

## 7.1

**INTRODUCTION**

This Chapter presents an assessment of the potential impacts of the proposed Combined Cycle Power Plant in Myingyan (hereafter referred to as “the Project”) on ambient air quality during the construction and operational phases. Air sensitive receivers (ASRs) and potential sources of air emissions were identified and an assessment of the potential air quality impacts arising from these air emissions was carried out. Mitigation measures and recommendations are provided for consideration where necessary to be implemented to reduce any potential residual impacts to acceptable levels where practicable.

## 7.2

**ASSUMPTIONS AND LIMITATIONS**

The air quality impact assessment presented in this Chapter is based on the information available from the Sponsor.

The construction air quality impact assessment was carried out qualitatively, while the operation air quality impact assessment was carried out quantitatively.

The air modelling input data of the Project have been agreed by Sponsor. The cumulative air quality impact assessment for the operational phase has taken into account the potential impact from the Project itself and the baseline air quality data. The baseline air quality data is derived from the background pollutant concentrations monitored at a number of identified monitoring stations in the vicinity of the Project, as outlined in the **Chapter 5**. An operating Steel Mill plant was identified to the south of the Project. It is assumed that the air quality impact due to emissions from the adjacent operating Steel Mill plant (Phase I) has been captured in the baseline air quality data.

Should there be significant change of the plant or stack design which will affect the predicted results, an update of the air quality modelling and additional operational phase assessment will be required.

## 7.3

**SCOPE OF THE ASSESSMENT**

The air quality impact assessment has focussed on the following components of the Project:

- Construction phase activities with potential air quality impact:
  - Fugitive dust emissions from the dusty activities from construction of power plant facilities including excavation and filling, materials handling, vehicle movement on the haul roads and wind erosion of open stockpile area or open bare ground; and
  - Emissions from vehicle movement and non-road machineries.
- Operational phase activities with potential air quality impact:
  - Air emissions from stacks during the operation of the Project.

The assessment of the potential construction air quality impacts has been focussed within the Area of Influence (AoI) which is generally defined as 500m area from the

Project site boundary as the impact is localized. For the impact assessment of stack emission, the AoI is extended to 10km area from the Project site boundary.

The air pollutants of concern during construction and operational phases are summarized in **Table 7.1** below:

**Table 7.1 Air Pollutants of Concern during Construction and Operational Phase of the Project**

Phase	Activities	Concerned Air Pollutant
Construction	Construction Dust Emissions from vehicle and non-road machinery	Particulate matters (PM) Nitrogen dioxide (NO <sub>2</sub> ), Sulphur dioxide (SO <sub>2</sub> ), particulate matters in terms of PM <sub>10</sub> and PM <sub>2.5</sub>
Operational	Stack emissions	NO <sub>2</sub> , SO <sub>2</sub> , PM <sub>10</sub> and PM <sub>2.5</sub>

#### 7.4 LEGISLATION REQUIREMENTS AND IFC GUIDELINES

At present, the Government of Myanmar has not yet established any numerical standard for ambient air quality. Following the IFC's *Environmental, Health and Safety Guidelines: Air Emissions and Ambient Air Quality*, in the absence of the national legislated standards, the current World Health Organization (WHO) Air Quality Guidelines should be used. **Table 7.2** shows WHO's Air Quality Guidelines for each of the ambient air parameters at different averaging periods.

In addition to guidance values, WHO also provides interim targets for concentrations of various air pollutants, which are aimed at promoting a gradual tightening of ambient air pollutant concentrations. Given that air pollution levels in some countries may far exceed the WHO recommended guidance values, these proposed interim target levels can be adopted by countries taking into account their specific local circumstances. Countries can choose to adopt different interim targets considering the balance amongst factors such as risks to public health, technological feasibility, economic development and other political and social factors.

Since Myanmar is a developing country which is yet to have its local national air quality standards to regulate local ambient air quality, it is recommended that the WHO Interim Target 1 would be adopted as the ambient air quality guidelines in Myanmar and the assessment criteria for this Project. If no WHO interim target is provided for some pollutants, the ultimate guideline value would be adopted.

**Table 7.2 WHO Ambient Air Quality Guidelines (2005) <sup>(a)</sup>**

Pollutant	Averaging Period (mean)	Guidance Value in $\mu\text{g}/\text{m}^3$	
Sulphur dioxide (SO <sub>2</sub> )	24-hour	125	(Interim target-1)
		50	(Interim target-2)
	10 minute	20	(guideline)
		500	(guideline)
Nitrogen dioxide (NO <sub>2</sub> )	1-year	40	(guideline)
	1-hour	200	(guideline)
Particulate Matter PM <sub>10</sub>	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 <sub>2.5</sub>	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)

**Note:**

<sup>(a)</sup> Extracted from WBG EHS General Guidelines, Environmental Chapter, Section 1.1, Table 1.1.1 based on World Health Organization (WHO). Air Quality Guidelines Global Update, 2005. PM 24-hour value is the 99th percentile.

For the said project, IFC's emissions guidelines for combustion turbine using natural gas are shown in **Table 7.3**.

**Table 7.3 Emission Guidelines for Combustion Turbine (in mg/Nm<sup>3</sup> or as indicated) <sup>(a)</sup>**

Combustion Technology / Fuel	Particulate Matter (PM)		Sulphur Dioxide (SO <sub>2</sub> )		Nitrogen Oxides (NO <sub>x</sub> )	Dry Gas, Excess O <sub>2</sub> Content (%)
	NDA <sup>(b)</sup>	DA <sup>(b)</sup>	NDA	DA	NDA/DA	NDA/DA
Natural Gas (all turbine types of Unit > 50MWth)	N/A	N/A	N/A	N/A	51 (25 ppm)	15%

**Notes:**

<sup>(a)</sup> Extracted from IFC EHS General Guidelines for Thermal Power Plant, Table 6(B), p21 dated December 19, 2008.

<sup>(b)</sup> 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. For detailed notes and explanation refer to IFC EHS General Guidelines for Thermal Power plants, Table 6(B).

**Chapter 5** provides the details on the baseline conditions for air quality in the Project Aol. Five locations (namely MAQN-1 to MAQN-5), which are located in the vicinity of the Project Site, were selected as the baseline air sampling locations. NO<sub>2</sub>, SO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub> were measured at the selected baseline air sampling locations for seven consecutive days each month from July 2014 to June 2015 (refer to **Table 5.6** in **Section 5**).

The measured NO<sub>2</sub>, SO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub> at all the selected baseline air sampling locations from July 2014 to June 2015 have been averaged to represent the average background concentrations of the air pollutants at the Project site area. A summary of the background concentrations of NO<sub>2</sub>, SO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub> for air quality impact assessment is presented in **Table 7.4**.

**Table 7.4** *Summary of the Average Background Air Pollutant Concentrations in the Project Site Area*

Air Pollutant	Average Background Concentration (µg/m <sup>3</sup> )
SO <sub>2</sub>	6.2
NO <sub>2</sub>	54.0
PM <sub>10</sub>	43.3
PM <sub>2.5</sub>	26.7

#### IDENTIFICATION OF AIR SENSITIVE RECEPTORS

The representative Air Sensitive Receptors (ASRs) that will potentially experience air quality impacts from activities during the construction and operation phase of the Project have been identified.

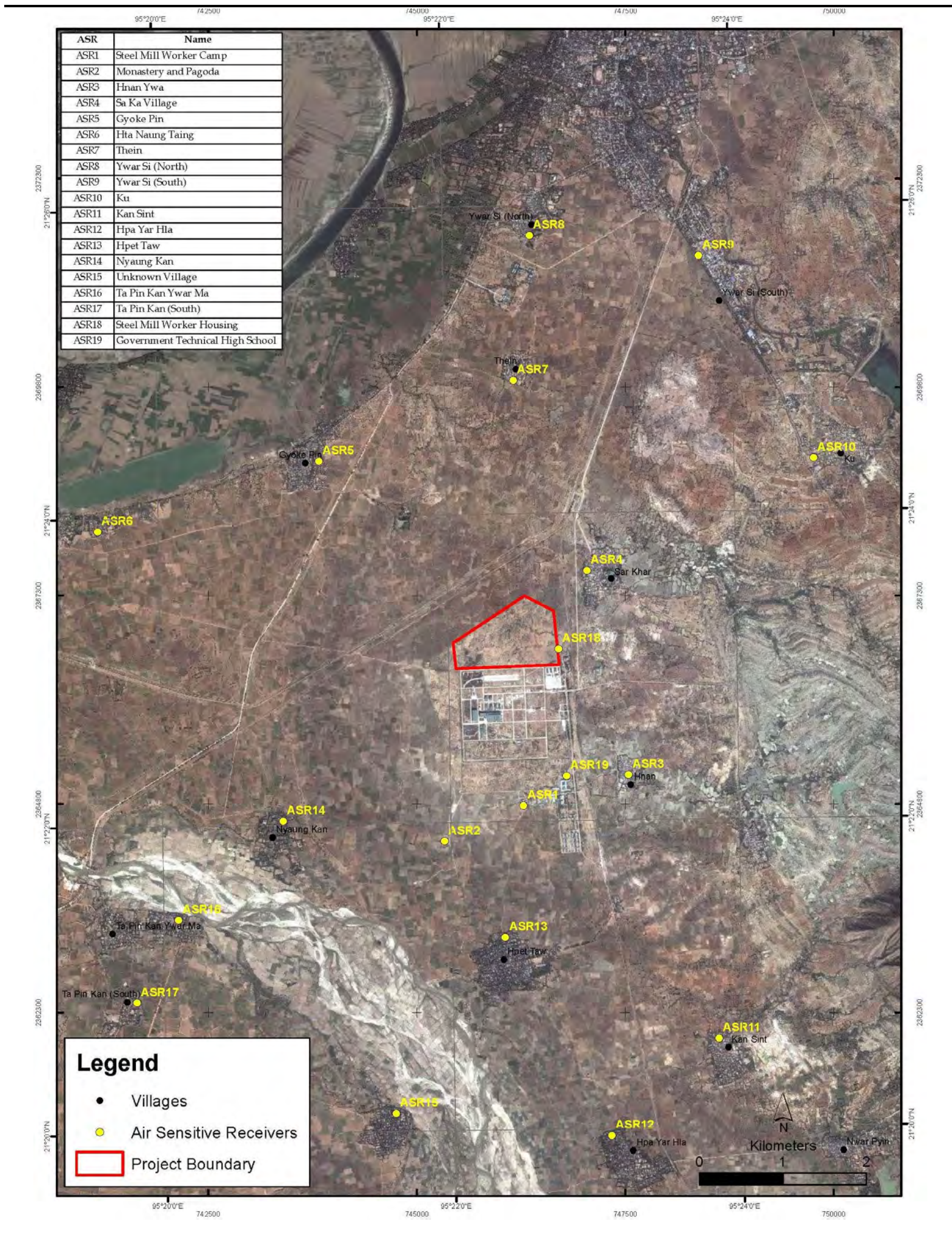
The locations of the identified representative ASRs are listed in **Table 7.5** and shown in **Figure 7.1**.

**Table 7.5** *Representative Air Sensitive Receptors (ASRs)*

ASR	Location	Type of Uses	Approximate Nearest Distance to the Project Site Boundary (m)
ASR1	Steel Mill Worker Camp	Industrial	1,670
ASR2	Monastery and Pagoda	Residential	2,075
ASR3	Hnan Ywa	Residential	1,560
ASR4	Sa Ka Village	Residential	630
ASR5	Gyoke Pin	Residential	2,720
ASR6	Hta Naung Taing	Residential	4,470
ASR7	Thein	Residential	2,590
ASR8	Ywar Si (North)	Residential	4,320
ASR9	Ywar Si (South)	Residential	4,585
ASR10	Ku	Residential	3,620
ASR11	Kan Sint	Residential	4,870
ASR12	Hpa Yar Hla	Residential	5,680
ASR13	Hpet Taw	Residential	3,240
ASR14	Nyaung Kan	Residential	2760
ASR15	Unknown Village	Residential	5,380
ASR16	Ta Pin Kan Ywar Ma	Residential	4,490
ASR17	Ta Pin Kan (South)	Residential	5,545

ASR	Location	Type of Uses	Approximate Nearest Distance to the Project Site Boundary (m)
ASR18	Steel Mill Worker Housing	Residential	10
ASR19	Government Technical High School	Institutional	1,350

Figure 7.1 Location of Representative Air Sensitive Receivers



## **7.7 IDENTIFICATION OF IMPACTS**

### **7.7.1 Construction Phase**

The construction activities of the Project have been outlined in **Chapter 2**. The construction of the Project is anticipated to commence in the first quarter of 2016 and will last for about 22.5 months. The key activities which may potentially cause air quality impacts are listed below:

- Site clearance, site formation and levelling involving excavation and backfilling; and
- Construction of substructure and superstructure of the main power plant facilities including infrastructure and buildings.

