue:	Residence of a villager
Attended by:	10 attendees
Conducted by:	FD, Public Consultation Consultant, HBP
Recorded by:	FD Public Consultation Consultant, HBP
Language:	Sindhi
Information Provided:	FD started the discussion by introducing herself. FD briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. FD informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, FD invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

No.	*Issues Raised*	*By*	*Response Provided*
1.	It would be good for the community, if the project proponent can provide gas facility to the villagers.	Attendee	Concern noted.
2.	If the power plant goes ahead, girl's school should be provided with in the settlement.	Attendee	Concern noted.

Views/Comments

1. The women appreciated the project and social augmentation plant.

Record of the Consultation Meeting

Stakeholder:	Khanot (Men)
Date:	Sep 6, 2014
Time:	1:25 pm
Meeting Venue:	Residence of a villager
Attended by:	10 attendees
Conducted by:	MS, Public Consultation Consultant, HBP
Recorded by:	MS, Public Consultation Consultant, HBP
Language:	Urdu
Preamble:	MS started the discussion by introducing himself. MS briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. MS informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, MS invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. The community appreciated the proposed mitigation plans to minimize the negative impact of air emissions and discharged water. The community also appreciated the social augmentation plan.

Record of the Consultation Meeting

Stakeholder:	Khanot (Women)
Date:	Sep 6, 2014
Time:	1:30 pm
Meeting Venue:	Residence of a villager
Attended by:	6 attendees
Conducted by:	QU, Public Consultation Consultant, HBP
Recorded by:	QU, Public Consultation Consultant, HBP
Language:	Sindhi
Information Provided:	QU started the discussion by introducing herself. QU briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. QU informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, QU invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Others:

1. The women appreciated the social augmentation plan and hope that skills training and capacity building activities will help the inhabitants to overcome their income problems.

Record of the Consultation Meeting

Stakeholder:	Thehbo (Men)
Date:	Sep 6, 2014
Time:	1:35 pm
Meeting Venue:	Residence of a villager
Attended by:	8 attendees
Conducted by:	RK, Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP
Language:	Urdu
Preamble:	RK started the discussion by introducing himself. RK briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. RK informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, RK invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. The community appreciated the proposed mitigation plans to minimize the negative impact of air emissions and discharged water. The community also appreciated the social augmentation plan.

Record of the Consultation Meeting

Stakeholder:	Thehbo (Women)
Date:	Sep 6, 2014
Time:	1:25 pm
Meeting Venue:	Residence of a villager
Attended by:	12 attendees
Conducted by:	FD, Public Consultation Consultant, HBP
Recorded by:	FD, Public Consultation Consultant, HBP
Language:	Sindhi
Information Provided:	FD started the discussion by introducing herself. FD briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. FD informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, FD invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

No.	*Issues Raised*	*By*	*Response Provided*
1.	The community does not have any facility of drinking water and drinking polluted water of Indus River. Arrangements should be made to provide clean drinking water.	Attendee	Concern noted.

Views/Comments

1. The women were happy to know about the social augmentation plan and appreciated the project.

Baseline Survey of Lakhra Coal-fired Power Plant

JICA Survey Team

Record of the Consultation Meeting

Stakeholder:	Dato Khoso (Men)
Date:	Sep 6, 2014
Time:	2:20 pm
Meeting Venue:	Autaq of Village
Attended by:	4 attendees
Conducted by:	RK , Public Consultation Consultant, HBP
Recorded by:	RK , Public Consultation Consultant, HBP
Language:	Urdu
Preamble:	RK started the discussion by introducing himself. RK briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. RK informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, RK invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Education is lacking, especially in case of women. Schools should be built in the community.	Attendee	Concern noted.
2.	The community does not have any facility of drinking water and drinking polluted water of Indus River. Filtration plant should be provided for the community.	Attendee	Concern noted.
3.	The treated discharged water from the existing power plant and new proposed plant should be provided for agricultural land instead of discharge in Indus River.	Attendee	Concern noted.

Views/Comments

1. The community is in the favour of new power plant if basic facilities such as drinkable water, health, educational facilities and employment are provided to the local people of the area.

Record of the Consultation Meeting

Stakeholder:	Dato Khoso (Women)
Date:	Sep 6, 2014
Time:	2:15 pm
Meeting Venue:	Residence of a villager
Attended by:	1 Attendee
Conducted by:	AD, Public Consultation Consultant, HBP
Recorded by:	FD , Public Consultation Consultant, HBP
Language:	Sindhi
Information Provided:	FD started the discussion by introducing herself. FD briefed the participant about the purpose of the meeting and provided information about the updated design and current status of the project. FD informed the participant how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, FD invited the participant to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. No reservations regarding the construction of the power plant in the area and hope it would improve the socioeconomic conditions in the region by generating employment.

Record of the Consultation Meeting

Stakeholder:	Abdul Ghani Bandwani (Men)
Date:	Sep 7, 2014
Time:	11:00 am
Meeting Venue:	Autaq of Village
Attended by:	17 attendees
Conducted by:	MS, Public Consultation Consultant, HBP
Recorded by:	MS, Public Consultation Consultant, HBP
Language:	Urdu
Preamble:	MS started the discussion by introducing himself. MS briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. MS informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, MS invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. The community appreciated the proposed mitigation plans to minimize the negative impact of air emissions and discharged water. The community also appreciated the social augmentation plan.

Record of the Consultation Meeting

Stakeholder:	Abdul Ghani Bandwani (Women)
Date:	Sep 7, 2014
Time:	11:00 am
Meeting Venue:	Residence of a villager
Attended by:	9 attendees
Conducted by:	QU, Public Consultation Consultant, HBP
Recorded by:	QU, Public Consultation Consultant, HBP
Language:	Sindhi
Information Provided:	QU started the discussion by introducing herself. QU briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. QU informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, QU invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. The women are in favor of development in the area, if proper mitigation measures are applied to reduce the negative impact of air emission. The women were happy to know about the social augmentation plan and hope that people will get employment according in the project.

Record of the Consultation Meeting

Stakeholder:	Pehlwan Khoso (Men)
Date:	Sep 7, 2014
Time:	11:00 am
Meeting Venue:	Autaq of Village
Attended by:	14 attendees
Conducted by:	RK , Public Consultation Consultant, HBP
Recorded by:	RK , Public Consultation Consultant, HBP
Language:	Urdu
Preamble:	RK started the discussion by introducing himself. RK briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. RK informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, RK invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Educational facility should be provided for the community.	Attendee	Concern noted.

Views/Comments

1. The community appreciated the proposed mitigation plans to minimize the negative impact of air emissions and discharged water. The community also appreciated the social augmentation plan.

Record of the Consultation Meeting

Stakeholder:	Pehlwan Khoso (Women)
Date:	Sep 6, 2014
Time:	11:00 am
Meeting Venue:	Residence of a villager
Attended by:	2 attendees
Conducted by:	FD, Public Consultation Consultant, HBP
Recorded by:	FD, Public Consultation Consultant, HBP
Language:	Sindhi
Information Provided:	FD started the discussion by introducing herself. FD briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. FD informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, FD invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Education is lacking, especially in case of women. Schools should be built in the area.	Attendee	Concern noted.

Views/Comments

1. The women were happy to know about the social augmentation plan and appreciated the new power plant project mitigation measures to minimize the negative impact of air emissions and treated discharged water.

Record of the Consultation Meeting

Stakeholder:	Mir Dost Khoso (Men)
Date:	Sep 7, 2014
Time:	11:50 am
Meeting Venue:	Autaq of Village
Attended by:	10 attendees
Conducted by:	MS, Public Consultation Consultant, HBP
Recorded by:	MS, Public Consultation Consultant, HBP
Language:	Urdu
Preamble:	MS started the discussion by introducing himself. MS briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. MS informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, MS invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. The community appreciated the proposed mitigation plans to minimize the negative impact of air emissions and discharged water. The community also appreciated the social augmentation plan and hope that in the new power plant, employment opportunities will be provided to the local people of the area.

Record of the Consultation Meeting

Stakeholder:	Mir Dost Khoso (Women)
Date:	Sep 7, 2014
Time:	11:45 am
Meeting Venue:	Residence of a villager
Attended by:	13 attendees
Conducted by:	QU, Public Consultation Consultant, HBP
Recorded by:	QU, Public Consultation Consultant, HBP
Language:	Sindhi
Information Provided:	QU started the discussion by introducing herself. QU briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. QU informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, QU invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Educational facility should be provided to the villagers.	Attendee	Concern noted.

Views/Comments

1. The women do not have any objection for the construction of new power plant. Women shared concerns regarding education and employment. They hope that after the construction of project the socioeconomic conditions of their settlement will improve.

Record of the Consultation Meeting

Stakeholder:	Jan Muhammad Khoso (Men)
Date:	Sep 7, 2014
Time:	11:55 am
Meeting Venue:	Autaq of Village
Attended by:	8 attendees
Conducted by:	RK, Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP
Language:	Urdu
Preamble:	RK started the discussion by introducing himself. RK briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. RK informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, RK invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

No.	*Issues Raised*	*By*	*Response Provided*
1.	The discharged treated water should be provided to community for agriculture use.	Attendee	Concern noted.

Views/Comments

1. The community appreciated the proposed mitigation plans to minimize the negative impact of air emissions and discharged water. The community also appreciated the social augmentation plan.

Record of the Consultation Meeting

Stakeholder:	Jan Muhammad Khoso (Women)
Date:	Sep 7, 2014
Time:	12:00 pm
Meeting Venue:	Residence of a villager
Attended by:	15 attendees
Conducted by:	FD, Public Consultation Consultant, HBP
Recorded by:	FD, Public Consultation Consultant, HBP
Language:	Sindhi
Information Provided:	FD started the discussion by introducing herself. FD briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. FD informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, FD invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. The women appreciated the project and hope that the project proponent will fulfill their commitment by following the social augmentation plan.

Record of the Consultation Meeting

Stakeholder:	Dodo Mithano (Men)
Date:	Sep 7, 2014
Time:	12:30 pm
Meeting Venue:	Govt Primary School
Attended by:	3 attendees
Conducted by:	MS, Public Consultation Consultant, HBP
Recorded by:	MS, Public Consultation Consultant, HBP
Language:	Urdu
Preamble:	MS started the discussion by introducing himself. MS briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. MS informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, MS invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. The community appreciated the social augmentation plan. The community also appreciated the proposed mitigation plans to minimize the negative impact of air emissions and discharged water.

Record of the Consultation Meeting

Stakeholder:	Dodo Mithano (Women)
Date:	Sep 7, 2014
Time:	12:25 pm
Meeting Venue:	Residence of a villager
Attended by:	9 attendees
Conducted by:	QU, Public Consultation Consultant, HBP
Recorded by:	QU, Public Consultation Consultant, HBP
Language:	Sindhi
Information Provided:	QU started the discussion by introducing herself. QU briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. QU informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, QU invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. The women appreciated the project and hope that the project proponent will fulfill their commitment by following the social augmentation plan.

Baseline Survey of Lakhra Coal-fired Power Plant

JICA Survey Team

Record of the Consultation Meeting

Stakeholder:	Paryo Khan Dia Dano (Men)
Date:	Sep 7, 2014
Time:	1:25 pm
Meeting Venue:	Autaq of Village
Attended by:	6 attendees
Conducted by:	MS, Public Consultation Consultant, HBP
Recorded by:	MS, Public Consultation Consultant, HBP
Language:	Urdu
Preamble:	MS started the discussion by introducing himself. MS briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. MS informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, MS invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. The community appreciated the social augmentation plan. The community also appreciated the proposed mitigation plans to minimize the negative impact of air emissions and discharged water.

Record of the Consultation Meeting

Stakeholder:	Paryo Khan Dai Dano (Women)
Date:	Sep 7, 2014
Time:	1:30 pm
Meeting Venue:	Residence of a villager
Attended by:	6 attendees
Conducted by:	QU, Public Consultation Consultant, HBP
Recorded by:	QU, Public Consultation Consultant, HBP
Language:	Sindhi
Information Provided:	QU started the discussion by introducing herself. QU briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. QU informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, QU invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. The women hope that with the construction of the project the socioeconomic conditions, especially in terms of water facility and women education will improve.
2. The women hope that the project proponent will fulfill their commitment by following the social augmentation plan.
3. The women community supports the project.

Record of the Consultation Meeting

Stakeholder:	WAPDA Colony (Men)
Date:	Sep 7, 2014
Time:	1:10 pm
Meeting Venue:	Wapda Colony
Attended by:	9 attendees
Conducted by:	RK, Public Consultation Consultant, HBP
Recorded by:	RK, Public Consultation Consultant, HBP
Language:	Urdu
Preamble:	RK started the discussion by introducing himself. RK briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. RK informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, RK invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Ambulance service should be provided 24/7 for the area	Attendee	Concern noted.

Views/Comments

1. Proposed mitigation plan to minimize the negative impact of air emissions was appreciated.

Record of the Consultation Meeting

Stakeholder:	Wapda Colony (Women)
Date:	Sep 7, 2014
Time:	1:10 pm
Meeting Venue:	Wapda Colony
Attended by:	4 attendees
Conducted by:	FD, Public Consultation Consultant, HBP
Recorded by:	FD, Public Consultation Consultant, HBP
Language:	Sindhi, Urdu
Information Provided:	FD started the discussion by introducing herself. FD briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. FD informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, FD invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

No.	*Issues Raised*	*By*	*Response Provided*
1.	Natural Gas facility is needed.	Attendee	Concern noted.

Views/Comments

1. The women hope that due to the construction of new power plant socioeconomic condition would improve.

Record of the Consultation Meeting

Stakeholder:	Traders of Habibullah Mor (Men)
Date:	Sep 7, 2014
Time:	2:30 pm
Meeting Venue:	Shop of a villager
Attended by:	11 attendees
Conducted by:	MS, Public Consultation Consultant, HBP
Recorded by:	MS, Public Consultation Consultant, HBP
Language:	Urdu
Preamble:	MS started the discussion by introducing himself. MS briefed the participants about the purpose of the meeting and provided information about the updated design and current status of the project. MS informed the participants how their issues/concerns, raised during the scoping consultation are addressed in EIA. At the end of the informative session, MS invited the participants to share their views/comments and any additional issues/concerns, if any. The views/comments and additional issues/concerns have been documented below.

Views/Comments

1. The people of the area are hopeful that they will get employment in the new power plant. In the past, the management of existing LPP did not provide jobs to locals.
2. The community appreciated the social augmentation plan.
3. The people will be happy, if proper measures are taken to avoid air emission.

Appendix 14: AMBIENT AIR QUALITY IMPACT OF IMPORTED COAL

Air modeling was undertaken assuming that the power plant will use 100 % imported coal. This appendix summarizes the input data and results for this scenario.

Emissions Sources and Modeling Parameters

Table 1 shows the modeling parameters used in this scenario.