Construction dust arising from the dust generating activities and air emissions from construction vehicles and non-road machinery within the construction site boundary are the key concerns during construction of the Project.

### **7.7.2 Operational Phase**

The key emission source associated with the operation of the Project is stack emissions from the combustion of natural gas during combined cycle and simple cycle operation.

The main air pollutant of concern for a gas-fired combined cycle power plant is nitrogen dioxide (NO<sub>2</sub>) whilst emissions of sulphur dioxide (SO<sub>2</sub>) and particulate matters (PM) including respirable suspended particulates (PM<sub>10</sub>) and fine suspended particulates (PM<sub>2.5</sub>) are likely to be minimal provided that the combustion process is optimised and efficient.

## **7.8 ASSESSMENT METHODOLOGY**

### **7.8.1 Construction Phase**

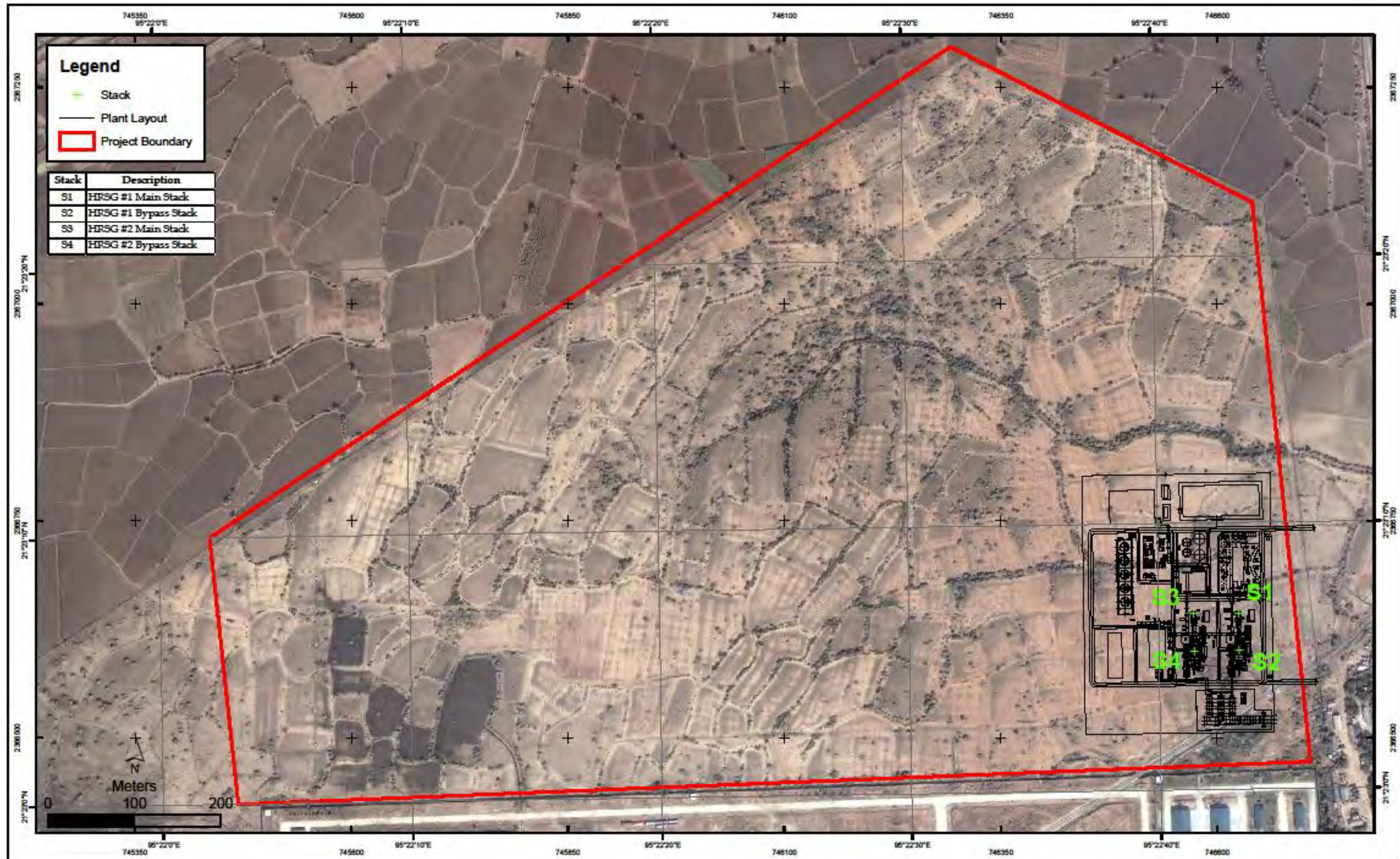
The air quality impacts during construction of the Project have been assessed in a qualitative manner following IFC guidelines and based on the best available information.

### **7.8.2 Operational Phase**

#### **Overview of Stack Emissions from the Project**

Stack emission has been identified as key source of air pollution during operation of the Project. The Project consists of two sets of gas turbine generating unit, two sets of heat recovery steam generator (HRSG) and one steam turbine generating unit with associated auxiliary equipment. The Project will be designed to operate continuously throughout the year in either simple cycle or combine cycle mode. Each gas turbine is equipped with one bypass stack for simple cycle mode and one main stack for combined cycle mode. The Project site boundary and the locations of the bypass stack and main stack for each gas turbine within the Project site are shown in **Figure 7.2**.

Figure 7.2 Stack Location with Project Site



During combined cycle operation, the heat of exhaust gas will be admitted to the HRSG where superheated steam will be produced which will then drive the steam turbine to generate additional electrical power. The flue gas from the HRSG will be emitted via the main stack (S1 and S3). During simple cycle operation, the flue gas from the gas turbine will be emitted via the bypass stack (S2 and S4).

During normal operation of the Project, the plant will be operated in combined cycle mode and the main stack will be in operation. Simple cycle operation will occur during the first 5 months of the operation of the Project before the combined cycle plant is commissioned, as well as during shutdown of steam turbine for maintenance of approximately 40 days once in 3 years. The main stack and the bypass stack will not be operating concurrently at any time.

The contributions of stack emissions from the Project during operation phase have been quantitatively assessed using an air dispersion model, AERMOD (version 14134) <sup>(1)</sup>. The modelling input data for the main stack and bypass stack as provided are presented in **Table 7.6**.

**Table 7.6 Summary of Modelling Input Data for Stack Emissions of the Project**

Input Parameter		HRSG Main Stacks	HRSG Bypass Stacks	Remarks
Operation mode		Combined-cycle	Simple-cycle	-
Number of stack		2 (S1 and S3)	2 (S2 and S4)	2 gas turbine units, each has 1 main stack and 1 bypass stack
Coordinates of stack (X, Y)		S1: 746624.6, 2366644 S3: 746572.8, 2366643	S2: 746625.3, 2366601 S4: 746573.4, 2366600	Obtained from site layout plan provided by Sembcorp
Stack height (m above ground)		40	30	Provided by Sembcorp
Diameter of each stack (m)		3.72	4	Provided by Sembcorp
Flue gas exit temperature (°K/ °C)		375/ 101	892 / 619	At operating condition
Flue gas exit velocity (m/s)		20.1	41.3	At operating condition
Flue gas exit flow rate (wet) under standard condition (Nm <sup>3</sup> /s)		158.72	158.72	Provided by Sembcorp; Condition: 0°C, 1 atm, 12.9% O <sub>2</sub> , 9.8% H <sub>2</sub> O
Flue gas exit flow rate (dry) under standard condition (Nm <sup>3</sup> /s)		194.12	194.12	Standard condition: 0°C, 1 atm, 15% O <sub>2</sub> , dry
Emission concentration of pollutants (per stack)	NO <sub>x</sub> (mg/m <sup>3</sup> ):	51.329	51.329	Provided by Sembcorp; Condition: 0°C, 1 atm, 15% O <sub>2</sub> , dry
	SO <sub>2</sub> (mg/m <sup>3</sup> ):	1.754	1.754	
	PM <sub>10</sub> (mg/m <sup>3</sup> ):	1.7	1.7	
	PM <sub>2.5</sub> (mg/m <sup>3</sup> ):	1.7	1.7	
Emission rates of pollutants (per stack)	NO <sub>x</sub> (g/s):	9.964	9.964	Estimated from emission concentration and flue gas exit flow rate under standard condition
	SO <sub>2</sub> (g/s):	0.34	0.34	
	PM <sub>10</sub> (g/s):	0.33	0.33	
	PM <sub>2.5</sub> (g/s):	0.33	0.33	

<sup>(1)</sup> AERMOD is an internationally recognized model, and is one of the preferred and recommended models of the US Environmental Protection Agency (US EPA).

## **Modelling Assumptions**

As the representative ASRs are generally low-rise village houses, ground level concentrations (GLCs) at 1.5m above ground (breathing level of human receptors) of these ASRs have been modelled.

Main stacks associated with normal combined cycle operation are assumed to be operating continuously throughout the year. Bypass stacks associated with simple cycle operation will only be operated intermittently throughout the year; therefore no annual air quality impact is predicted for simple cycle operation. Main stacks and bypass stacks will not be operational concurrently. Two modelling scenarios have been assessed and they are summarised in **Table 7.7**.

**Table 7.7 Modelling Scenarios**

Scenario	HRSG 1 Main Stack (S1)	HRSG 1 Bypass Stack (S2)	HRSG 2 Main Stack (S3)	HRSG 2 Bypass Stack (S4)
Main stacks in operation	✓		✓	
Bypass stacks in operation		✓		✓

**Notes:**  
(a) ✓ = assessed in the modelling scenario

NO<sub>2</sub> is assumed to be 50% of NO<sub>x</sub> for short-term averages (i.e., hourly and daily averaged) and 100% of NO<sub>x</sub> for long-term average (annual average) as a conservative approach. This assumption is made reference to the air quality modelling guidelines recommended by the *Air Quality Modelling and Assessment Unit of UK Environmental Agency*<sup>(1)</sup>.

A general factor of 1.43 has been applied to convert hourly SO<sub>2</sub> modelled results to 10-min averaged results<sup>(2)</sup>.

For conservative approach in this assessment, emission rates for PM<sub>10</sub> and PM<sub>2.5</sub> are assumed to be the same.

## **Meteorological Data**

The MM5 surface and upper air meteorological data<sup>(3)</sup> in the vicinity for the recent 5 years (i.e., 2010 – 2014) were adopted for the model simulation. **Figure 7.3** shows the wind roses at the Project site area for the five years.

The MM5 meteorological data were processed using AERMET (version 14134) to generate AERMOD-ready meteorological data. According to rainfall record, the wet season in Myanmar runs from May to October and the dry season runs from November to April. The land use within 3km of the Project was analysed to

(1) UK EA, Air Modelling Guidelines on conversion ratio for NO<sub>x</sub> to NO<sub>2</sub> : [http://www.environment-agency.gov.uk/static/documents/Conversion\\_ratios\\_for\\_NOx\\_and\\_NO2\\_.pdf](http://www.environment-agency.gov.uk/static/documents/Conversion_ratios_for_NOx_and_NO2_.pdf)

(2) Richard A. Duffee, Martha A. O'Brien and Ned Ostojic (1991) Odor Modeling - Why and How. Page 295, Recent Developments and Current Practices in Odor Regulations, Controls and Technology. Air & Waste Management Association, 1991.

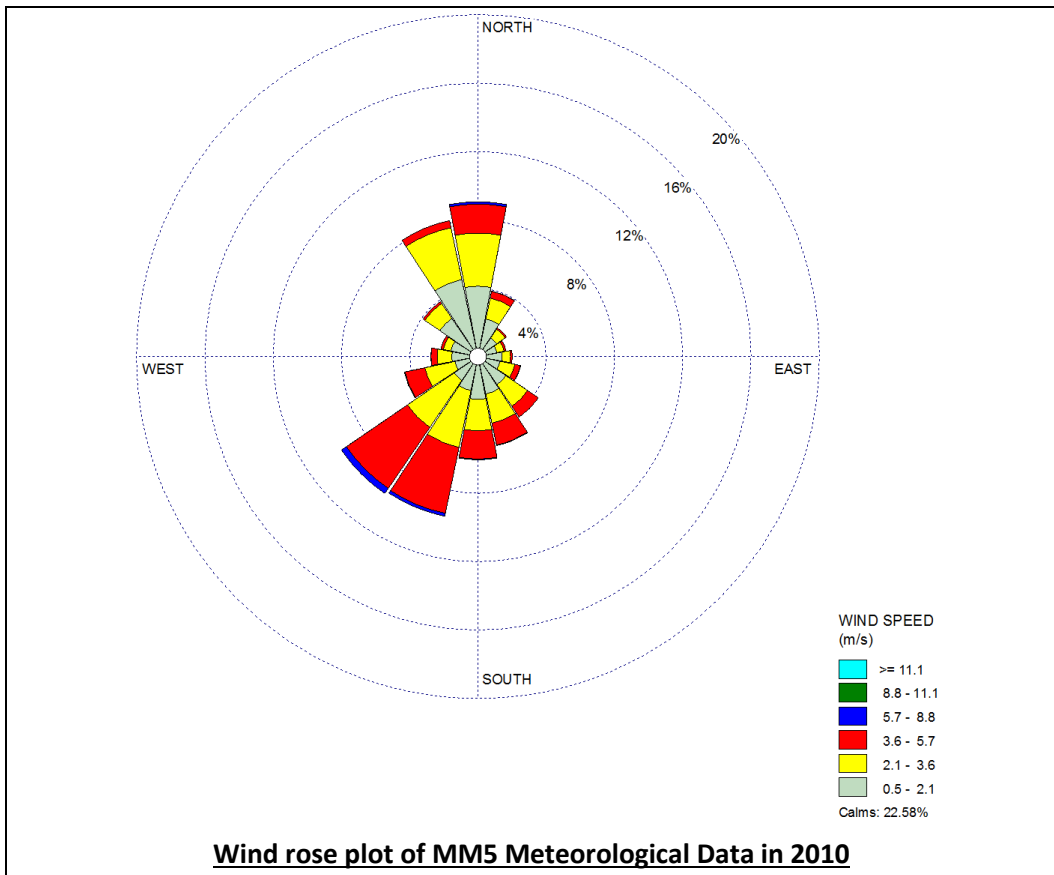
(3) MM5 is the Fifth-generation NCAR / Penn State Mesoscale Model which is the latest in a series that developed from a mesoscale model.

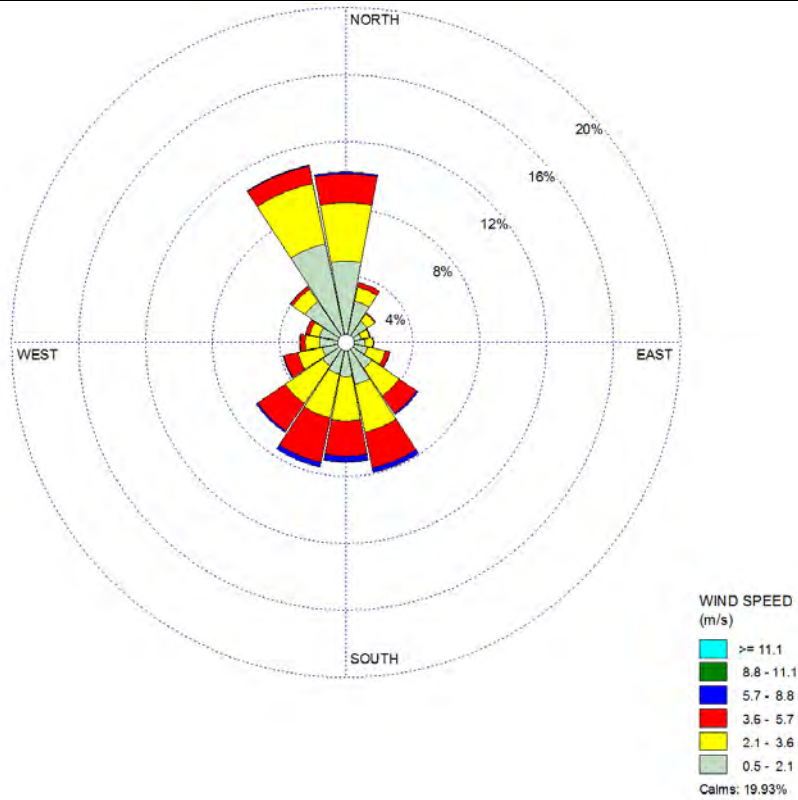
determine values assumed for the roughness length, Bowen ratio and Albedo. In view of the nature of the land use, it should be classified as cultivated land and its assumed values shown in **Table 7.8** are used for the meteorological data processing.

**Table 7.8** *Summary of Assumed Parameter Values for Meteorological Data Processing*

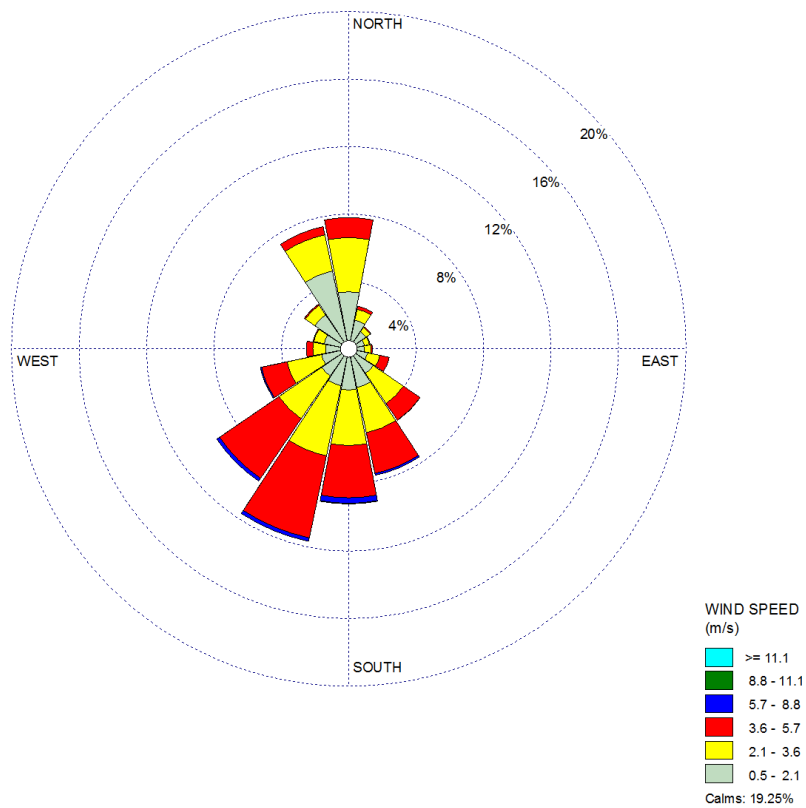
Parameter	Cultivated Land
Sector (0° as due North)	0° – 360°
Albedo	0.2
Bowen Ratio	0.3 (wet season) 1.5 (dry season)
Surface roughness length (m)	0.2

**Figure 7.3** *Wind roses of MM5 Meteorological Data for Year 2010 – 2014*

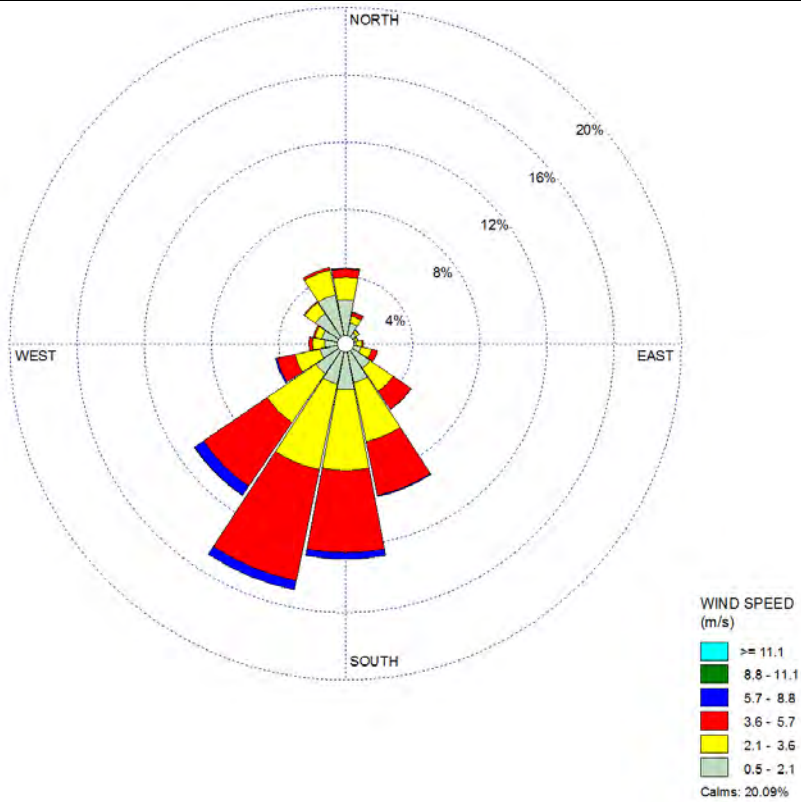




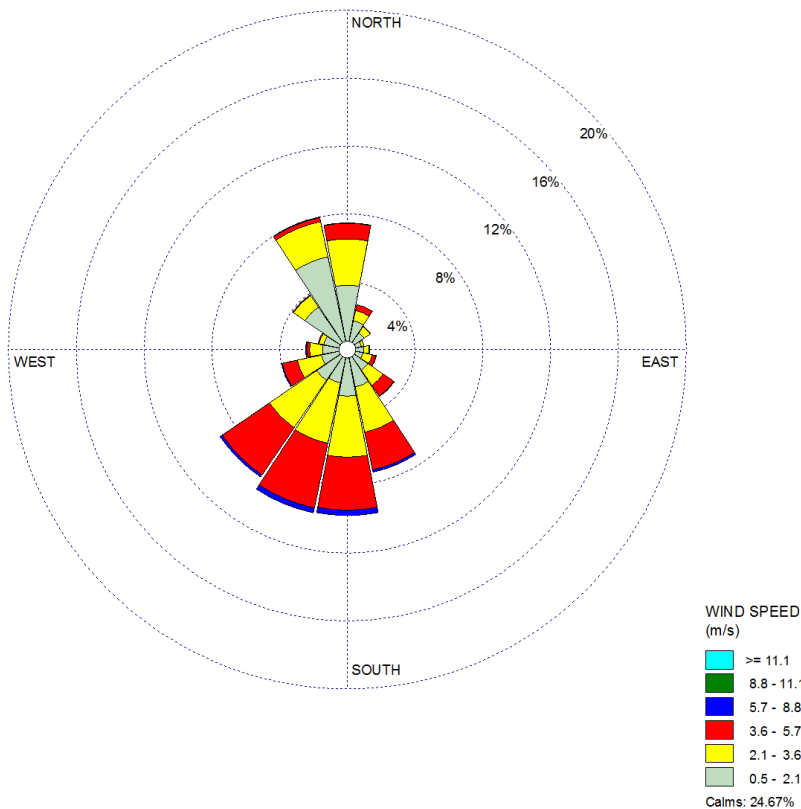
**Wind rose plot of MM5 Meteorological Data in 2011**



**Wind rose plot of MM5 Meteorological Data in 2012**



**Wind rose plot of MM5 Meteorological Data in 2013**



**Wind rose plot of MM5 Meteorological Data in 2014**

## Terrain

Local terrain data within 10km of the emission source were processed using AERMAP (version 11103) for input into AERMOD to model the effects of terrain features on the dispersion of air emissions from the Project.

## Building Downwash

Since nearby buildings and structures (e.g. administration building, warehouses) are less than 10m high while the stack height of the main stack and bypass stack is 40m and 30m, respectively, building downwash effects on plume dispersion would be minimal and have not been taken into account.

## Receptor Grid

A grid of 20km by 20km centred at the stack locations was used for predicting GLCs within this area. A grid spacing of 100m was chosen for the first 1km from the centre of the stack locations and a spacing of 500m was used for the next 9km away from the centre of the stack locations.