Table 1: Air Quality Modeling Parameters Used

Parameter	Proposed Power Plant (660 MW)
Fuel	Imported coal 100%
Load Factor	80%
Gross Capacity, MW	660
Stack Height, m	210
Inner Dia, m	6.4
Flue Gas Temperature, K	430
Exit Velocity, m/s	20
SO_2, g/s	61.0
PM_{10}, g/s	12.1
$PM_{2.5}$ g/s	6.6
NO_2, g/s	103.4

Air Quality Modeling Results

Table 2 summarizes the air quality modeling results for the simulations. Concentration levels in ambient air were predicted for SO_2, NO_2, PM_{10}, and $PM_{2.5}$ for the simulations, whereas; **Figure 1** through **Figure 8** show the contour maps for the increment in pollutants concentration caused by the proposed Project once commissioned using 100 % imported coal. Whereas **Figure 9** through **Figure 16** show the contour maps for the predicted ambient air quality after the proposed plant is commissioned using 100 % imported coal and LFPS is rehabilitated.

For SO_2, NO_2, PM_{10}, and $PM_{2.5}$ the maximum concentration levels were modeled for 24-hour averaging period and annual averaging period to correspond with the SEQS requirements. The maximum value is the highest concentration reached for a particular averaging period based on 3 years meteorological data. The 98th percentile value shows the highest concentration 98% of the time in a year, which is found by eliminating 2% of the highest values as per the standards.

Table 2: Air Quality Modeling Results (μg/m³)

	Period	SEQS	IFC Guide-lines	Estimated Background	Predicted Increment due to Proposed Plant (660 MW)	Predicted Ambient Air Quality After Proposed Plant Commissioning and LFPS Rehabilitation[1]
SO_2	Maximum 24–hr	–	125	10.8	7.1	120.5
	24–hr (98th %le)	120	–		6.7	87.8
	Annual	80	–		1.8	38.2
NO_2	Maximum 24–hr	–	200	21.1	6.1	86.5
	24–hr (98th %le)	80	–		5.8	67.2
	Annual	40	40		1.5	37.4
PM_{10}	Maximum 24–hr	–	150	69.1	1.6	76.2
	24–hr (98th %le)	150	–		1.4	74.1
	Annual	120	70		0.4	70.9
$PM_{2.5}$	Maximum 24–hr		75	43.1	0.8	46.7
	24–hr (98th %le)	75	–		0.7	45.6
	Annual	40 or background plus 9	35		0.2	44.0

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[1] Includes emission from the Proposed Plant, the existing plant with 150 MW capacity after rehabilitation and the background concentration of the pollutants.

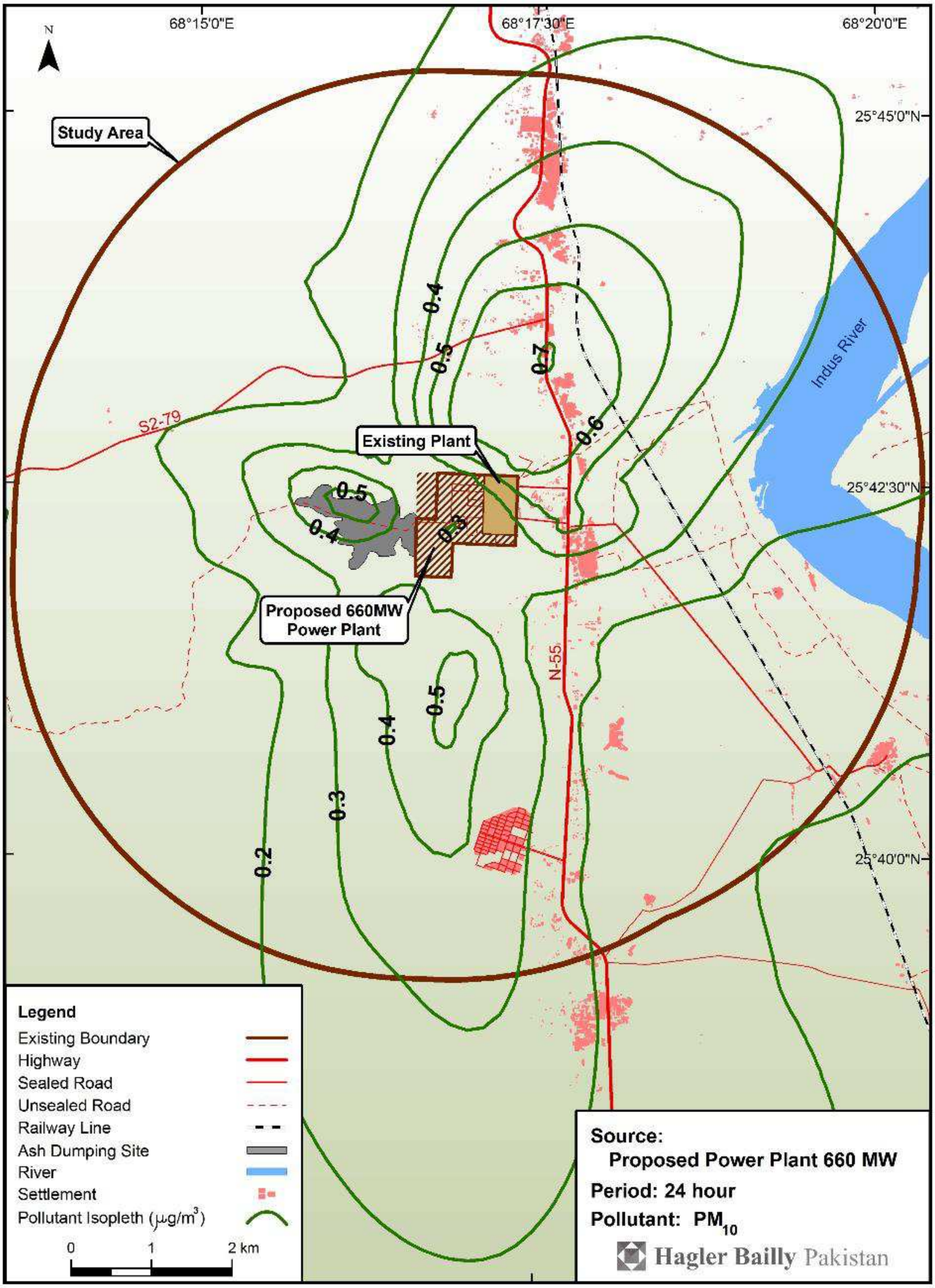
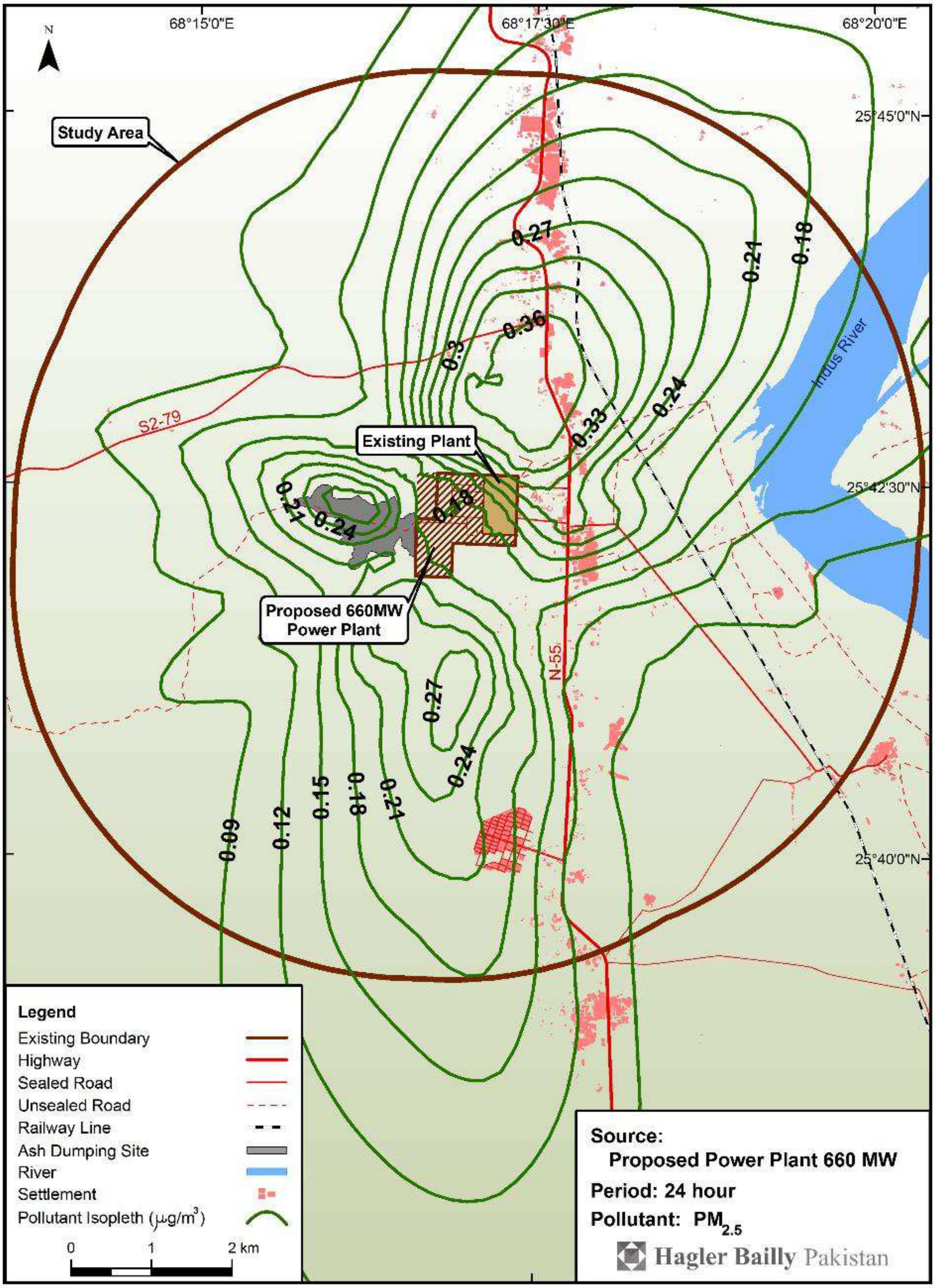


Figure 1: Predicted Increment to the 24–hour PM$_{10}$ Levels Caused by the Proposed Plant



Source:
Proposed Power Plant 660 MW

Period: 24 hour

Pollutant: $PM_{2.5}$

Figure 2: Predicted Increment to the 24–hour $PM_{2.5}$ Levels Caused by the Proposed Plant

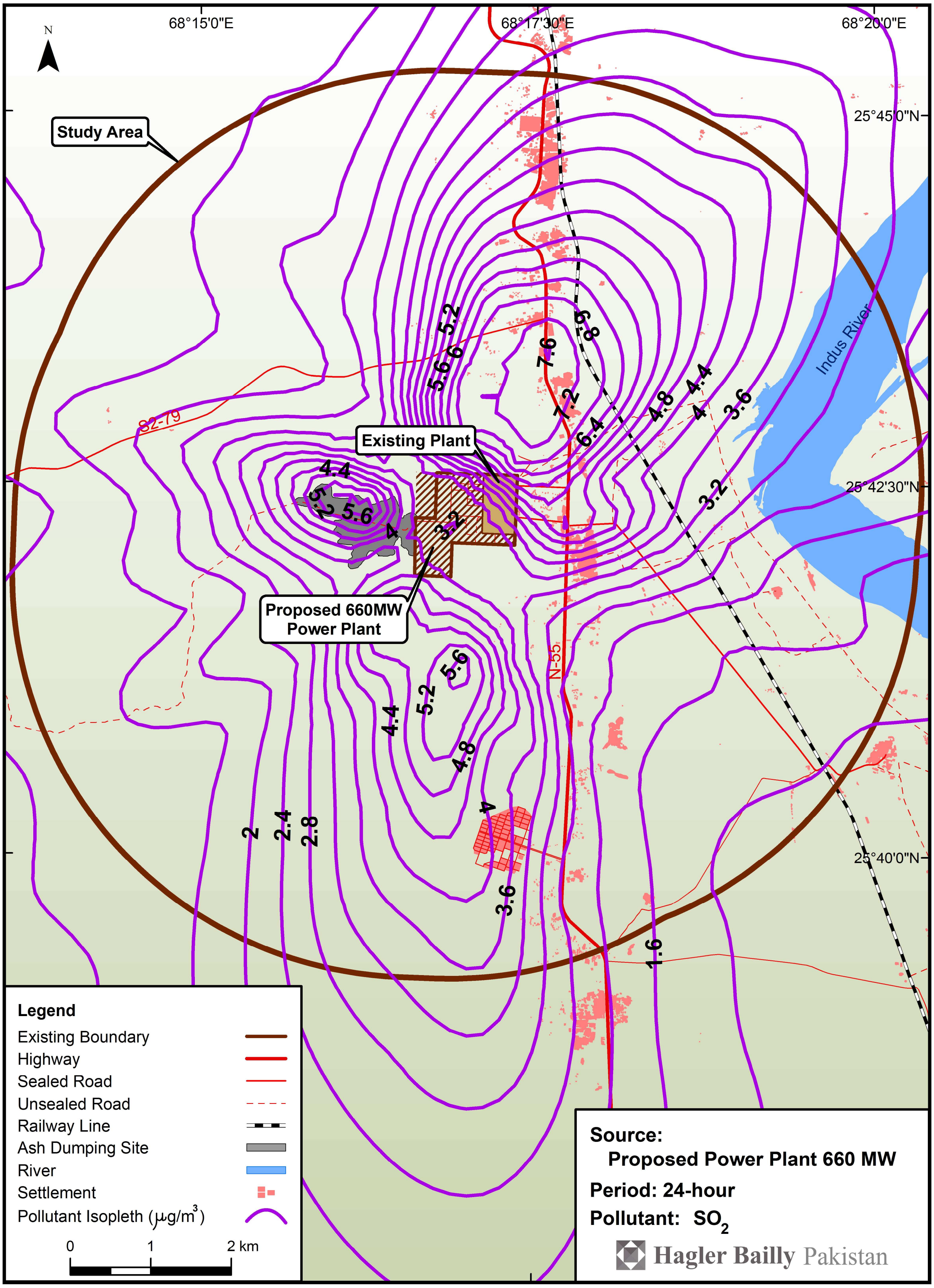


Figure 3: Predicted Increment to the 24–hour SO_2 Levels Caused by the Proposed Plant

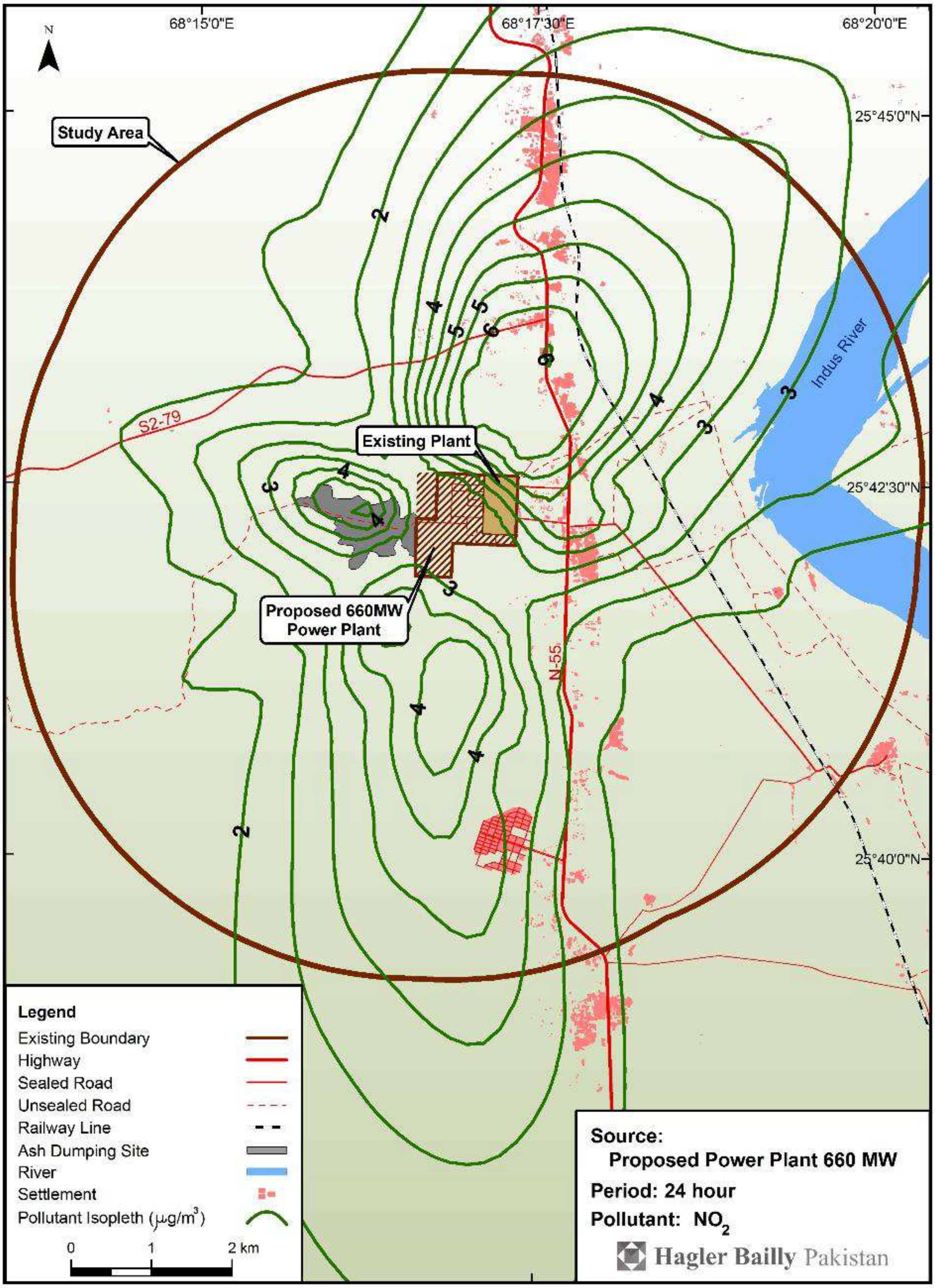


Figure 4: Predicted Increment to the 24–hour NO_2 Levels Caused by the Proposed Plant

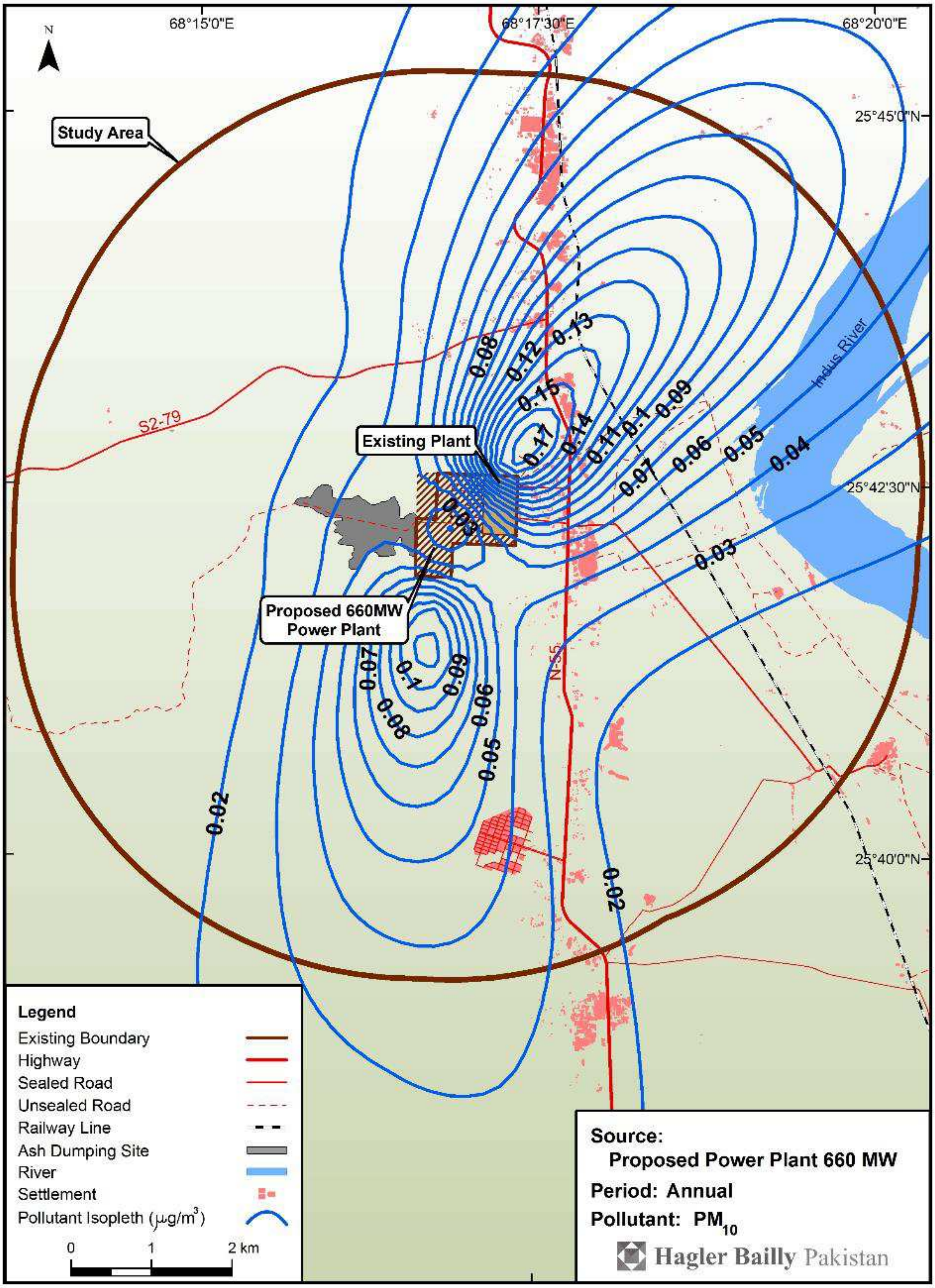


Figure 5 : Predicted Increment to the Annual PM_{10} Levels Caused by the Proposed Plant

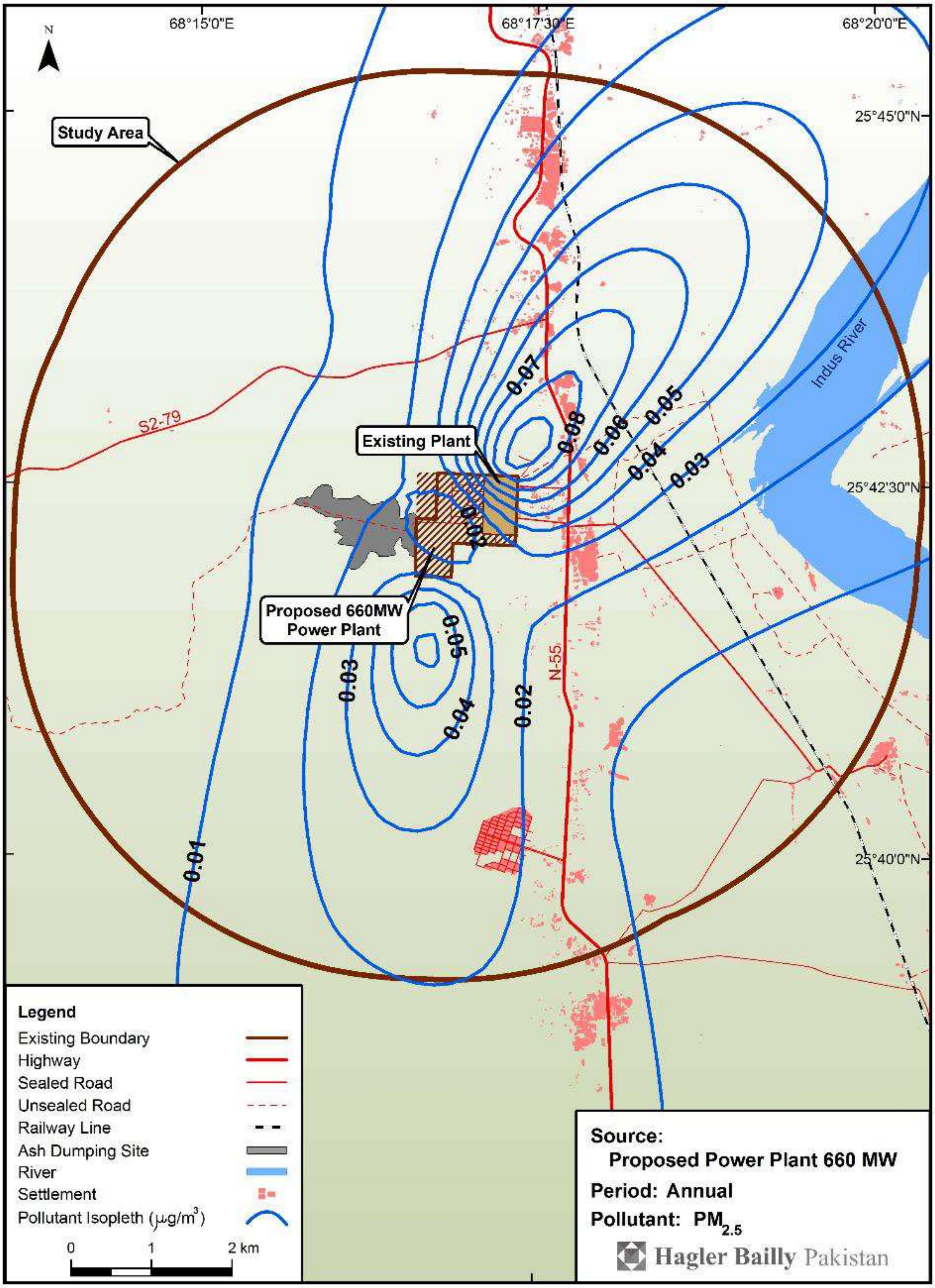


Figure 6: Predicted Increment to the Annual $PM_{2.5}$ Levels Caused by the Proposed Plant

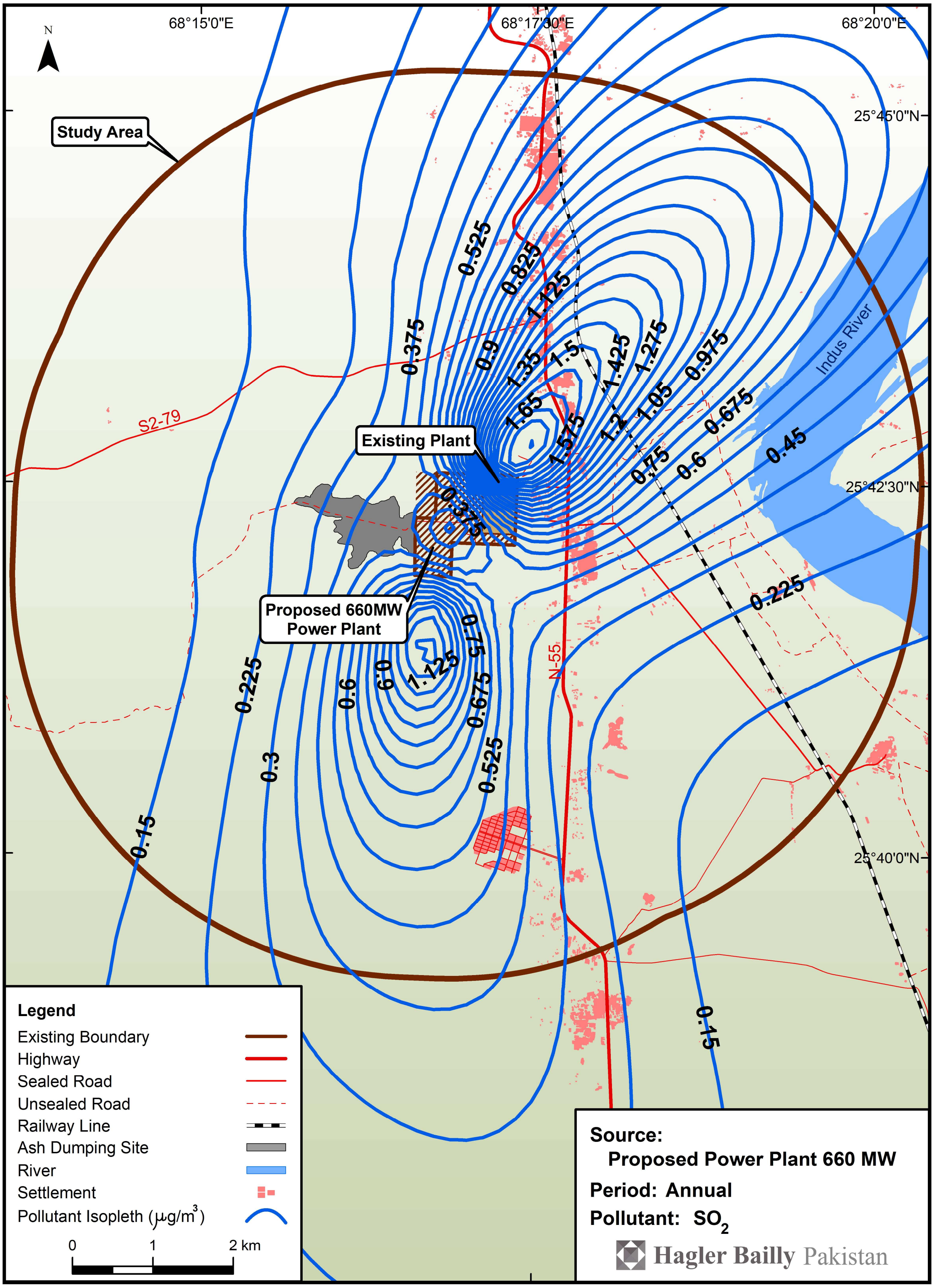


Figure 7: Predicted Increment to the Annual SO_2 Levels Caused by the Proposed Plant