## Assessment of Air Quality Impacts

Impact from project contribution only and cumulative impacts (Project and general background) have been quantitatively assessed. Quantitative assessment for the emissions of these air pollutants during combined cycle operation and simple cycle operation has been conducted separately in two modelling scenarios, and the contributions of Project emissions at the representative ASRs were predicted. The maximum GLCs of the air pollutants at the ASRs were predicted for each of the five recent years (2010 to 2014). The overall maximum predicted GLCs at the ASRs within these five years were presented. For assessment of cumulative impacts, general background concentrations of the air pollutants, as presented in **Table 7.4**, were added to the maximum predicted GLCs at the ASRs.

### **7.8.3**

#### ***Assessment Criteria for Quantitative Assessment***

In jurisdictions that do not have an agreed approach to assess the magnitude of the impact, the most commonly used approach is that based upon guidance from the IFC and Asian Development Bank (ADB) Safeguards Policy Statement 2009, which is typically used in projects seeking IFC, ADB or external funding and follows the Equator Principles. This approach, which in general conforms with guidelines for projects located in non-degraded or degraded airsheds as stated in IFC's *Environmental, Health and Safety Guidelines: Air Emissions and Ambient Air Quality* and IFC's *Environmental, Health and Safety Guidelines: Thermal Power Plants*, is outlined in **Table 7.9**. On the basis of the project contribution (PC), predicted environmental concentration (PEC) and the air quality standard (AQS), the magnitude is determined. This is then combined with the sensitivity of the receptor to determine the impact significance using the standard impact assessment methodology. As explained in **Section 7.4**, relevant WHO guidelines have been adopted as the AQS for this Project and are presented in **Table 7.10**.

**Table 7.9 Determination of Impact Magnitude based upon IFC Method**

Magnitude of Impact	Non Degraded Airshed (Baseline < AQS)	Degraded Airshed (Baseline > AQS)
Negligible	PC < 25% of AQS	PC < 10% of AQS
Small	PC>25% of AQS, <50% of AQS, and PEC<100% of AQS	PC>10% of AQS, <15% of AQS
Medium	PC>25% of AQS, <50% of AQS, and PEC>100% of AQS; or PC>50% of AQS, <100% of AQS, and PEC<100% of AQS	PC>15% of AQS, <25% of AQS
Large	PC>100% of AQS	PC<25% of AQS

**Note:**

- (a) The impact magnitude table is referenced from Annex B-7 (Air Quality Impacts) of *The ERM Impact Assessment Standard*. *The ERM Impact Assessment Standard* has been developed with reference to IFC Guidelines and includes key guiding principles and best practices for assessing environmental impacts of projects. It is applied to environmental impact assessment projects including ESIA.

**Table 7.10 Relevant WHO Guidelines Adopted as Air Quality Standards for this Project**

Pollutant	Averaging Period (mean)	Guidance Value in µg/m <sup>3</sup>
Sulphur dioxide (SO <sub>2</sub> )	24-hour	125 (Interim target-1)
	10 minute	500 (guideline)
Nitrogen dioxide (NO <sub>2</sub> )	1-year	40 (guideline)
	1-hour	200 (guideline)
Particulate Matter PM <sub>10</sub>	1-year	70 (Interim target-1)
	24-hour	150 (Interim target-1)
Particulate Matter PM <sub>2.5</sub>	1-year	35 (Interim target-1)
	24-hour	75 (Interim target-1)

**7.9 ASSESSMENT OF IMPACTS**

**7.9.1 Construction Phase**

**Potential Impact**

The construction of the Project will last for about 22.5 months from notification to proceed. The construction of Project that may potentially generate air quality impacts involves site clearance, site formation and levelling, as well as construction of substructure and superstructure of the Power Plant facilities.

Site formation and levelling works will be required within the Project site where excavation, backfilling and stockpiling of materials will be carried out on site and there will be potential to cause fugitive dust impact. It is estimated that about 20,000m<sup>3</sup> of soil will be excavated and all excavated material will be backfilled with no surplus. The excavated materials suitable for backfilling will be temporarily stockpiled onsite. The Project site is more than 600m away from the nearest village, Sa Ka Village, to the northeast of the Project site.

Heavy cargo will be transported by barge from Thilawa Port in Yangon to Nyaung Hla Jetty on the Ayeyarwady River, and then from Nyaung Hla Jetty to the Project site by trucks and trailers.

Construction equipment (electric and diesel-powered) will be operating in different areas of the entire worksite area. Materials handling, trucks movements within the work sites, wind erosion of the open uncovered areas are the potential sources of fugitive dust emissions. Hoardings of minimum 2m height will be erected along the boundary of the Project site to suppress wind-blown dust. Furthermore, dust suppression measures and good site practices as mentioned below will be implemented to minimize the fugitive dust emission during the construction works.

The access roads within works areas will be watered and maintained wet all the time.

An onsite concrete batching plant (CBP) with a total production rate of 500m<sup>3</sup> per day will be located within the Project site. The operation time will be 12 hours per day throughout the construction period. The CBP has the potential to generate dust emissions to ASRs. The nearest identified ASR, the Sa Ka Village, is more than 600m away.

### **Potential Consequence**

Fugitive dust impact is localized within about 100m area due to relatively large particle size of fugitive dust. The nearest ASR, the Sa Ka Village located to the northeast of the Project site, is more than 600m away from the Project site boundary. This large separation distance would provide sufficient setback for protecting Sa Ka Village (ASR 4) from any potential construction dust impacts. During the construction period, dust suppression measures and good site practices as described below will be implemented. With the implementation of the dust suppression measures and good site practices mentioned below as well as the provision of sufficient setback and site hoardings, the fugitive dust impact on the ASRs is anticipated to be minor and transient.

Dust suppression measures described below will be in-place during the operation of the CBP. Also, the CBP will be located at least 600m away from the air sensitive receptors and the CBP will only be operated during the construction phase, therefore, the dust impact from emission of the CBP is expected to be minor and short term.

With the implementation of recommended mitigation measures described below, the air quality impact arising from the fugitive dust emissions from site clearance, site formation and levelling works during the construction phase would be minimal.

### **Existing and / or In-place Controls**

The following dust suppression measures and good site practices are recommended for the construction phase and taken into account when assessing the significance of potential impacts:

- Erection of minimum 2m high site hoardings around the site boundary;
- Water spraying of or covering all exposed areas and stockpiles;
- Specifying transport networks and locating stockpiles as far away from the site boundary which is close to the air sensitive receptors, as practicable to minimize the impact of air pollutants and dust;

- Minimizing the size of exposed areas and material stockpiles and the periods of their existence;
- Temporary stockpiles of dusty materials will be either covered entirely by impervious sheets or sprayed with water to maintain the entire surface wet all the time;
- Covering the construction materials transported by trucks or vehicles entirely to prevent dust emissions;
- Cleaning wheels and the lower body parts of trucks at all exits of the construction site;
- Cleaning the entire construction work sites at least once per week;
- Controlling the height of unloading the fill materials during filling as far as possible. Where possible, this should be well below the height of the hoardings along the Project site boundary;
- Watering the main haul road regularly to suppress dust emissions during truck movement;
- Prohibiting the burning of waste or vegetation on site;
- Compacting the reclaimed land immediately to avoid fugitive dust emissions;
- Maintaining and checking the construction equipment regularly;
- Switching off engines when idling; and
- Using ultra-low sulphur diesel for trucks and diesel-fuelled construction equipment if available.

In particular for concrete batching plant, the following air suppression measures will be implemented:

- Using grid electricity for the operation of the CBP to minimize the potential air emissions from diesel burning;
- Equipping all vent exhausts with dust suppression measures such as dust filter or scrubber, etc., to reduce dust emissions as much as possible;
- Carrying out in such a manner that dust emissions will be prevented or minimized during loading, unloading, handling, transfer or storage of other raw materials which may generate airborne dust emissions such as crushed rock, sand, stone aggregates;
- Enclosing all receiving hoppers and belt conveyor systems totally;
- Storing all aggregates with a nominal size of less than or equal to 5 millimetres and cement in an enclosed area;
- Wetting all access roads and routes within the CBP; and
- Maintaining a high standard of housekeeping always. All spillages or deposits of materials on ground, support structures or roofs will be cleaned up promptly. Any dumping of materials in open areas will be prohibited.

### **Significance of Impact**

With the implementation of the recommended control measures (namely, the dust suppression measures and good site practices at the construction worksites and the CBP), the magnitude of the construction dust impact is considered to be small and short-term. The sensitivity for human health within the general population is considered as “medium” as the identified ASRs are residential. The overall impact

significance during the construction is considered **minor**. The impact assessment is summarised in **Table 7.11** below.

**Table 7.11 Assessment of Air Quality Impact during Construction of Project**

Impact	Fugitive dust emissions associated with the materials handling, wind erosion of open areas and truck movements on access roads within the construction worksites and operation of concrete batching plant; and Air emissions including NO <sub>2</sub> , SO <sub>2</sub> , PM <sub>10</sub> and PM <sub>2.5</sub> from construction equipment and trucks within the entire work areas.				
Impact Nature	Negative	Positive	Neutral		
	Impact on human health within the general population is negative.				
Impact Type	Direct	Indirect	Induced		
	Impact on human health within the general population is direct.				
Impact Duration	Temporary	Short-term	Long-term	Permanent	
	Impacts are considered short-term, as the construction will last for 22.5 months.				
Impact Extent	Local	Regional	International		
	Impacts on human health within the general population are expected to be local.				
Impact Scale	The fugitive dust impacts are expected to be limited, localized (within 100m from the worksite boundary) and short-term (i.e., throughout the construction period of 22.5 months).				
	The air quality impacts are expected to be small provided that all mitigation measures and good site practices are implemented.				
Frequency	Throughout the construction period.				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
	Impact magnitude is considered to be small as the fugitive dust impact will be reduced as much as possible after the proper implementation of all in-place dust suppression measures and good site practice. There is also large separation distance between the Project site boundary and the air sensitive receptors.				
Receptor Sensitivity	Low	Medium	High		
	The receptor sensitivity is considered medium as the ASRs identified in the surrounding are residential type which is general population.				
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered to be <b>Minor</b> .				

### **Mitigation and / or Management Measures**

As the significance of the potential fugitive dust during the construction phase is assessed as minor and short-term, no additional mitigation/management measures are required.

### **Residual Impacts**

As the impact significance is minor and no additional mitigation measures are required, the residual impact remains **minor**.

### **Environmental Monitoring and Audit (EM&A) during the Construction Phase**

As the air quality impact during the construction phase of the Project is anticipated to be minor, monitoring of fugitive dust at the air sensitive receptors is considered not necessary. However, to ensure proper implementation of all recommended dust

suppression measures and good site practices, monthly site inspection is recommended throughout the construction period. Details on the EM&A programme should be referred to **Chapter 17**.

## 7.9.2

### Operation Phase

#### **Potential Impact**

Quantitative assessment has been conducted for stack emissions of NO<sub>2</sub>, SO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub> at the identified air sensitive receptors and the area within 10km from the centre of the stack locations following the assessment methodology described in **Section 7.8.2**. The highest predicted GLCs of NO<sub>2</sub>, SO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub> under different time averaging at the representative ASRs attributed to the Project during normal combined cycle operation and simple cycle operation are presented in **Table 7.12** and **Table 7.13**. For simple cycle operation, annual averaged results are not presented since simple cycle mode will only be carried out intermittently throughout the year. Detailed results for each assessment year are presented in **Annex E1**. The predicted NO<sub>2</sub>, SO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub> concentrations under different time averaging at the ASRs are small, with maximum project contribution at the ASRs about 11% of the relevant air quality standards.