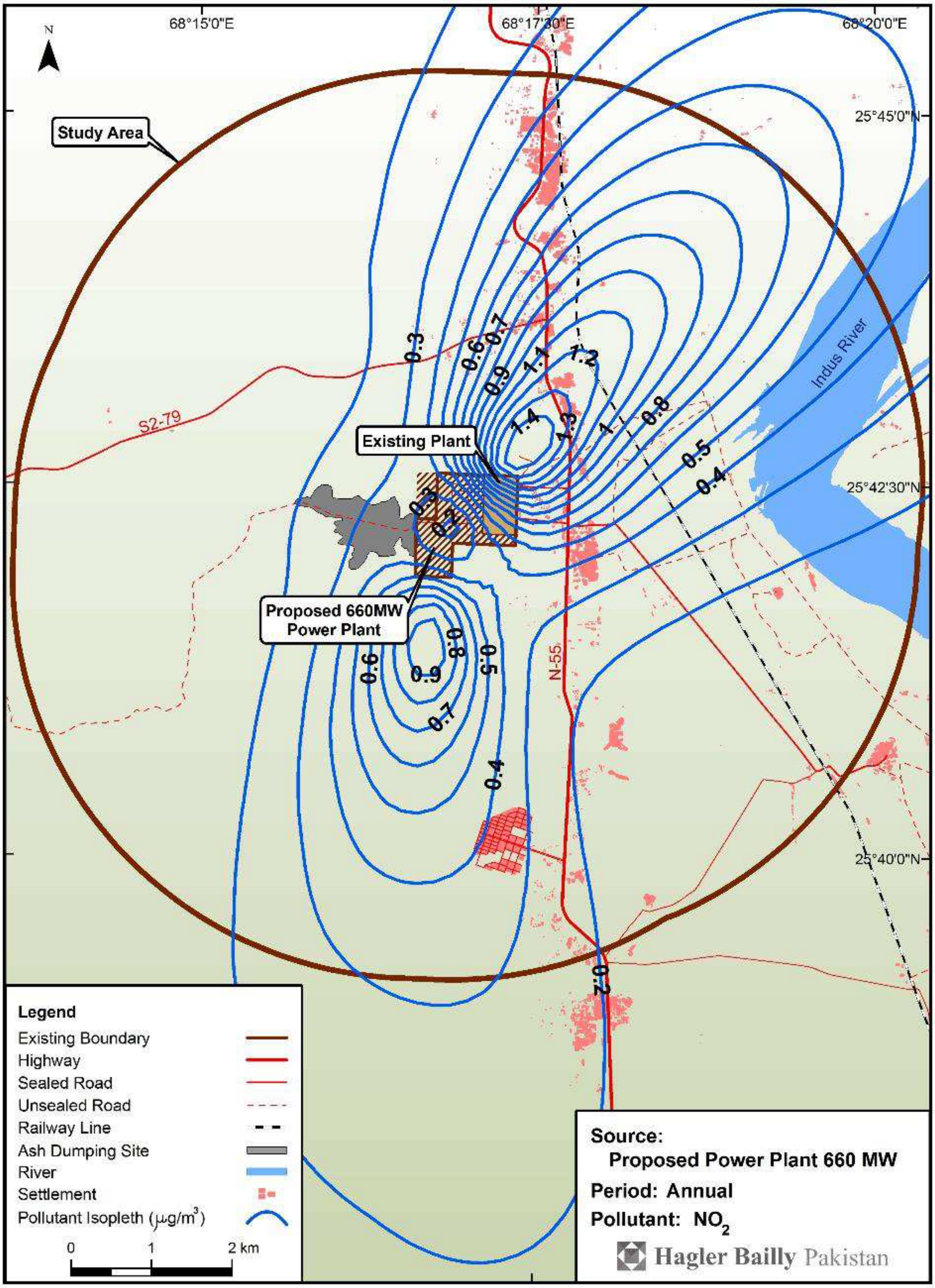


Figure 8: Predicted Increment to the Annual NO_2 Levels Caused by the Proposed Plant

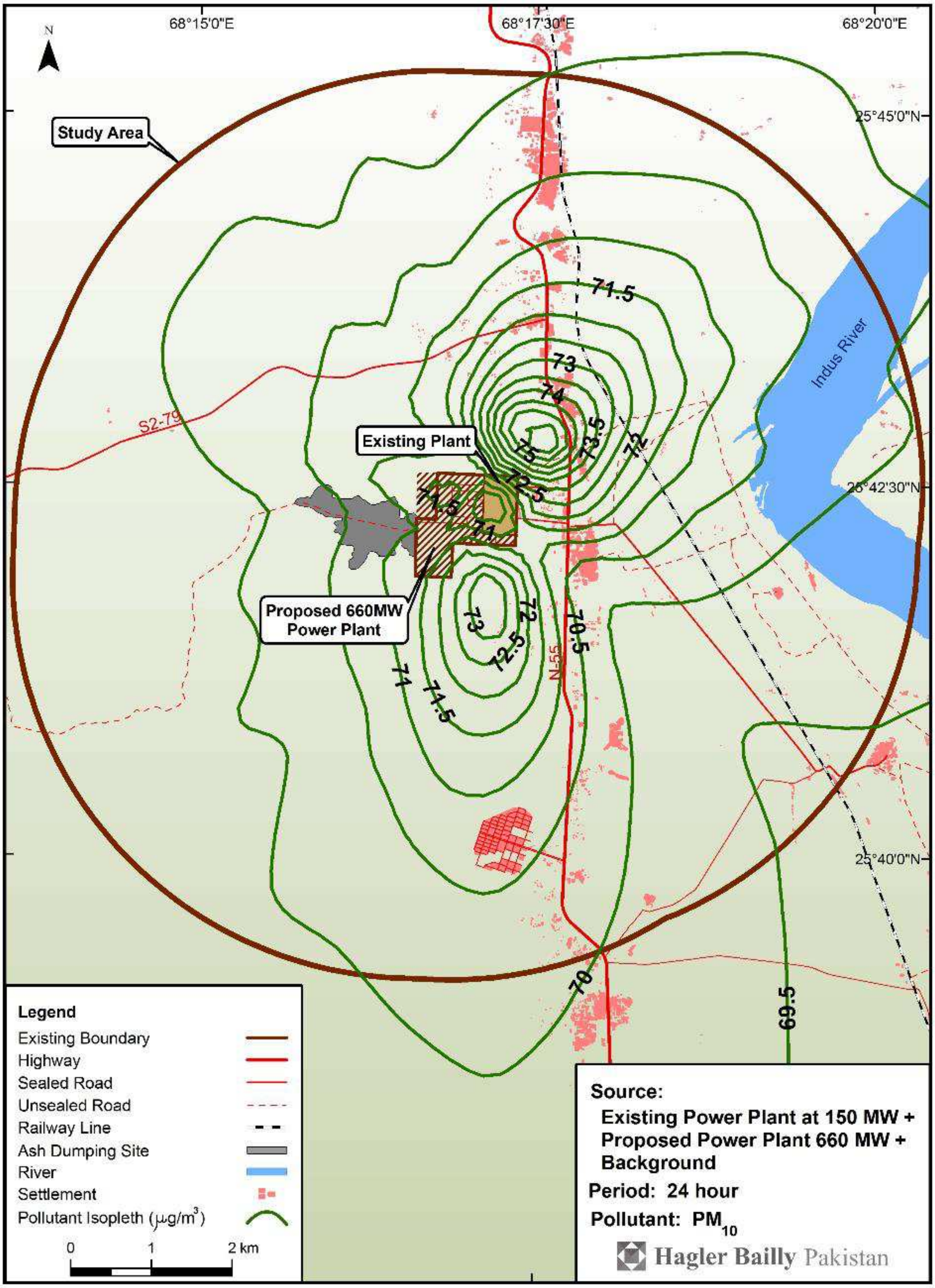


Figure 9: Combined 24–hour PM_{10} Levels

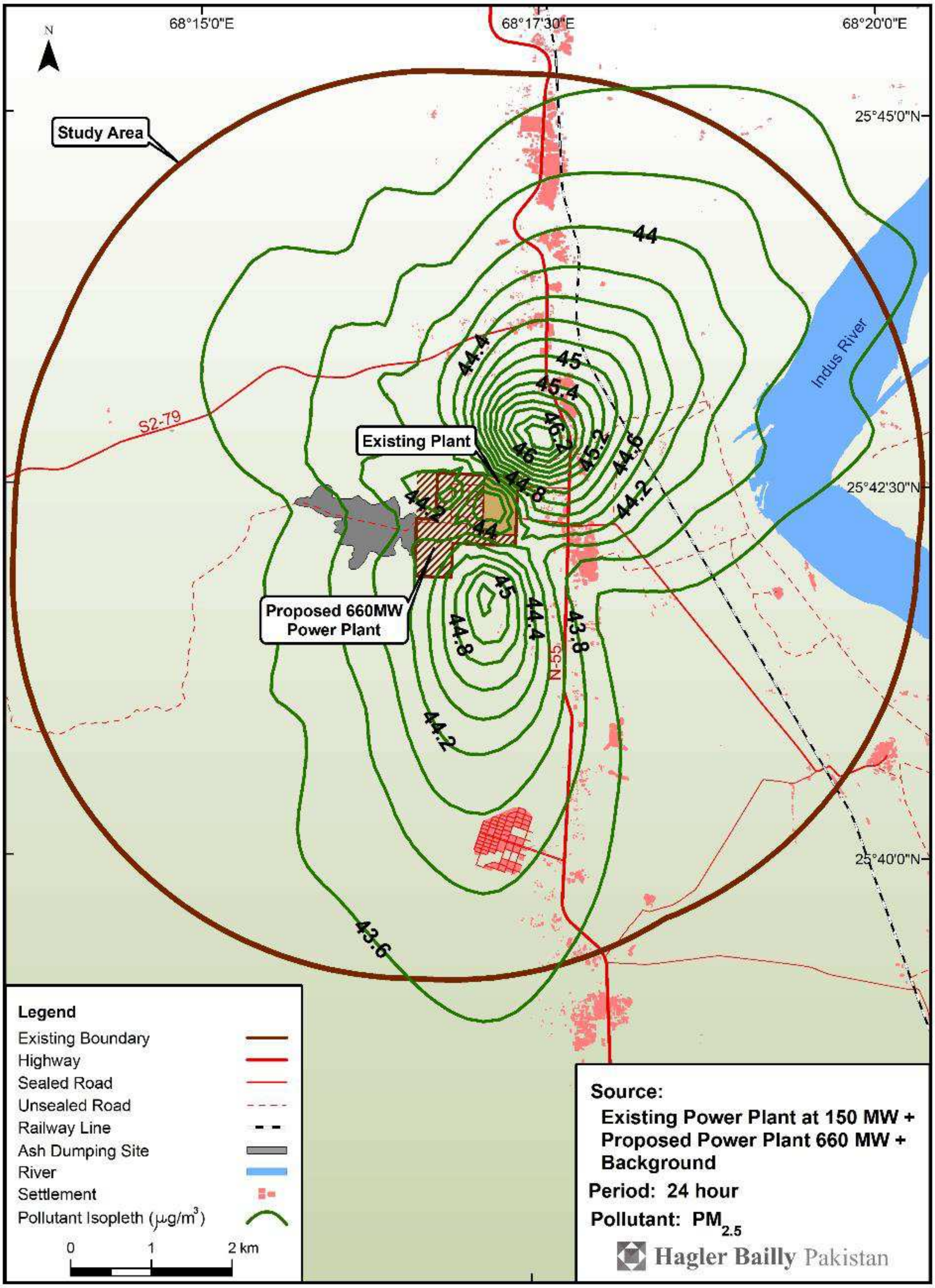


Figure 10: Combined 24–hour $PM_{2.5}$ Levels

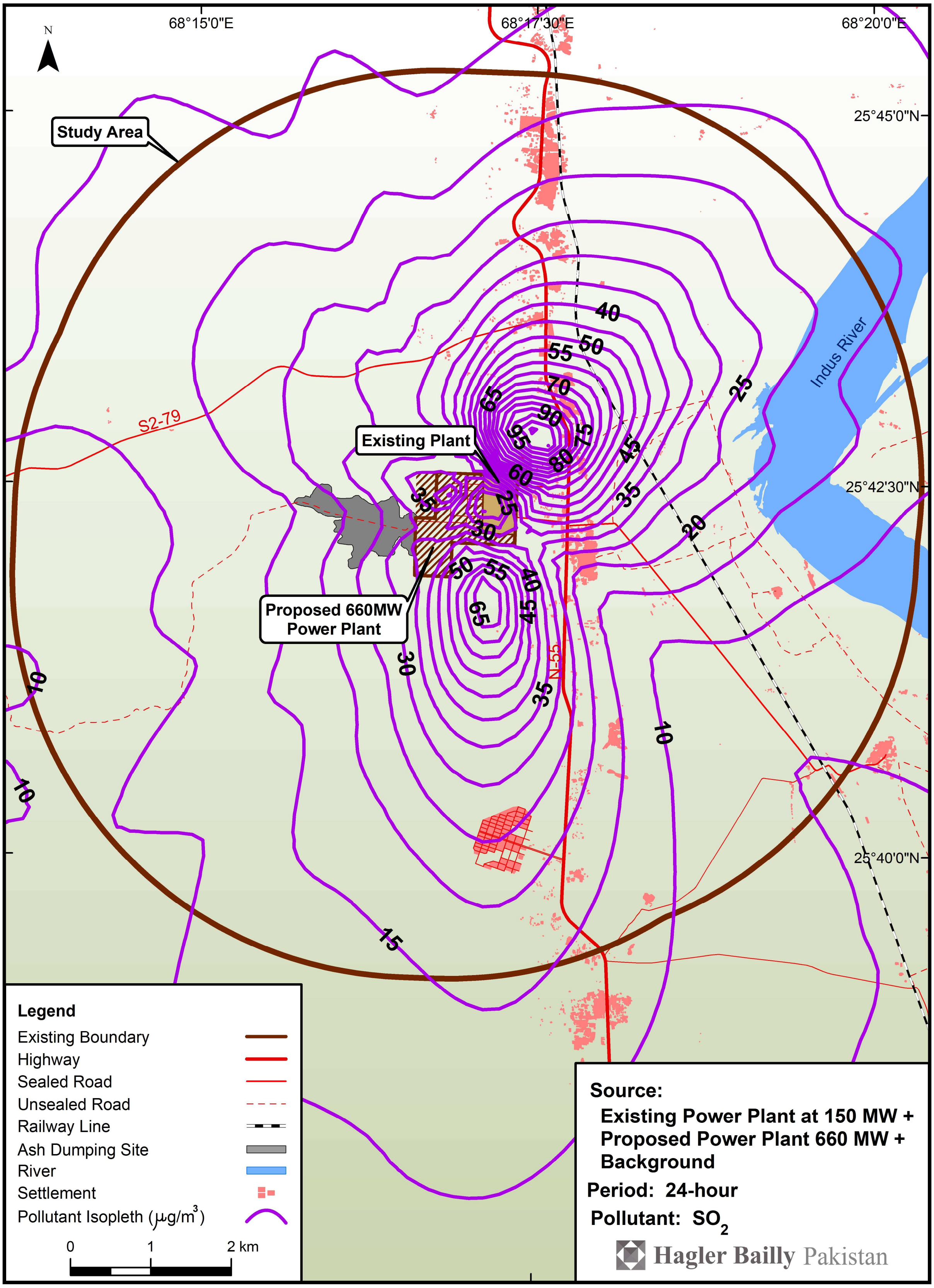


Figure 11: Combined 24–hour SO_2 Levels

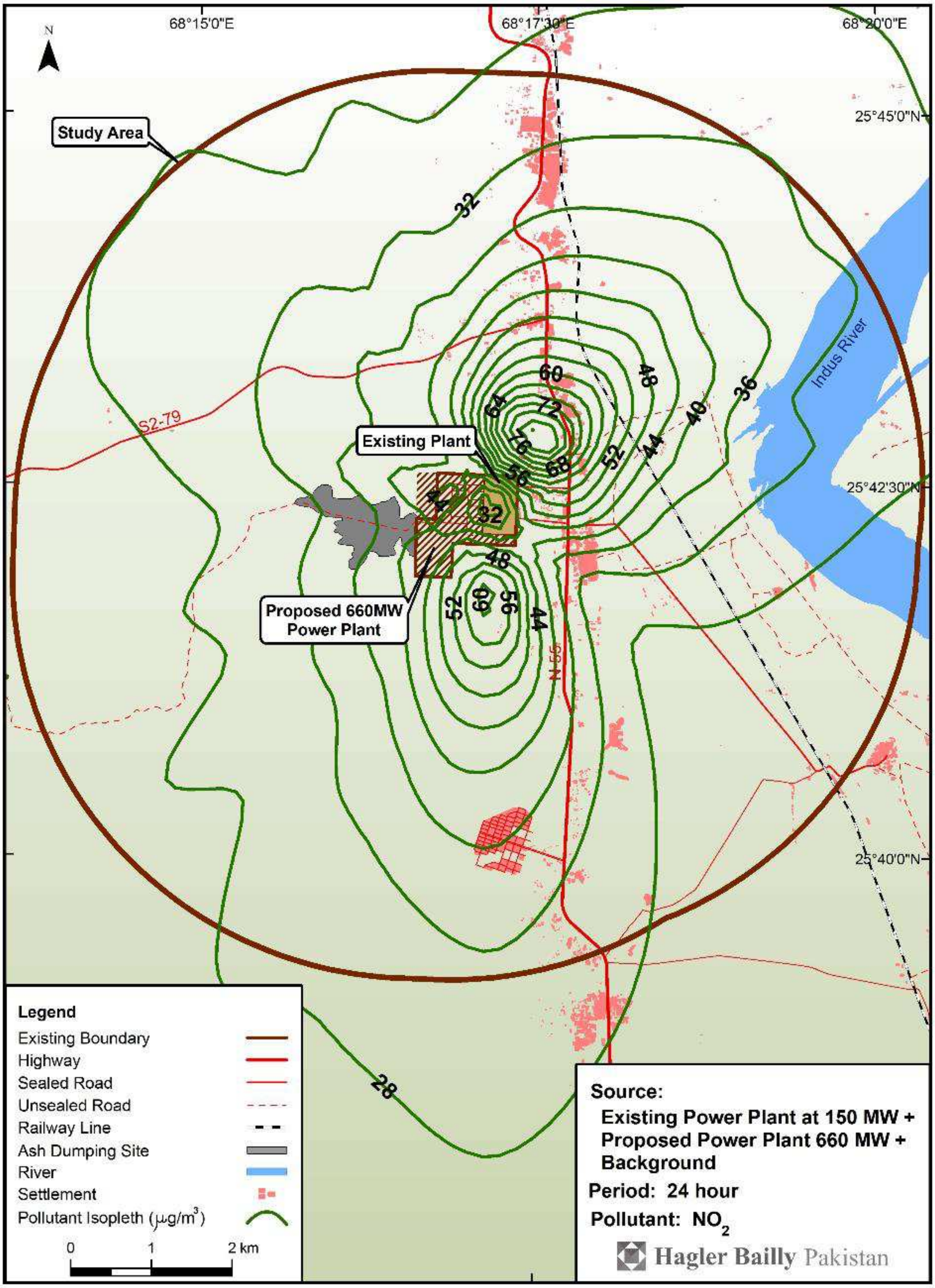


Figure 12: Combined 24–hour NO_2 Levels

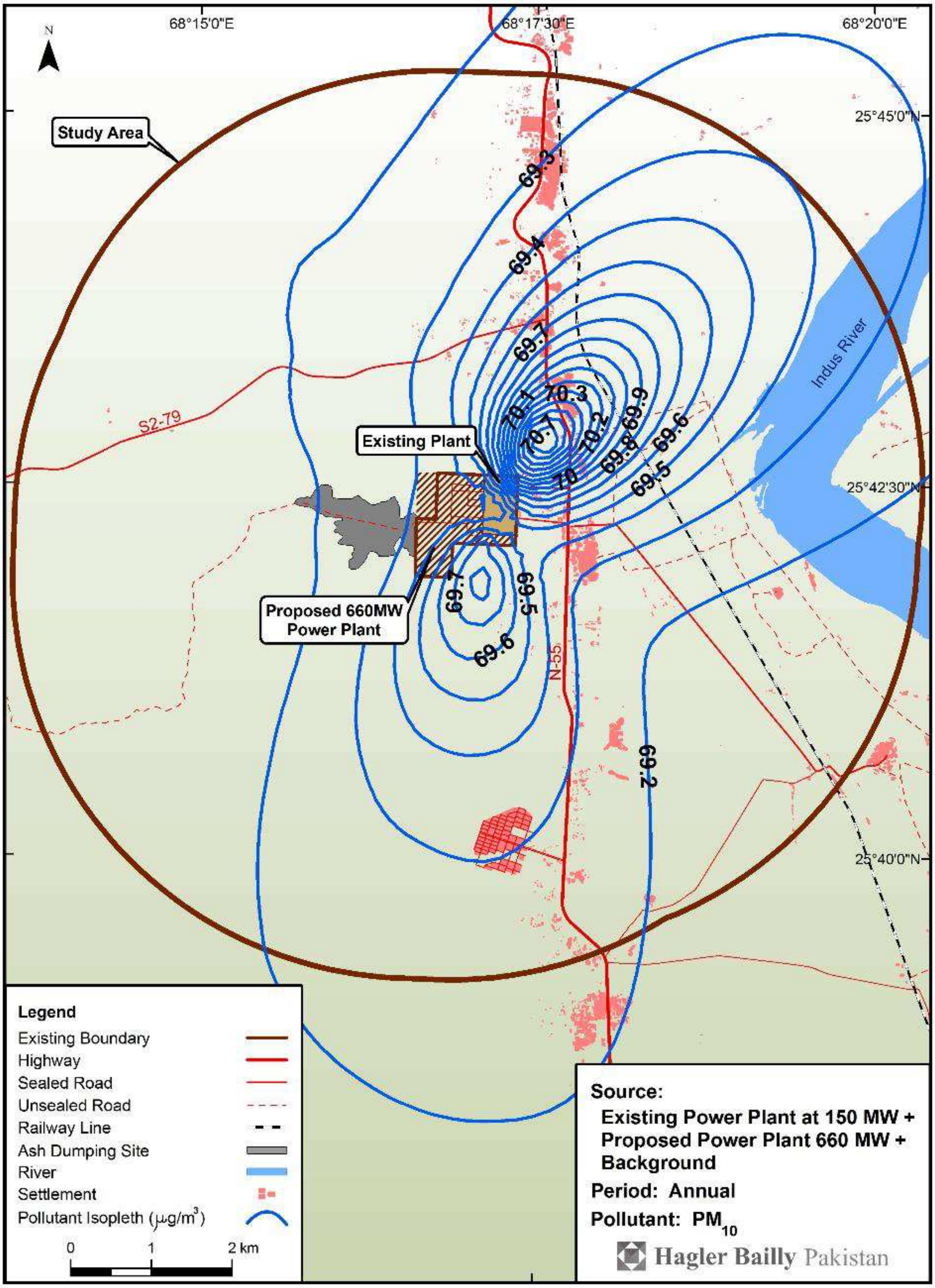


Figure 13: Combined Annual PM_{10} Levels

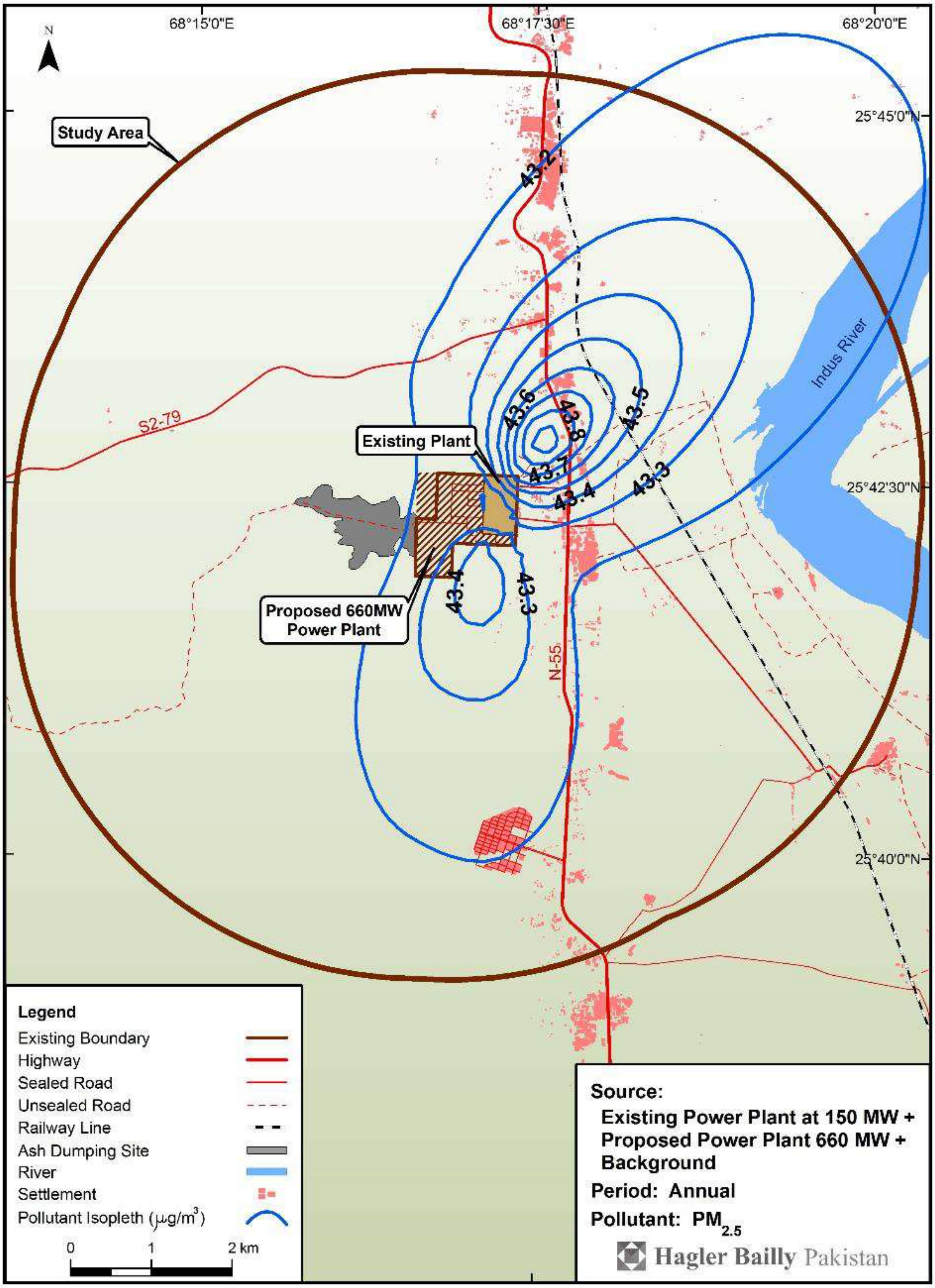


Figure 14: Combined Annual $PM_{2.5}$ Levels

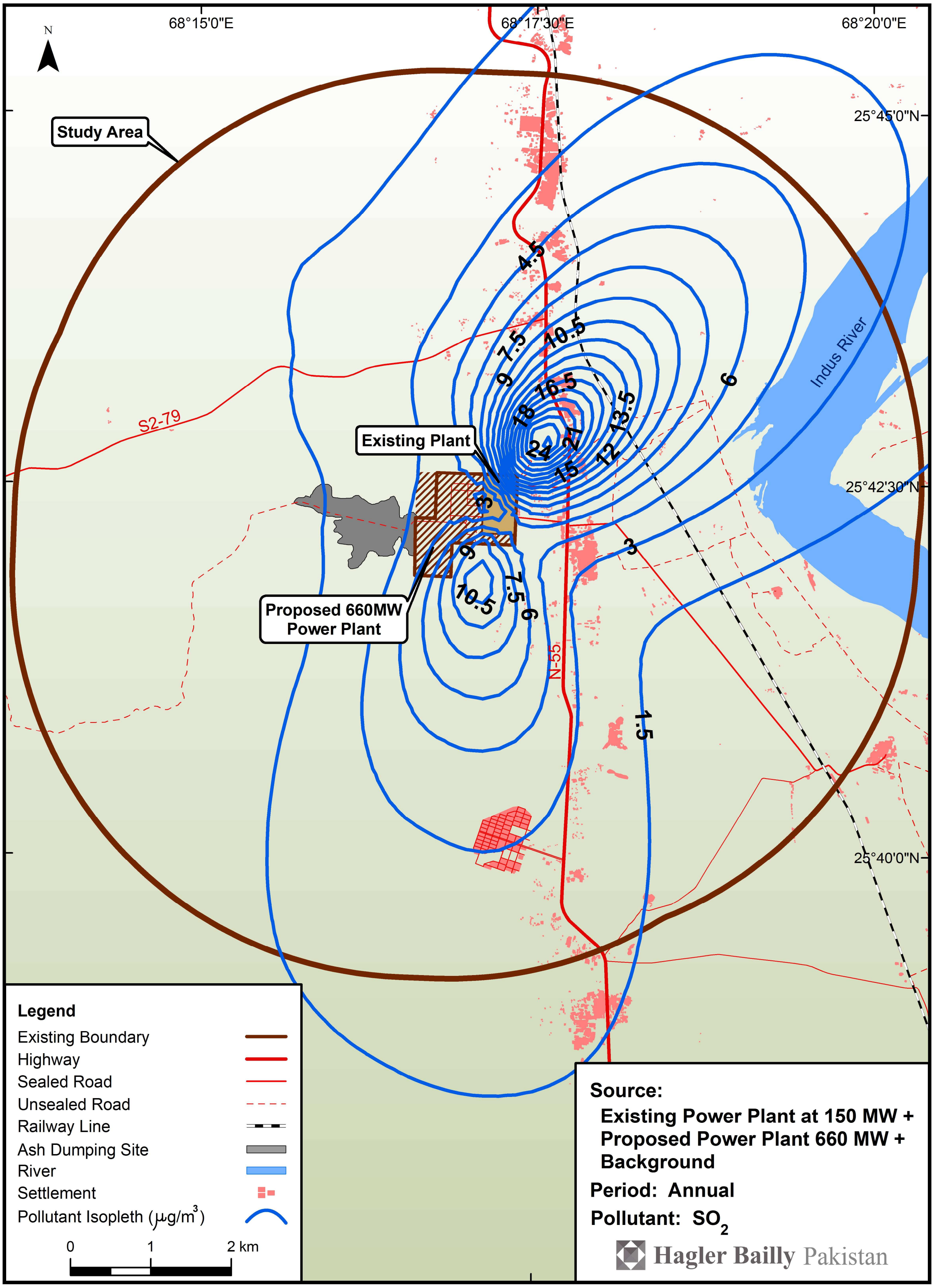


Figure 15: Combined Annual SO_2 Levels

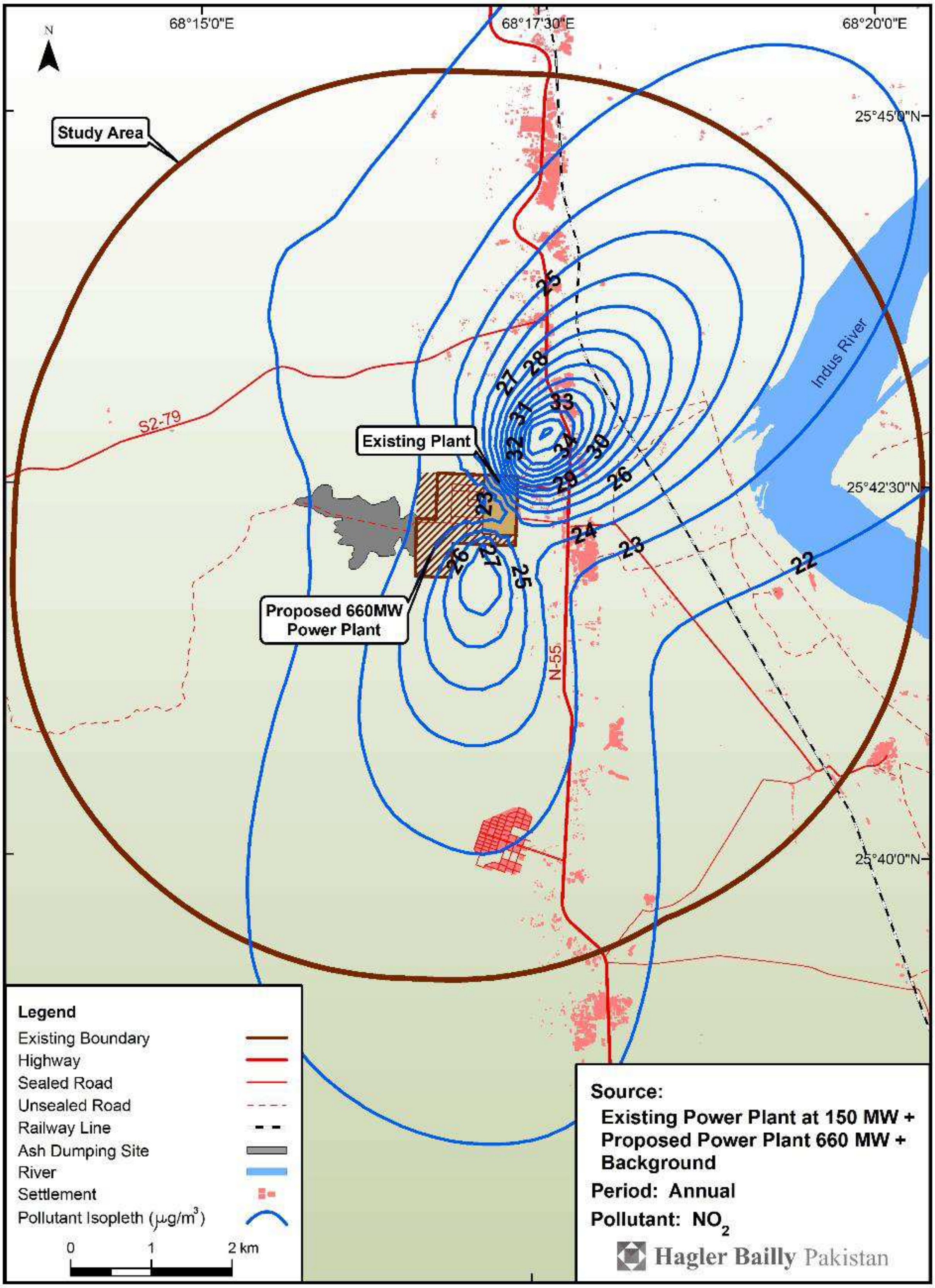


Figure 16: Combined Annual NO_2 Levels

APPENDIX 15: MONITORING FORM

1. Monitoring Form (during construction)

The latest results of the below monitoring items shall be submitted to the lenders as part of Quarterly Progress report throughout the construction phase.

Construction Phase

(1) Response/Actions to Comments and Guidelines from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
Number and contents of formal comments made by the public.	
Numer and contents of responces from Government agencies	

(2) Pollution

- General

Item	Monitoring results during report period	Measures to be taken	Location	Frequency
Handling and storage of parts and equipment at plant		Visual inspection	Work sites	Daily
Top soil		Top soil of 0.5 m depth will be excavated and stored properly	Construction area	Beginning of earth filling works
Erosion		Visual inspection of erosion prevention measures and occurrence of erosion	Construction areas and material storage sites	Monthly
Hydrocarbon and chemical storage		Visual inspection of storage facilities	Construction sites	Monthly
Local roads		Visual inspection to ensure local roads are not damaged	Approach roads	Monthly
Traffic safety		Visual inspection to see whether proper traffic signs are placed and flagmen for traffic management are engaged	Haul roads	Monthly

- Air (Ambient Air Quality)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	NEQS /SEQS	Standards for Contract	IFC Standards	Measurement Point	Frequency
PM$_{10}$	μg/m^3			120 (Annual Average)	SEQS	70 (IT-1) 50 (IT-2) 30 (IT-3) 20 (guideline)	a) locations where the impact of power plant, road traffic, and other sources are minimal b) locations near the N-55 c) locations near maximum ground level concentration (GLC) d) sensitive receptors	Suggested frequency is continuously at two locations (fixed station) and once in a month at other locations for one day.
	μg/m^3			150 (24 hours)	SEQS	150 (IT-1) 100 (IT-2) 75 (IT-3) 50 (guideline)		
PM$_{2.5}$	μg/m^3			40 (Annual Average)	SEQS	35 (IT-1) 25 (IT-2) 15 (IT-3) 10 (guideline)		
	μg/m^3			75 (24 hours)	SEQS	75 (IT-1) 50 (IT-2) 37.5 (IT-3) 25 (guideline)		
SO$_2$	μg/m^3			80 (Annual Average)	SEQS	-		
	μg/m^3			120 (24 hours)	SEQS	125 (IT-1) 50 (IT-2) 20 (guideline)		
CO	mg/m^3			5 (8 hours)	SEQS	-		
	mg/m^3			10 (1 hour)	SEQS	-		
NO$_2$	μg/m^3			40 (Annual Average)	SEQS	40 (guideline)		
	μg/m^3			80 (1 hour)	SEQS	-		

Item	Monitoring results during report period	Measures to be taken	Location	Frequency
Dust, smoke		Visual inspection to ensure good standard equipment is in use and dust suppression measures (spraying of waters) are in place.	Construction sites	Daily
		Visual inspection to ensure dust suppression work plan is being implemented	Material storage sites	Monthly

- Noise

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	NEQS /SEQS	Standards for Contract	IFC Standards	Measurement Point	Frequency
Noise	dB			75 (day time) 65 (night time) [Industrial area]	NEQS	70 (day time) 70 (night time)	Construction site Boundary area of the power plant Nearest residence or primary school	Quarterly

Item	Monitoring results during report period	Measures to be taken	Location	Frequency
Noise		Visual inspection to ensure good standard equipment is in use	Construction site Boundary area of the power plant Nearest residence or primary school	Weekly

- Water Quality

Item	Monitoring results during report period	Measures to be taken	Location	Frequency
Drinking water and sanitation		Ensure the construction workers are provided with safe water and sanitation facilities in the site	In construction sites and construction camps	Monthly