**Table 7.12 Predicted Maximum Ground Level Concentrations at Representative Air Sensitive Receptors during Combined Cycle Operation (Project Only)**

ASR	Combined Cycle Mode (Main stacks S1 and S3 in operation)							
	Maximum Ground Level Concentration ( $\mu\text{g m}^{-3}$ )							
	1-hr NO <sub>2</sub> <sup>(a)</sup>	Annual NO <sub>2</sub> <sup>(a)</sup>	10-min SO <sub>2</sub> <sup>(b)</sup>	24-hr SO <sub>2</sub>	24-hr PM <sub>10</sub> <sup>(c)</sup>	Annual PM <sub>10</sub> <sup>(c)</sup>	24-hr PM <sub>2.5</sub> <sup>(c)</sup>	Annual PM <sub>2.5</sub> <sup>(c)</sup>
ASR1	8.80	0.54	0.86	0.08	0.08	0.02	0.08	0.02
ASR2	7.93	0.28	0.77	0.06	0.06	0.01	0.06	0.01
ASR3	10.65	0.54	1.04	0.09	0.09	0.02	0.09	0.02
ASR4	10.10	1.06	0.99	0.20	0.19	0.04	0.19	0.04
ASR5	6.75	0.19	0.66	0.04	0.04	0.01	0.04	0.01
ASR6	7.10	0.12	0.69	0.03	0.03	0.00	0.03	0.00
ASR7	7.81	0.31	0.76	0.06	0.06	0.01	0.06	0.01
ASR8	8.29	0.23	0.81	0.04	0.04	0.01	0.04	0.01
ASR9	7.77	0.30	0.76	0.05	0.05	0.01	0.05	0.01
ASR10	7.15	0.25	0.70	0.04	0.04	0.01	0.04	0.01
ASR11	7.22	0.27	0.70	0.05	0.05	0.01	0.05	0.01
ASR12	6.23	0.25	0.61	0.05	0.04	0.01	0.04	0.01
ASR13	6.93	0.31	0.68	0.06	0.06	0.01	0.06	0.01
ASR14	7.50	0.16	0.73	0.06	0.06	0.01	0.06	0.01
ASR15	7.72	0.17	0.75	0.04	0.04	0.01	0.04	0.01
ASR16	6.79	0.12	0.66	0.05	0.05	0.00	0.05	0.00
ASR17	6.48	0.11	0.63	0.05	0.05	0.00	0.05	0.00
ASR18	22.13	1.74	2.16	0.38	0.36	0.06	0.36	0.06
ASR19	10.51	0.79	1.03	0.12	0.11	0.03	0.11	0.03
<b>Assessment Criteria</b>	<b>200</b>	<b>40</b>	<b>500</b>	<b>125</b>	<b>150</b>	<b>70</b>	<b>75</b>	<b>35</b>
<b>Max % of Project contribution to criteria</b>	<b>11.07%</b>	<b>4.35%</b>	<b>0.43%</b>	<b>0.30%</b>	<b>0.24%</b>	<b>0.08%</b>	<b>0.49%</b>	<b>0.16%</b>

ASR	Combined Cycle Mode (Main stacks S1 and S3 in operation)							
	Maximum Ground Level Concentration ( $\mu\text{g m}^{-3}$ )							

**Notes:**

- (a) Reference to UK Air Quality Assessment Guidelines – short-term (1-hour)  $\text{NO}_2 = 50\%$  of  $\text{NO}_x$ ; long-term (annual)  $\text{NO}_2 = 100\%$  of  $\text{NO}_x$
- (b) A general factor of 1.43 is used to convert hourly  $\text{SO}_2$  results to 10-min results <sup>1</sup>
- (c) For conservative approach, emissions of  $\text{PM}_{10}$  and  $\text{PM}_{2.5}$  are assumed to be the same. Therefore, modelling results of  $\text{PM}_{10}$  and  $\text{PM}_{2.5}$  are identical.

**Table 7.13 Predicted Maximum Ground Level Concentrations at Representative Air Sensitive Receptors during Simple Cycle Operation (Project Only)**

ASR	Simple Cycle Mode (Main stacks S2 and S4 in operation)							
	Maximum Ground Level Concentration ( $\mu\text{g m}^{-3}$ )							
	1-hr $\text{NO}_2$ <sup>(a)</sup>	Annual $\text{NO}_2$ <sup>(a)(d)</sup>	10-min $\text{SO}_2$ <sup>(b)</sup>	24-hr $\text{SO}_2$	24-hr $\text{PM}_{10}$ <sup>(c)</sup>	Annual $\text{PM}_{10}$ <sup>(c) (d)</sup>	24-hr $\text{PM}_{2.5}$ <sup>(c)</sup>	Annual $\text{PM}_{2.5}$ <sup>(c) (d)</sup>
ASR1	2.32	-	0.23	0.03	0.03	-	0.03	-
ASR2	2.33	-	0.23	0.02	0.02	-	0.02	-
ASR3	3.06	-	0.30	0.03	0.03	-	0.03	-
ASR4	3.11	-	0.30	0.05	0.05	-	0.05	-
ASR5	2.04	-	0.20	0.02	0.02	-	0.02	-
ASR6	1.62	-	0.16	0.02	0.02	-	0.02	-
ASR7	2.23	-	0.22	0.02	0.02	-	0.02	-
ASR8	1.77	-	0.17	0.02	0.02	-	0.02	-
ASR9	1.99	-	0.19	0.02	0.02	-	0.02	-
ASR10	2.14	-	0.21	0.02	0.02	-	0.02	-
ASR11	2.60	-	0.25	0.03	0.02	-	0.02	-
ASR12	2.19	-	0.21	0.03	0.02	-	0.02	-
ASR13	2.83	-	0.28	0.02	0.02	-	0.02	-
ASR14	1.99	-	0.19	0.02	0.02	-	0.02	-
ASR15	1.99	-	0.19	0.02	0.02	-	0.02	-
ASR16	1.81	-	0.18	0.02	0.02	-	0.02	-
ASR17	1.70	-	0.17	0.02	0.02	-	0.02	-
ASR18	2.99	-	0.29	0.05	0.05	-	0.05	-
ASR19	2.87	-	0.28	0.05	0.04	-	0.04	-
<b>Assessment Criteria</b>	<b>200</b>	<b>40</b>	<b>500</b>	<b>125</b>	<b>150</b>	<b>70</b>	<b>75</b>	<b>35</b>
<b>Max % of Project contribution to criteria</b>	<b>1.56%</b>	<b>-</b>	<b>0.06%</b>	<b>0.04%</b>	<b>0.03%</b>	<b>-</b>	<b>0.07%</b>	<b>-</b>

**Notes:**

- (a) Reference to UK Air Quality Assessment Guidelines – short-term (1-hour)  $\text{NO}_2 = 50\%$  of  $\text{NO}_x$ ; long-term (annual)  $\text{NO}_2 = 100\%$  of  $\text{NO}_x$
- (b) A general factor of 1.43 is used to convert hourly  $\text{SO}_2$  results to 10-min results<sup>2</sup>
- (c) For conservative approach, emissions of  $\text{PM}_{10}$  and  $\text{PM}_{2.5}$  are assumed to be the same. Therefore, modelling results of  $\text{PM}_{10}$  and  $\text{PM}_{2.5}$  are identical.
- (d) Annual averaged results are not presented since simple cycle mode will only be operating intermittently throughout the year.

(1) Richard A. Duffee, Martha A. O'Brien and Ned Ostojic (1991) Odor Modeling - Why and How. Page 295, Recent Developments and Current Practices in Odor Regulations, Controls and Technology. Air & Waste Management Association, 1991

(2) Richard A. Duffee, Martha A. O'Brien and Ned Ostojic (1991) Odor Modeling - Why and How. Page 295, Recent Developments and Current Practices in Odor Regulations, Controls and Technology. Air & Waste Management Association, 1991

## **Potential Consequence**

For short-term and long-term impacts during normal combined cycle operation, it has been predicted that the project contribution for all pollutants at ASRs is low. Detailed results predicted in 2010 to 2014 and **Table 7.12** show that the project contribution from different air pollutants at ASRs under normal combined cycle operation was predicted to be well below their respective air quality standards. The highest project contribution to air quality standards at the ASRs is about 11% (1-hour averaged NO<sub>2</sub>). Contour plots of maximum 1-hour averaged and annual averaged NO<sub>2</sub> concentrations at ground level for different years under normal combined cycle operation are shown in **Figure 7.4** to **Figure 7.13**.

Figure 7.4 Predicted Maximum Ground Level 1-hour Average NO<sub>2</sub> Concentrations during Combined Cycle Operation (Project Only) in 2010

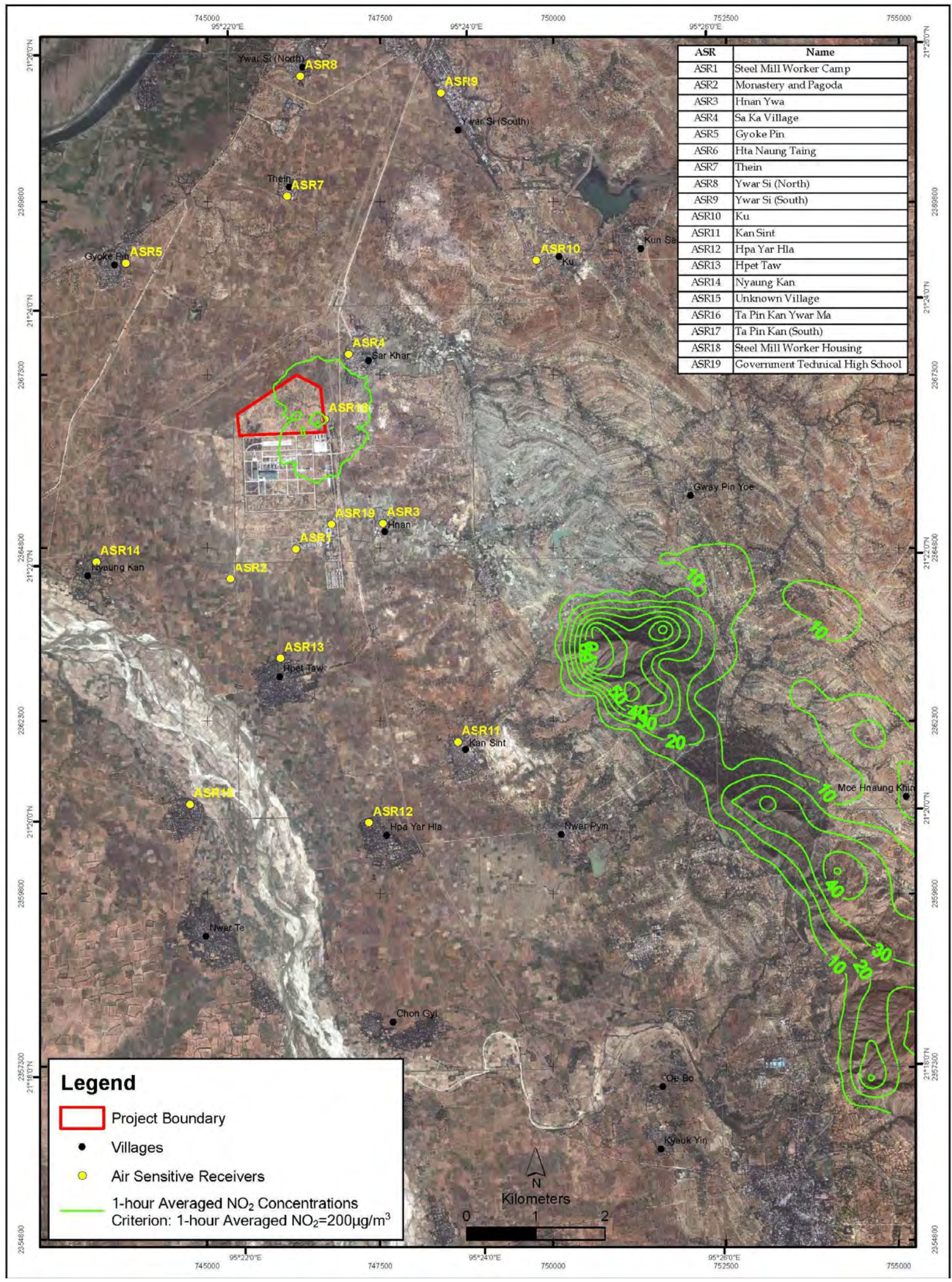


Figure 7.5 Predicted Maximum Ground Level 1-hour Average NO<sub>2</sub> Concentrations during Combined Cycle Operation (Project Only) in 2011

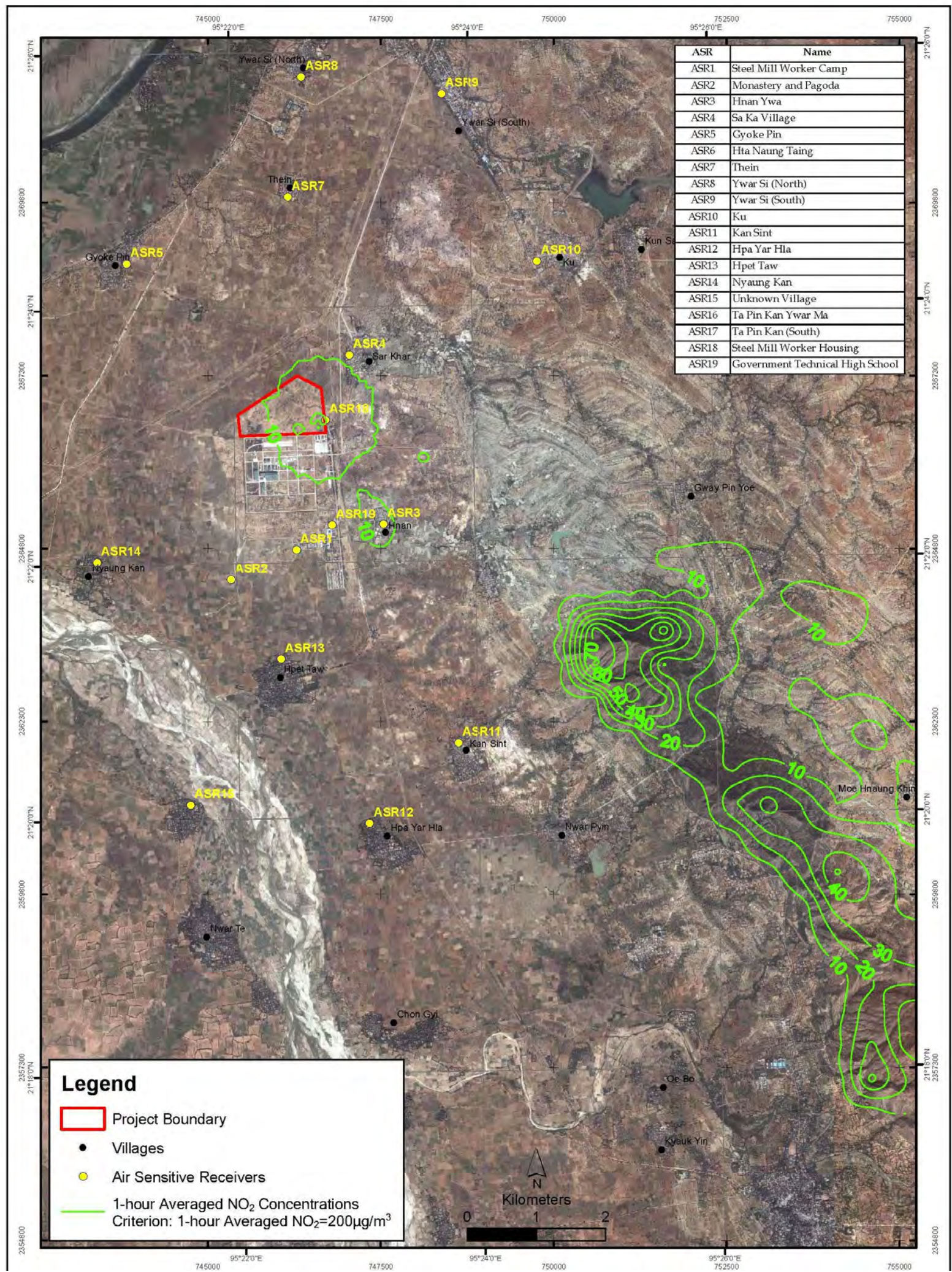


Figure 7.6 Predicted Maximum Ground Level 1-hour Average NO<sub>2</sub> Concentrations during Combined Cycle Operation (Project Only) in 2012

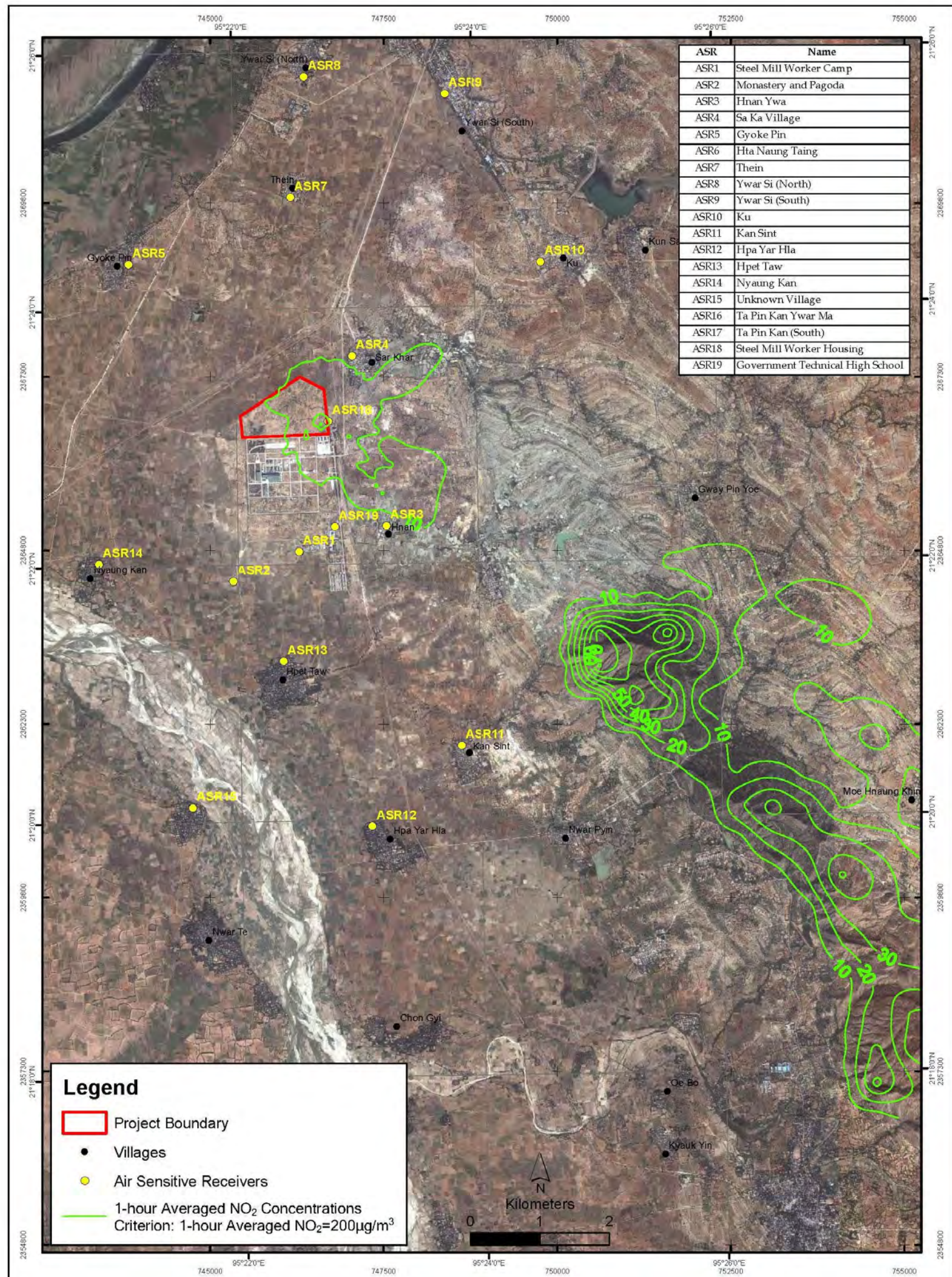


Figure 7.7 Predicted Maximum Ground Level 1-hour Average NO<sub>2</sub> Concentrations during Combined Cycle Operation (Project Only) in 2013

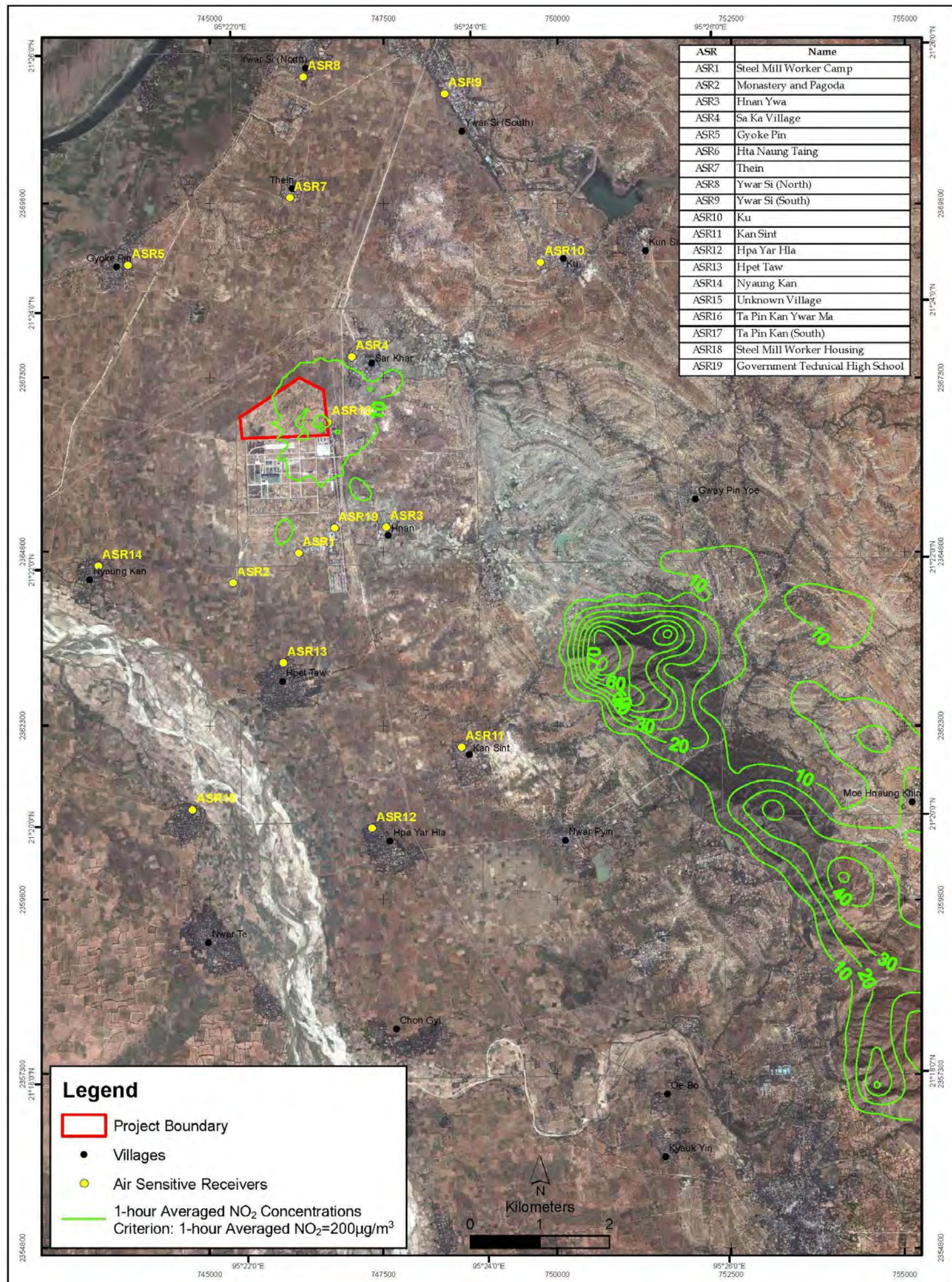


Figure 7.8 Predicted Maximum Ground Level 1-hour Average NO<sub>2</sub> Concentrations during Combined Cycle Operation (Project Only) in 2014