River water pollution by effluent		Ensure the construction workers are provided with sanitation facilities (temporary lavatories) in the site	Construction sites along the Indus River	Monthly

- Waste Management

Municipal waste, industrial waste, hazardous waste		Visual inspection that solid waste is disposed at designated site	Construction camps and construction sites	Monthly

- Odor

Kitchen waste		Visual inspection that those wastes are disposed of at designated sites	Waste storage facility	Monthly
Septic tank		Visual inspection that the lavatories are properly managed.	Lavatory	Monthly

(3) Socio-economics

- Cultural and archeological sites

Item	Monitoring results during report period	Measures to be taken	Location	Frequency
Cultural and archeological sites		Visual observation for chance finding	At all work sites	Daily

- Reinstatement of work sites

Item	Monitoring results during report period	Measures to be taken	Location	Frequency
Reinstatement of work sites		Visual inspection	At all work sites	After completion of all works

- Infectiuos Diseases

Item	Monitoring results during report period	Measures to be taken	Location	Frequency
Infectous diseases		The number of reported infections	Construction sites	Regular health checks

- Accidents and Safety

Item	Monitoring results during report period	Measures to be taken	Location	Frequency
Accidents and safety		Numbers, contens, and procesing results of diseases, accsident if occurred.	Construction site	Every day

- Safety of Workers

Item	Monitoring results during report period	Measures to be taken	Location	Frequency
Safety of workers		Usage of Personal Protective equipment	At work sites	Monthly

- Gender

Item	Monitoring results during report period	Measures to be taken	Location	Frequency
Gender		Status of the Grievance Redress Mechanisms (GRM) establishment, The number of grievance	Project site	Monthly

Operation Phase

(1) Response/Actions to Comments and Guidelines from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
Number and contents of formal comments made by the public.	
Numer and contents of responces from Government agencies	

(2) Pollution

- Air (Stack Emission)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	NEQS /SEQS	Standards for Contract	IFC Standards	Measurement Point	Frequency
SO_2	mg/m^3			100 - 500 Tons per day	SEQS(NEQS)	200 - 850	Prior to pre-treatment in ESP, FGD and at the exit of the stack	Continuous monitoring
NOx	mg/m^3			260 ng/J of heat input 1,200 mg/Nm^3	SEQS(NEQS)	510		
CO	mg/m^3			800	SEQS(NEQS)	-		
PM_{10}	mg/m^3			500	SEQS(NEQS)	50		
$PM_{2.5}$	mg/m^3			500	SEQS(NEQS)	50		
Exit gas temp.	deg C			-	-	-		
Exit gas speed	m/sec			-	-	-		

- Air (Ambient Air Quality)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	NEQS /SEQS	Standards for Contract	IFC Standards	Measurement Point	Frequency
PM_{10}	µg/m^3			120 (Annual Average)	SEQS	70 (IT-1) 50 (IT-2) 30 (IT-3) 20 (guideline)	Near sensitive sites and settlements	Suggested frequency is: Continuously at two location (fixed station) and once every month at other locations for one day
	µg/m^3			150 (24 hours)	SEQS	150 (IT-1) 100 (IT-2) 75 (IT-3) 50 (guideline)		
$PM_{2.5}$	µg/m^3			40 (Annual Average)	SEQS	35 (IT-1) 25 (IT-2) 15 (IT-3) 10 (guideline)		
	µg/m^3			75 (24 hours)	SEQS	75 (IT-1) 50 (IT-2) 37.5 (IT-3) 25 (guideline)		
SO_2	µg/m^3			80 (Annual Average)	SEQS	-		
	µg/m^3			120 (24 hours)	SEQS	125 (IT-1) 50 (IT-2) 20 (guideline)		
CO	mg/m^3			5 (8 hours)	SEQS	-		
	mg/m^3			10 (1 hour)	SEQS	-		
NO_2	µg/m^3			40 (Annual Average)	SEQS	40 (guideline)		
	µg/m^3			80 (24 hours)	SEQS	-		

- Water Quality (Effluent)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	NEQS /SEQS	Standards for Contract	IFC Standards	Measurement Point	Frequency
Temperature	ºC			≤ 3 ℃	SEQS(NEQS)	-	At the point where effluent leaves within the plant boundary	Monthly
pH	-			6 to 9	SEQS(NEQS)	6 to 9		
BOD	mg/l			80	SEQS(NEQS)	-		
COD	mg/l			150	SEQS(NEQS)	-		
TSS	mg/l			200	SEQS(NEQS)	50		
Oil & grease	mg/l			10	SEQS(NEQS)	10		
TDS	mg/l			3500	SEQS(NEQS)	-		
Zn	mg/l			5.0	SEQS(NEQS)	1	At the point where effluent leaves within the plant boundary	Quarterly
Pb	mg/l			0.5	SEQS(NEQS)	0.5		
Ni	mg/l			1.0	SEQS(NEQS)	-		
Fe	mg/l			8.0	SEQS(NEQS)	1		
Hg	mg/l			0.01	SEQS(NEQS)	0.005		
Cu	mg/l			1.0	SEQS(NEQS)	0.5		
Co	mg/l			2.0	SEQS(NEQS)	-		
Cr	mg/l			1.0	SEQS(NEQS)	0.5		
As	mg/l			1.0	SEQS(NEQS)	0.5		
Cd	mg/l			0.1	SEQS(NEQS)	0.1		