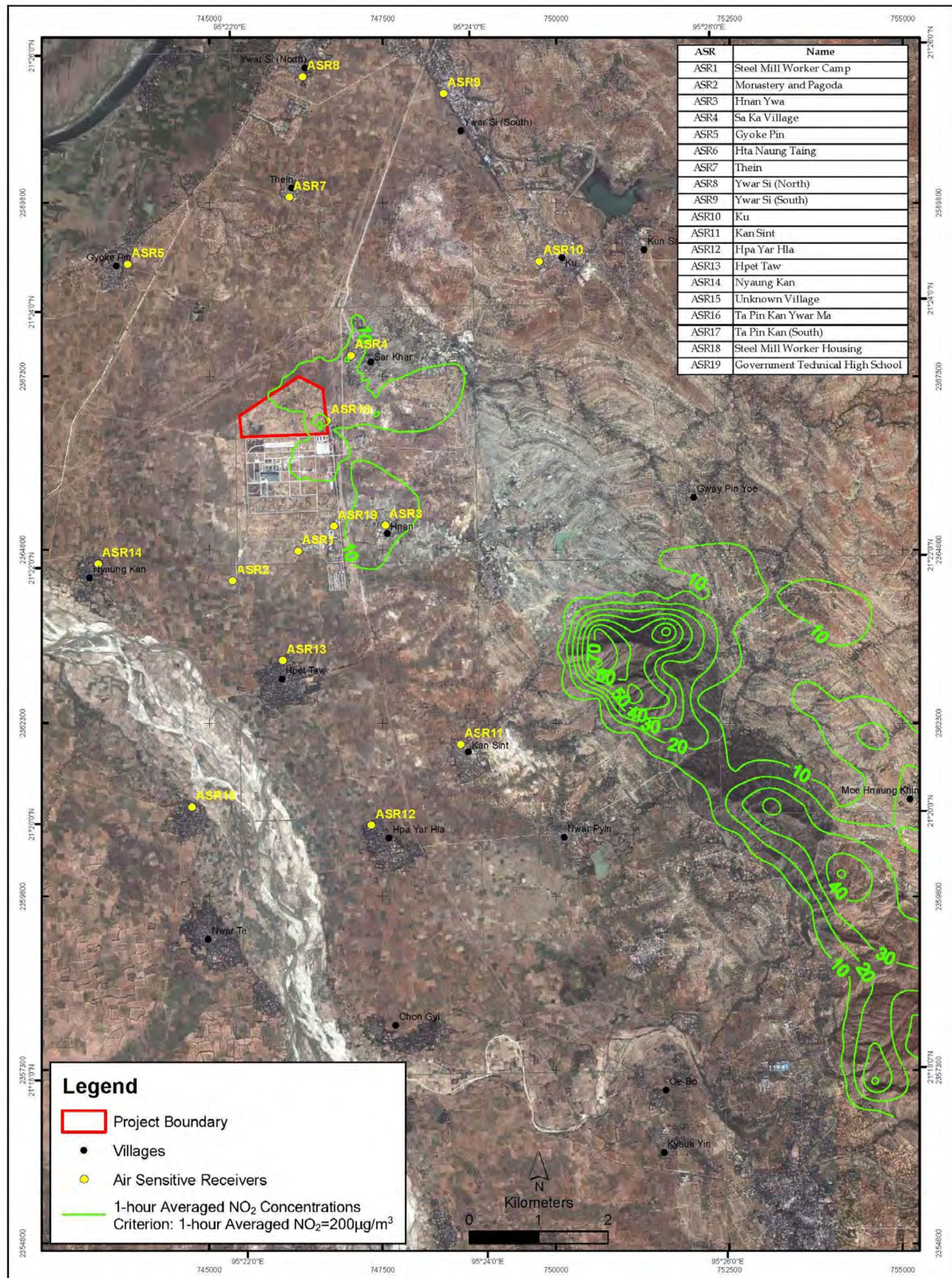


Figure 7.9 Predicted Maximum Ground Level Annual Average NO<sub>2</sub> Concentrations during Combined Cycle Operation (Project Only) in 2010

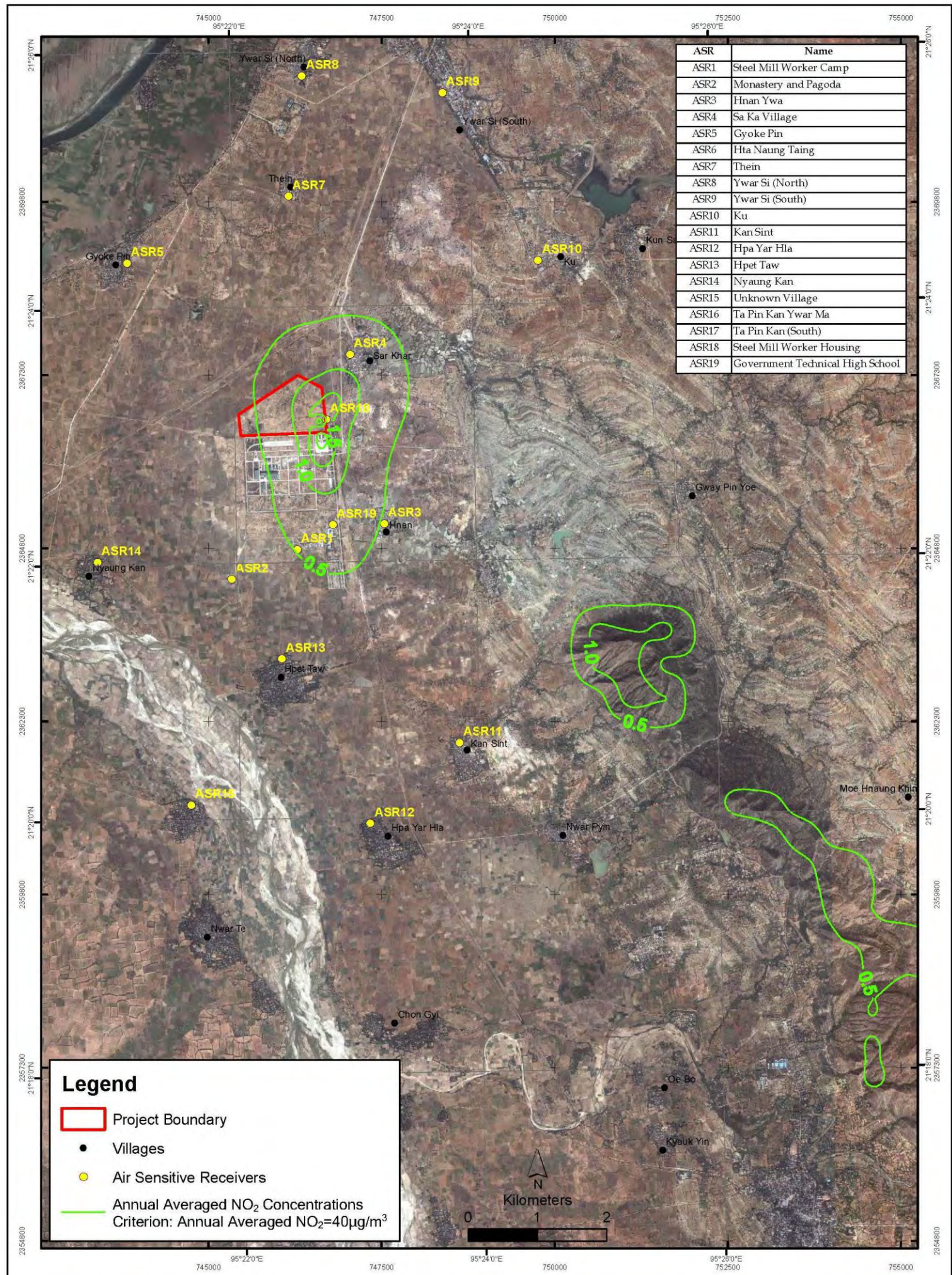


Figure 7.10 Predicted Maximum Ground Level Annual Average NO<sub>2</sub> Concentrations during Combined Cycle Operation (Project Only) in 2011

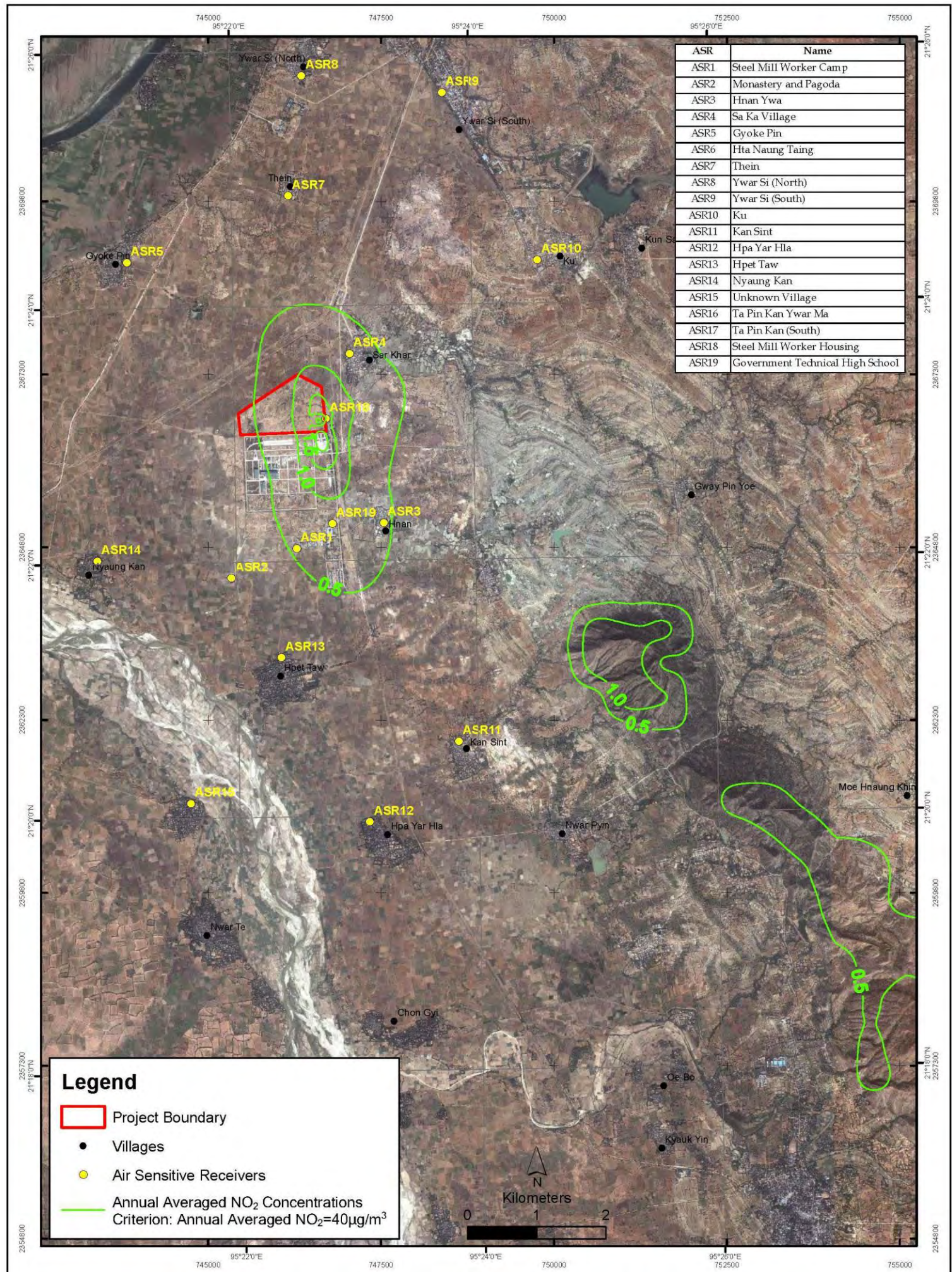


Figure 7.11 Predicted Maximum Ground Level Annual Average NO<sub>2</sub> Concentrations during Combined Cycle Operation (Project Only) in 2012