- Water Quality (Goundwater)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	NEQS /SEQS for values for Drinking water	Standards for Contract	WHO Guidelines for drinking watr	Measurement Point	Frequency
Temperature	ºC				SEQS(NEQS)	-	Groundwater around the ash pond	Monthly
TDS	-			6.5 to 8.5	SEQS(NEQS)	6.5 to 8.5		
Aluminum	mg/l			0.2	SEQS(NEQS)	0.2		
Antimony	mg/l			0.005	SEQS(NEQS)	0.02		
Arsenic	mg/l			0.05	SEQS(NEQS)	0.01		
Barium	mg/l			0.7	SEQS(NEQS)	0.7		
Boron	mg/l			0.3	SEQS(NEQS)	0.3		
Cadmium	mg/l			0.01	SEQS(NEQS)	0.003		
Chloride	mg/l			250.0	SEQS(NEQS)	250		
Chromium	mg/l			0.05	SEQS(NEQS)	0.05		
Copper	mg/l			2	SEQS(NEQS)	2		
Cyanide	mg/l			0.05	SEQS(NEQS)	0.07		
Fluoride	mg/l			1.5	SEQS(NEQS)	1.5		
Lead	mg/l			0.05	SEQS(NEQS)	0.01		
Manganese	mg/l			0.5	SEQS(NEQS)	0.5		
Mercury	mg/l			0.001	SEQS(NEQS)	0.001		
Nickel	mg/l			0.02	SEQS(NEQS)	0.02		
Nitrate	mg/l			50	SEQS(NEQS)	50		
Nitrite	mg/l			3	SEQS(NEQS)	3		
Selenium	mg/l			0.01	SEQS(NEQS)	0.01		
Residual chlorine	mg/l			0.5 to 1.5 at source	SEQS(NEQS)	-		
Zinc	mg/l			5	SEQS(NEQS)	3		

- Noise

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	NEQS /SEQS	Standards for Contract	IFC Standards	Measurement Point	Frequency
Noise	dB			75 (day time) 65 (night time) [Industrial area]	NEQS	70 (day time) 70 (day time)	- Boundary area of the power plant - Nearest residence or primary school	Quarterly

(3) Natural Environment

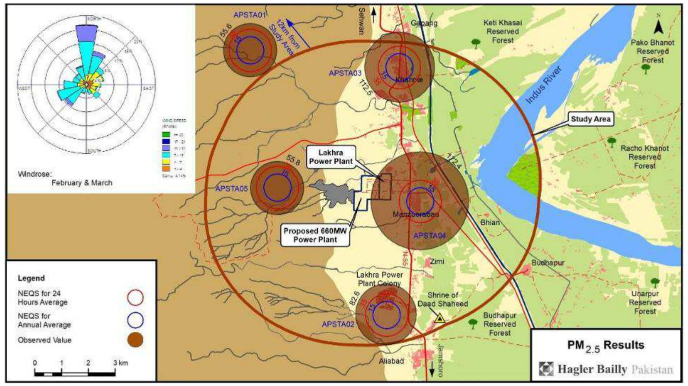
Item	Monitoring results during report period	Measures to be taken	Measurement Point	Frequency
Fish fauna			At three locations: 1) Upstream of Project site 2) Point of effluent discharge 3) Downstream of Project site	Annualy in November

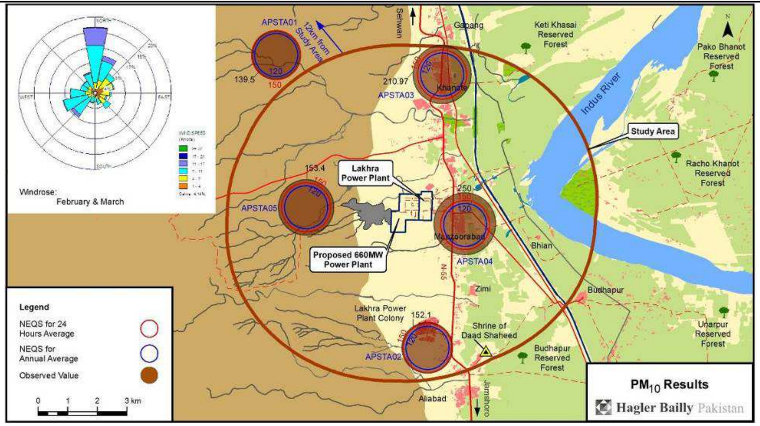
(4) Social Environment

Item	Monitoring results during report period	Measures to be taken	Location	Frequency
Grievances on land acquisition, resettlement, living & livelihood, land use, water & social infrastructure, social conflicts, unevenness of project benefits			N/A	Everyday
Report on working condition and accident			Power plant	Everyday

APPENDIX 16: ENVIRONMENTAL CHECKLIST

Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation			
(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process?	(a)Y	**Evaluation: EIA report has been completed.** (a) The EIA report has been completed as per guidelines of the JICA.
	(b) Have EIA reports been approved by authorities of the host country' government?	(b)N	(b) Not yet.
	(c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	(c)N	(c) Not yet.
	(d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(d)N	(d) Not yet. ・ Land for intake facility: Approval required from Sindh Revenue Department. The approval must be obtained prior to occupying the site. ・ Water from Indus River. Approval required from Irrigation Department to construct Intake Facility in Indus River. The Irrigation Department will also allocate water for the plant.
(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders?	(a)Y	**Evaluation: Contents of the project and the potential impacts were adequately explained to the local stakeholders.** (a) Explanations to local stakeholders were conducted between February and August in 2014.
	(b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(b)Y	**Evaluation: Comments from the stakeholders have been reflected to the project design.** (b) The comments obtained from stakeholder meetings have been reflected to the project design.
(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a)Y	**Evaluation: Alternatives of site selection were examined with social and environmental considerations.** (a) Three locations for the power plant and two locations for the ash pond were selected as alternatives and have been considered from environmental, social, technical and economic aspects.
2 Pollution Control			

Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
(1) Air Quality	(a) Do air pollutants, such as sulfur oxides (SOx), nitrogen oxides (NOx), and soot and dust emitted by the power plant operations comply with the country's emission standards? Is there a possibility that air pollutants emitted from the project will cause areas that do not comply with the country's ambient air quality standards? Are any mitigating measures taken?	Y	**Evaluation: According to the ambient air quality baseline study, PM_{10} and $PM_{2.5}$ have already exceeded the SEQS at most of the sampling points probably due to anthropogenic sources, natural circumstances and the existing Lakhra Plant. However air pollutants from the Project are negligible compared with those from the Lakhra Plant. JST has suggested GENCO to implement mitigation measures such as rehabilitation to the Lakhra Plant in order to meet SEQS.** [Impact by the Project] As per the air quality modeling results, predicted ambient air quality after proposed plant commissioning and LFPS rehabilitation meets the designated values (PM_{10} and $PM_{2.5}$) in SEQS. [Baseline of PM_{10} and $PM_{2.5}$] - As shown in the Figure 1 ($PM_{2.5}$) and Figure 2(PM_{10}), the ambient air quality baseline result indicates the current air quality has already exceeded the SEQS and IFC guidelines at most of the sampling sites. - The possible reasons of the excess are 1) existing Lakhra Plant, 2) local traffic on unsealed roads, 3) cooking in the houses using biomass fuel, and 4) desert and dry conditions. - In case the excesses are due to the Lakhra Plant, some mitigation measures shall be taken to the plant in order to reduce the PM_{10} and $PM_{2.5}$.  Source: Hagler Bailly Pakistan Figure 1 $PM_{2.5}$ Ambient Air Quality Baseline Result

Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
			 Source: Hagler Bailly Pakistan Figure 2 PM_{10} Ambient Air Quality Baseline Result - JST has suggested GENCO to take action to reduce PM_{10} and $PM_{2.5}$. Among the following options, JST selected the third one taking into account financial, technical and environmental aspects. 1) to shut down the plant (0 MW); 2) to install ESP on the existing boiler (30 MW); or 3) to restore or rehabilitate the plant up to original design (150 MW)
	(b) In the case of coal-fired power plants, is there a possibility that fugitive dust from the coal piles, coal handling facilities, and dust from the coal ash disposal sites will cause air pollution? Are adequate measures taken to prevent the air pollution?	Y	**Evaluation: As water sprinkling is conducted regularly at the coal piles and ash disposal sites to prevent the air pollution from those sites.**
(2) Water Quality	(a) Do effluents including thermal effluents from the power plant comply with the country's effluent standards? Is there a possibility that the effluents from the project will cause areas that do not comply with the country's ambient water quality	Y	**Evaluation: As no thermal discharge is generated, increase of river water temperature is not expected. Effluent from the Project is appropriately treated to meet the national standards at the effluent treatment facility.**

<table>
<tr><th>Environmental Item</th><th>Main Check Items</th><th>Yes: Y No: N</th><th>Confirmation of Environmental Considerations
(Reasons, Mitigation Measures)</th></tr>
<tr><td></td><td>standards or cause any significant temperature rise in the receiving waters?</td><td></td><td></td></tr>
<tr><td></td><td>(b) In the case of coal-fired power plants, do leachates from the coal piles and coal ash disposal sites comply with the country's effluent standards?</td><td>Y</td><td>Evaluation: Leachates are treated to meet the NEQS for effluents.

[Leachates flow]
Storm water from coal piles and coal ash disposal sites are drained into the coagulator with specific ditches. Then the surface water is treated at the effluent treatment facility and the sludge is collected and returned to the ash pond.</td></tr>
<tr><td></td><td>(c) Are adequate measures taken to prevent contamination of surface water, soil, groundwater, and seawater by the effluents?</td><td>Y</td><td>Evaluation: As adequate measures are taken, no significant impact on surface water, soil and groundwater is expected.

[Measures]
- During construction at the river, construction method which brings about less impact on the water quality is adopted.
- All effluents from the project are treated at the effluent treatment facility before discharging into the river.
- Storm water is drained into specific ditches which prevent the water from going outside of the boundary.
- Chemicals and oils are kept in the specific storages in order to prevent contamination of soil and groundwater.</td></tr>
<tr><td>(3) Wastes</td><td>(a) Are wastes, (such as waste oils, and waste chemical agents), coal ash, and by-product gypsum from flue gas desulfurization generated by the power plant operations properly treated and disposed of in accordance with the country's regulations?</td><td>Y</td><td>Evaluation: As the wastes are appropriately collected by licensed company and dumped safely in accordance with The Sindh Environmental Protection Act, 2014, no significant impact is expected.

[Type of Waste]
- During construction, municipal waste and hazardous waste are generated from base camps and construction sites, which should be appropriately treated by contractors.
- The type of wastes generated during operation is given in Table 1.

Table 1 Type of Waste during Operation
<table>
<tr><th colspan="2">Type</th><th>Source</th><th>Quantity</th></tr>
<tr><td colspan="4">Industrial Waste</td></tr>
<tr><td>(1)</td><td>Fly ash</td><td>ESP, scrubber system</td><td>549,806 ton/day</td></tr>
<tr><td>(2)</td><td>Bottom ash</td><td>Boiler</td><td>61,090 ton/day</td></tr>
<tr><td>(3)</td><td>Gypsum</td><td>FGD</td><td>96,096 ton/day</td></tr>
<tr><td colspan="4">Municipal Waste</td></tr>
<tr><td>(4)</td><td>Sludge</td><td>- Waste water treatment facility
- Septic tanks</td><td>N/A</td></tr>
<tr><td>(5)</td><td>Plastic, garbage, paper, green</td><td>Admin. Builing, power plant</td><td>N/A, little quantity</td></tr>
</table></td></tr>
</table>

Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)

	waste, melal, glass etc.		
Hazardous Waste			
(6)	lubricant, turbine oil, HSD oil, hydraulic oil, etc.	Power plant, work shop	N/A, little quantity

Source: JICA Survey Team

[Segregation]

- (1) would be purchased by cement companies for recycling as cement material.
- Of (5), recyclable paper, plastics, glasses and metals should be segregated and recycled by recycling company, if possible.

[Disposal Methods]

- Disposal method during operation is given in Table 2.
- Agreement with licensed company should be reviewed every year and open tender is called for competitive bid.

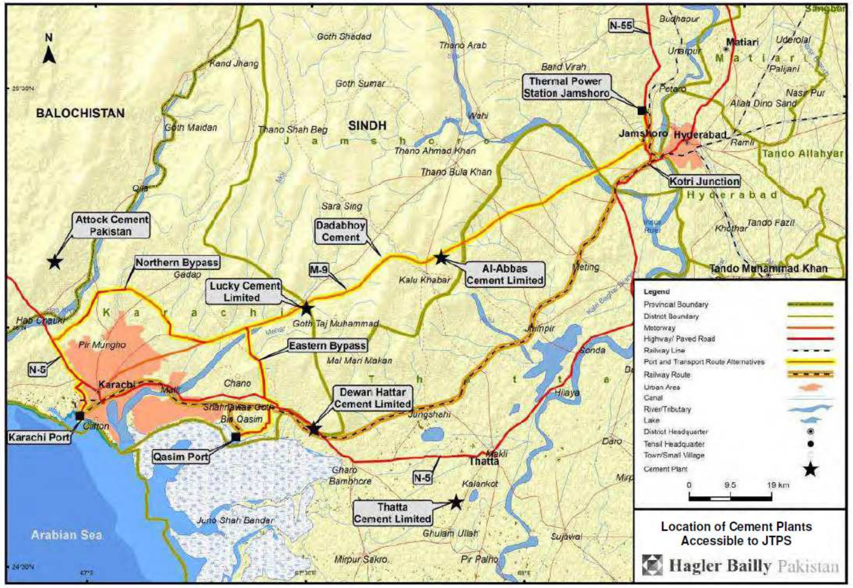
Table 2 Disposal Method

Category	Type	Disposal methods
Industrial waste	Fly ash	Collected and sold to cement company. They utilize them as a cement material. Otherwise, disposed of at the ash pond.
	Gypsum	Gypsum can be utilized as a gypsum board material. However, there is no company with such technology in Pakistan so far. In future, this recycling method can be adopted.
Municipal waste	Sludge	Sludge from waste water treatment facility and septic tanks will be collected by licensed company and dumped safely.
	Plastic, paper, glasses	Junk shoppers will collect them and sell to the market.
Hazardous waste	Oil	Collected by licensed company and treated safely

Source: JICA Survey Team

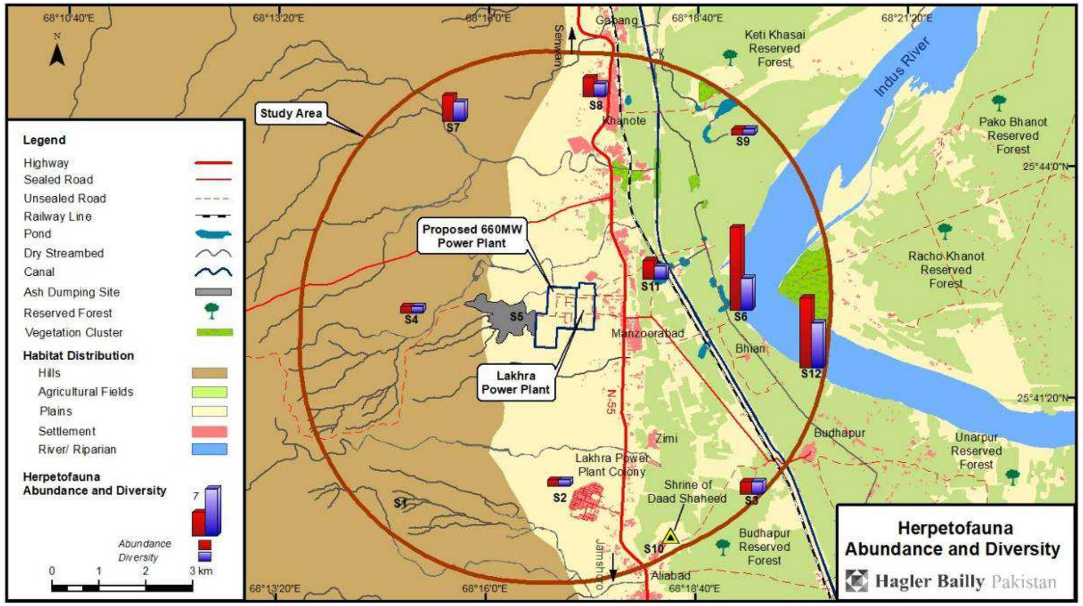
[Cement Application to Cement Material]

- Pakistan Standards and Quality Control Authority ('SQCA'), on the initiative of cement manufacturers have modified the Portland cement standards in 2008 to allow for up to 5% blending of fly ash in the manufacturing of cement.
- There are a number of potential users of ash produced by the project in the vicinity of the plant. The location of cement factories are as below map.
- One of the manufactures, Power Cement Limited (formerly Al-Abbas Cement Limited) located about 90 km from Lakhra Plant has indicated that their plant can accept the ash about 50,000 ton per year till 2017 and 150,000 ton per year from 2017. (Hearing survey at Power Cement during 3rd Site Work)

Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
			 Source: Jamshoro Final EIA Figure 3 Location of Cement Plants

<table>
<tr><th>Environmental Item</th><th>Main Check Items</th><th>Yes: Y No: N</th><th>Confirmation of Environmental Considerations
(Reasons, Mitigation Measures)</th></tr>
<tr><td>(4) Noise and Vibration</td><td>(a) Do noise and vibrations comply with the country's standards?</td><td>Y</td><td>
<p>Evaluation: As insulation measures are conducted, no significant impact is expected.</p>
<p>[Noise source]
Main noise sources, each noise level and insulation measures are shown in Table 3. The project adopts the most appropriate devices for insulation measures taking into account the installation location and distance to the nearest affected residence/primary school.</p>
<p>Table 3 Noise Sources and its Level</p>
<table>
<tr><th>Noise source</th><th>Noise level</th><th>Insulation measure and the effect</th></tr>
<tr><td>Boiler</td><td>- Bottom of boiler: 85 dB(A)
- Upside of boiler: 75 - 80 dB(A)</td><td>- Building enclosure: 25 dB (A)
- Insulation wall: 5 - 10 dB(A)
- Insulation lagging: N/A</td></tr>
<tr><td>Turbine building</td><td>- 65 - 70 dB(A)</td><td>- Insulation wall: 30 dB(A)</td></tr>
<tr><td>Transformer</td><td>- 80 - 85 dB(A)</td><td>- Insulation wall: 5 - 10 dB(A)
- Steel sheet insulation tank: 10 - 20 dB(A)
- Concrete panel insulation tank: 20 - 30 dB(A)
- Concrete insulation building: 30 - 40 dB(A)</td></tr>
<tr><td>Pump</td><td>- 60 - 70 dB(A)
(noise controlled level)</td><td>- Insulation lagging, suction port silencer</td></tr>
<tr><td>Belt conveyor</td><td>- 75 - 85 dB(A)</td><td>- Insulation cover, small noise roler, vibration control device: N/A</td></tr>
</table>
<p>Source: Environmental Conservation Technology and Equipment (Thermal and Nuclear Power Engineering Society)</p>
<p>[NEQS for Noise]
The project adopts equipments and the insulation measure to meet the NEQS nighttime noise level (45 dB(A)).</p>
<p>Table 4 NEQS for Noise</p>
<table>
<tr><th>Category</th><th>Daytime (06:00 - 22:00)</th><th>Nighttime (22:00 - 06:00)</th></tr>
<tr><td>Residential area</td><td>55 dB(A)</td><td>45 dB(A)</td></tr>
</table>
</td></tr>
<tr><td>(5) Subsidence</td><td>(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?</td><td>N</td><td>Evaluation: As groundwater is not used in the project, subsidence does not occur.</td></tr>
<tr><td>(6) Odor</td><td>(a) Are there any odor sources? Are adequate odor control measures taken?</td><td>Y</td><td>Evaluation: Appropriate control measures are taken to avoid odor to generate.
As to kitchen waste, appropriate waste storage facilities are designed and constructed at the power plant, and licensed company collects them regularly. Septic tanks are maintained in good condition by regular management with chlorine. During operation phase, water is sprinkled on the coal and ash for avoiding spontaneous ignition. Consequently, no significant impact due to their odor would be expected.</td></tr>
</table>

Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
3 Natural Environment			
(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	N	**Evaluation: Proposed site is not located in any protected area. Though there are three reserved forests, i.e., Keti Khasai, Budhapur, and Racho Khanot Reserved Forests, those forests are situated in more than 5 km from the proposed site. Therefore no significant impact would be expected.** - A reserved forest is a one where the species are protected in their natural habitat and no human interference is allowed or any kind of human activity is strictly prohibited without any special permission. (Stakeholder meeting at Forest Department, Hyderabad, during 3rd Site Work)  Keti Khasai Reserved Forest  Budhapur Reserved Forest
(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?	N	**Evaluation: The project site encompasses no primeval forests, tropical rain forests, ecologically vulnerable habitats.**
	(b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?	N	**Evaluation: The project site encompasses no protected habitats of endangered species designated by the country's laws or international treaties and conventions.**
	(c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	N	**Evaluation: No significant ecological impact is predicted.** - The project site for the power plant is situated inside of the existing Lakhra Plant estate. Though ash pond land (70 acre) needs to be acquired and land leveled, there is no precious species on the land. - To avoid fish suction by intaking water from the river, intake screen is applied at the intake facility. - Regarding reptiles, especially turtles, their nests are taken care of during their hibernation period. If necessary, EPC Contractor

Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
			gets professional advice from ecological experts.  Source: Hagler Bailly Pakistan Figure 4 Herpeto-fauna Abundance and Diversity
	(d) Is there a possibility that the amount of water (e.g., surface water, groundwater) used by the project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	N	**Evaluation: No adverse impact on aquatic environment in the Indus River is predicted by the water intake.** - The amount of water taken from the river is approx. 0.5 m^3/s. The lowest water flow amount is 177 m^3/sec in December. The intake amount corresponds to approx. 0.3 % of total flow amount. Therefore no adverse impact on aquatic environments is predicted.
	(e) Is there a possibility that discharge of thermal effluents, intake of a large volume of cooling water or discharge of leachates will adversely affect the ecosystem of surrounding water areas?	(e)N	**Evaluation: No adverse impact on the ecosystem is predicted.** - As the projet adopts wet type cooling system, no thermal effluent is discharged. - The project needs 0.5 m^3/s of water for the power plant. To avoid fish suction, intake screen is applied at the water intake facility.

Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
			- All effluents from the power plant is treated to meet the NEQS for effluents.
4 Social Environment			
(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement?	Y	**Evaluation: Land acquisition will be required for this project.** Alternatives were considered and efforts were made to minimize the impacts of resettlement. Implementation of the power plant project will require 46.25 acres of land but only affect the uncultivated land of three households with a population of 18. Three AHs will only lose 0.87 acre of uncultivated land and no other impacts on their assets and livelihood. As a result of survey with support of Revenue staff, other plots of required land are preliminarily identified as unregistered land (land with no record) that falls under stage land. The ownership of these unregistered land will be verified through formal land acquisition process of LAA.
	(b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement?	Y	**Evaluation: Adequate explanation on compensation and resettlement assistance will be given to affected people prior to resettlement.** Affected people were consulted and explained adequately during EIA and LARAP studies.
	(c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement?	Y	**Evaluation: Abbreviated Land Acquisition and Resettlement Action Plan (Abbreviated LARAP) was prepared.** LARAP includes compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies.
	(d) Are the compensations going to be paid prior to the resettlement?	Y	**Evaluation: LARAP provides comprehensive policy and procedure of land acquisition.** Compensation will be ensured to be paid prior to the resettlement.
	(e) Are the compensation policies prepared in document?	(e)Y	**Evaluation: LARAP provides comprehensive policy of compensation.**
	(f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?	Y	**Evaluation: LARAP provides policy on special assistance for vulnerable groups of people.** Special assistance for vulnerable groups of people is proposed in LARAP but there is no such vulnerable people in project AHs.
	(g) Are agreements with the affected people obtained prior to resettlement?	Y	**Evaluation: Agreements will be made prior to resettlement**.

Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?	Y	**Evaluation: LARAP provides institutional framework.** LARAP propose a plan to secure Capacity and budget
	(i) Are any plans developed to monitor the impacts of resettlement?	Y	**LARAP provides monitoring plan for resettlement.**
	(j) Is the grievance redress mechanism established?	Y	**LARAP provides grievance redress mechanism.**
(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?	Y	**Evaluation: Potential adverse impacts on living conditions will be appropriately mitigated and the mitigation measures are addressed in LARAP.** Three AHs will only lose 0.87 acre of uncultivated land and no other impacts on their assets and livelihood.Therefore, no aadverse impact on inhabitants and their living conditions is expected.
	(b) Is sufficient infrastructure (e.g., hospitals, schools, and roads) available for the project implementation? If the existing infrastructure is insufficient, are any plans developed to construct new infrastructure or improve the existing infrastructure?	Y	**Evaluation: Insufficiency of infrastructure due to influx of external labors and construction work activities will be** A camp site will be developed within the LFPS premises to facilitate necessary basic infrastructures for labors during construction period. EIA addresses following social augmentation plans to mitigate insufficiency of the existing local infrastructures; - construction/rehabilitation of drinking water supply scheme - rehabilitation of primary health care clinic in Manzurabad - rehabilitation of basic health unit in Khanot - NGO training services for health care service staff - primary health training equipment and material
	(c) Is there a possibility that large vehicles traffic for transportation of materials, such as raw materials and products will have impacts on traffic in the surrounding areas, impede the movement of inhabitants, and any cause risks to pedestrians?	Y	**Evaluation: Increase in large vehicles traffic is expected but will be mitigated.** All the roads that will be used for the transportation of plant equipment are national highways, dual carriage and have at least 4 lanes. The current volume of traffic on any of the highways ranges from 8,000 to 21,000 vehicles per day. In comparison the volume of traffic generated by the movement of plant equipment is likely to be less than 500 trucks, spread over several weeks. The incremental traffic and consequently the impact will therefore be insignificant. Environmental management measures have been included in the EMP.
	(d) Is there a possibility that diseases, including infectious diseases, such as HIV, will be brought due to the immigration of workers associated with the project? Are adequate considerations given to	Y	**Evaluation: Potential risk of infectious diseases during construction period is expected but will be mitigated.** There is a possibility that diseases will be brought due to the immigration of workers. Labor health management plan shall be prepared and disease generation status shall be monitored. The project will implement periodic medical check and conduct education programs on health of workers.

Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	public health, if necessary?		
	(e) Is there a possibility that the amount of water used (e.g., surface water, groundwater) and discharge of thermal effluents by the project will adversely affect existing water uses and uses of water areas (especially fishery)?	N	**Evaluation: No significant impact on water resources is predicted.** Volume of existing water flow will be secured not to impact on the local use of the river water. There is no thermal effluents from the proposed Project.
(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	N	**Evaluation: No significant impact on heritage is predicted.** The closest heritage is Syed Daad Shaheed Graveyard located in about 6 km southeast from the candidate site. The proposed Project site is located and kept appropriate distance from the Syed Daad Shaheed Graveyard to avoid impact of noise, vibration and traffic increase.
(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	N	**Evaluation: The project does not adversely affect the local landscape.**
(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?	N/A	**Evaluation: No ethnic minorities and indigenous peoples exist around the candidate site.**
	(b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	N/A	**Evaluation: No ethnic minorities and indigenous peoples exist around the candidate site.**
(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?	Y	**Evaluation: Project proponent will comply with the relevant law and ordinances** The Municipal Laws such as Pakistan Labor Policy, 2010 are observed.
	(b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials?	Y	**Evaluation: Project proponent will comply with the relevant law and ordinances** The following measures are proposed. - Long-time exposure of workers to noise will be restricted. - The workers will be directed to wear personal protective gears. - Construction of temporary first aid station at the working site with nurse. - Establishment of cooperative relationship with the local medical facilities.

Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.?	Y	**Evaluation: Projects are exposed to the risks of accident and spread of infectious diseases especially during construction period. To control these risks, following mitigation measures are proposed.** - Safety and sanitation management plan will be developed - Regular health check of the labors will be implemented.
	(d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	Y	**Evaluation: Workers will be educated to comply with the safety of other individuals as well as local residents.** Employed labors may increase impact on female daily activities, privacy of the female and/or increase possibility of abuse to the local female. The contracted labors will be educated and the local communities will be consulted and monitored.
5 Others			
(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?	Y	**Evaluation: Adequate measures are proposed in EMP to reduce impact during construction.**
	(b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce the impacts?	N/A	**Evaluation: : Project will not adversely affect the natural environment.**
	(c) If construction activities adversely affect the social environment, are adequate measures considered to reduce the impacts?	Y	**Evaluation: Adequate measures on predicted social concerns are proposed in EMP** Social augmentation plan and development of campsite are proposed to mitigate the shortage of local infrastructure. Establishment of a "Recruitment plan" is also proposed to provide appropriate guidance to the local people and avoid any possible social conflicts.
(2) Accident Prevention Measures	(a) In the case of coal-fired power plants, are adequate measures planned to prevent spontaneous combustion at the coal piles (e.g., sprinkler systems)?	Y	**Evaluation: Adequate measures for preventing spontaneous combustion at coal piles will be taken.** Prevention measures for spontaneous ignition for coal transportation and coal storage facility will be developed.
(3) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?	Y	**Evaluation: GENCO implements the monitoring program.** (a) GENCO will implement the monitoring: Monitoring Plan for Power Plant" in this report.
	(b) What are the items, methods and frequencies of the monitoring program?	Y	(b) Same as above.
	(c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?	Y	(c) Same as above.

Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	Y	**Evaluation: Monitoring format is regulated by national law.** (d) The monitoring format is regulated by NEQS (Self-Monitoring and Reporting by Industry) Rules, 2001.
6 Note			
Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Power Transmission and Distribution Lines checklist should also be checked e.g., projects including installation of electric transmission lines and/or electric distribution facilities).	N	(a) N/A
	(b) Where necessary, pertinent items described in the Ports and Harbors checklist should also be checked (e.g., projects including construction of port and harbor facilities).	N	(b) N/A
Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems,such as transboundary waste treatment, acid rain, destruction of the ozone layer, and global warming).	Y	**Evaluation: No transboudary of waste is predicted. The project generates 2.7 million ton - CO2 per year from the power plant.** [CO2 reduction measure] - Ultra super critical (USC) pressure boiler is installed, which emit less CO_2 than sub-critical and super critical type. - Carbon Capture System (CCS) is not feasible for the project to adopt so far. In the future, this technology will be considered for reduction of CO_2 emission.

Source: JICA Survey Team