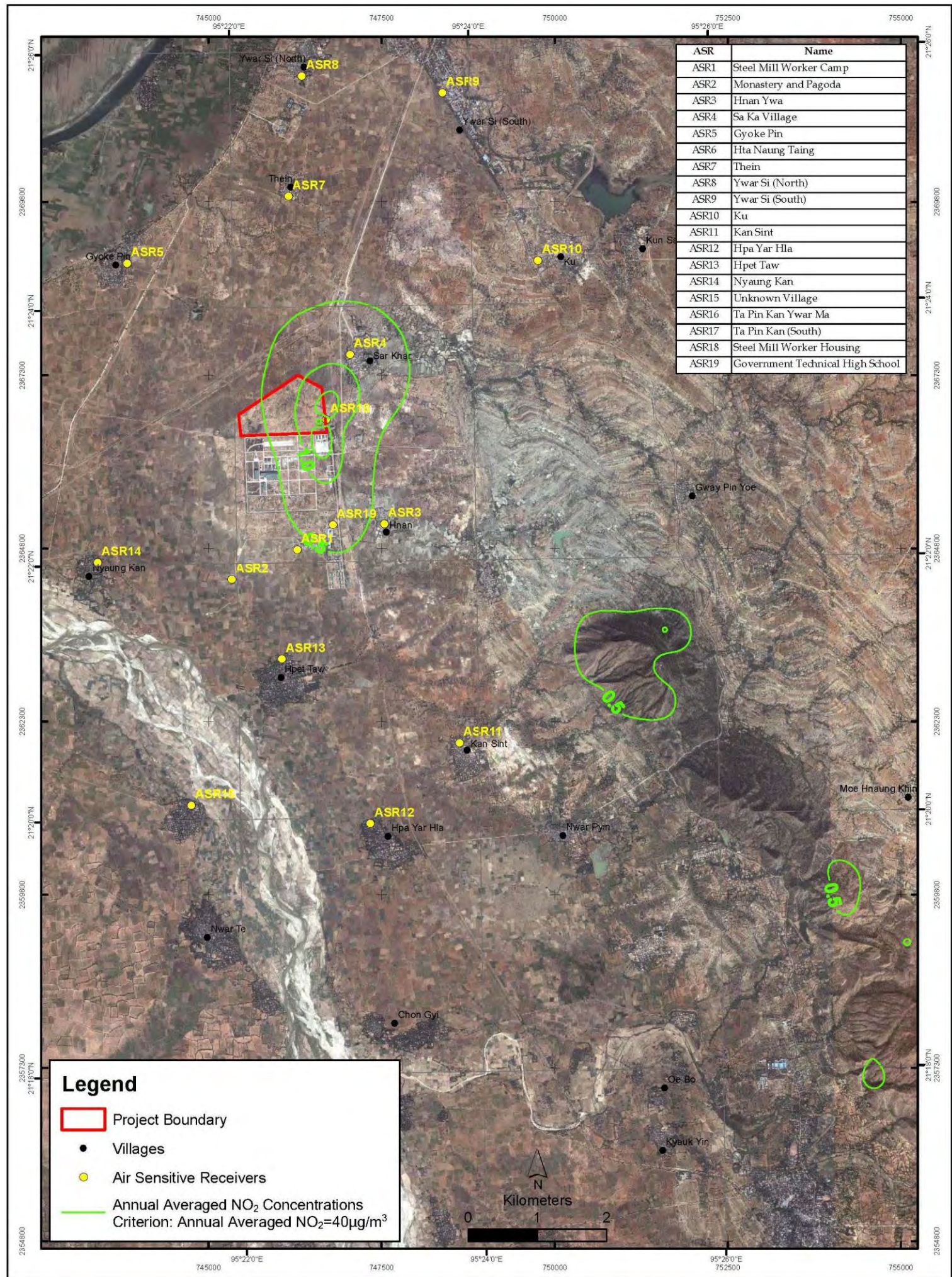


Figure 7.12 Predicted Maximum Ground Level Annual Average NO<sub>2</sub> Concentrations during Combined Cycle Operation (Project Only) in 2013

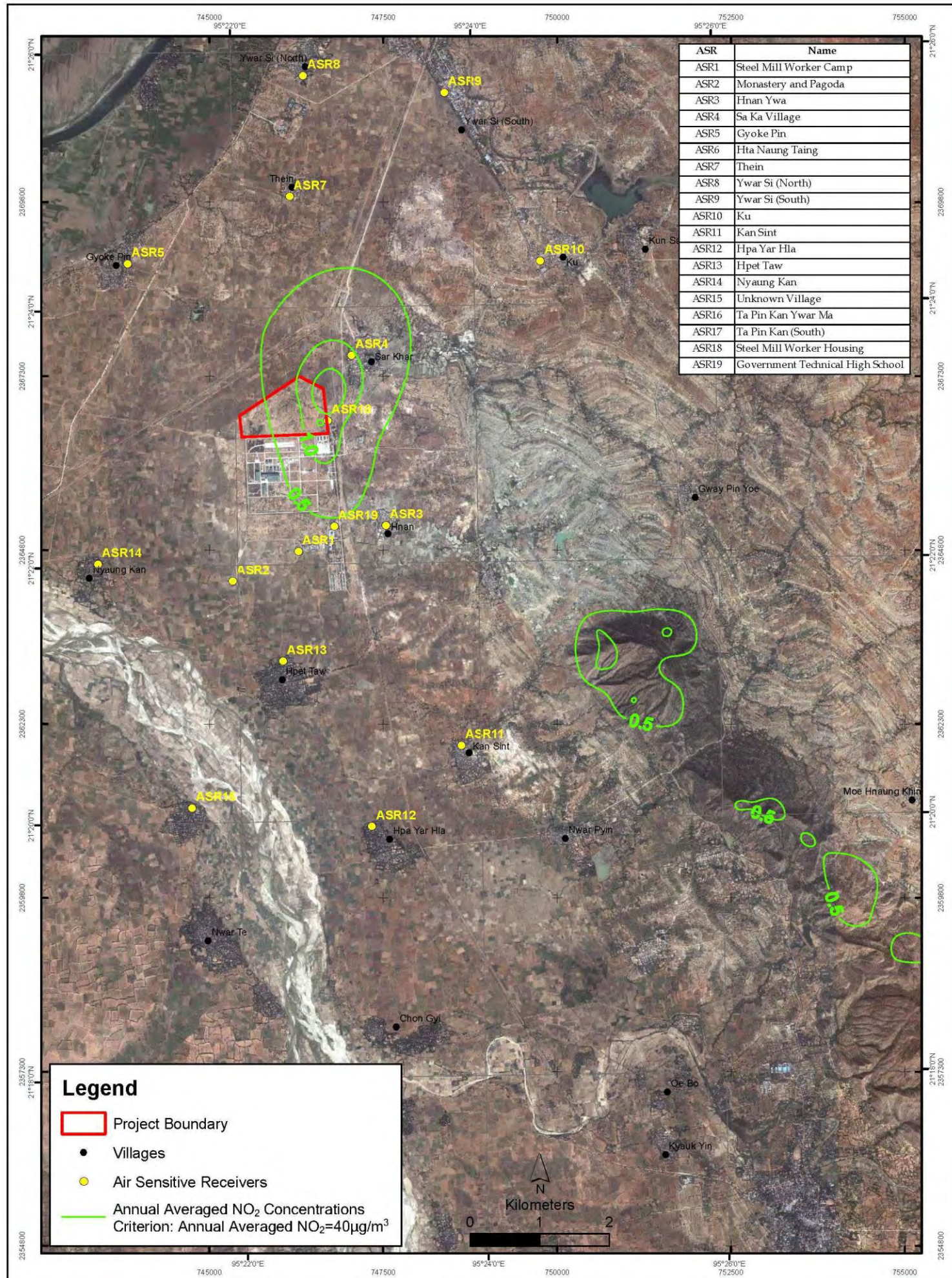
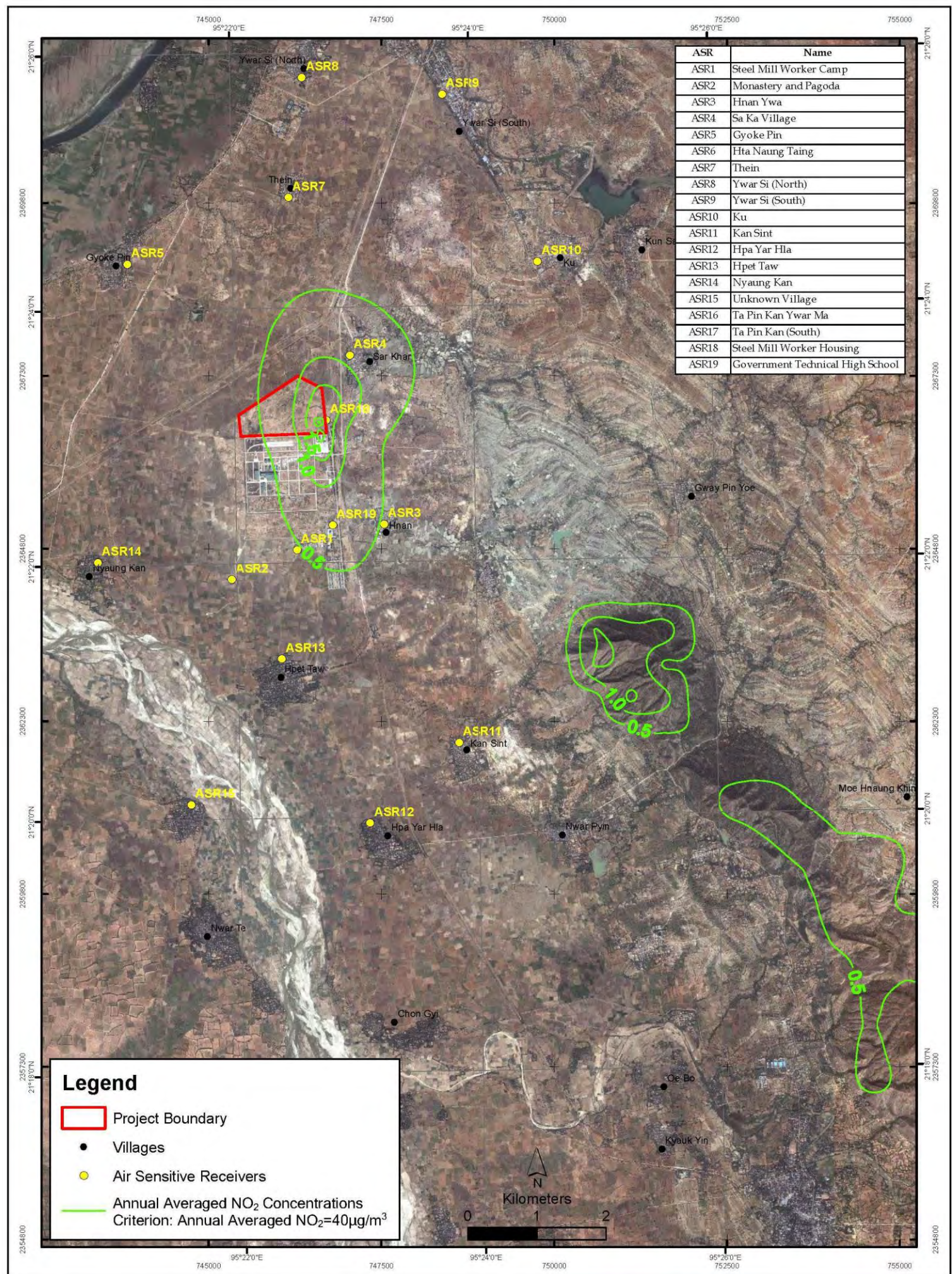


Figure 7.13 Predicted Maximum Ground Level Annual Average NO<sub>2</sub> Concentrations during Combined Cycle Operation (Project Only) in 2014



Similarly, for short-term impact during simple cycle operation, it has been predicted that the project contribution for all pollutants at ASRs is also low. Detailed results predicted in 2010 to 2014 and **Table 7.13** show that the project contribution from different air pollutants at ASRs under simple cycle operation was predicted to be well below their respective air quality standards. The highest project contribution to air quality standards at the ASRs is about 1.6% (1-hour averaged NO<sub>2</sub>). Contour plots of maximum 1-hour averaged NO<sub>2</sub> concentrations at ground level for different years under simple cycle operation are shown in **Figure 7.14** to **Figure 7.18**.

As presented in **Table 7.4**, the background NO<sub>2</sub> level at the Project site area has exceeded the air quality standard for annual NO<sub>2</sub> and the airshed within which the Project site is located should be considered degraded. Modelling results show that pollutant concentrations at ASRs contributed by normal combined cycle operation or simple cycle operation of the Project are predicted to be low, with maximum contribution of about 11% of the relevant air quality standards. Therefore, following the criteria for defining magnitude of impact for degraded airshed in **Table 7.9**, the impact magnitude is considered small.

#### **Existing and / or In-place Controls**

The following controls have been included in the stack design:

- Built-in dry low NO<sub>x</sub> burners to reduce NO<sub>x</sub> emission at stack to below 25ppm at all times.

#### **Significance of Impact**

The magnitude of impacts from the stack emissions at identified ASRs, during normal combined cycle operation or simple cycle operation, is considered small as the maximum project contribution is between 10% and 15% of relevant air quality standards for degraded airshed, following the criteria for defining magnitude of impact in **Table 7.9**.

Figure 7.14 Predicted Maximum Ground Level 1-hour Average NO<sub>2</sub> Concentrations during Simple Cycle Operation (Project Only) in 2010

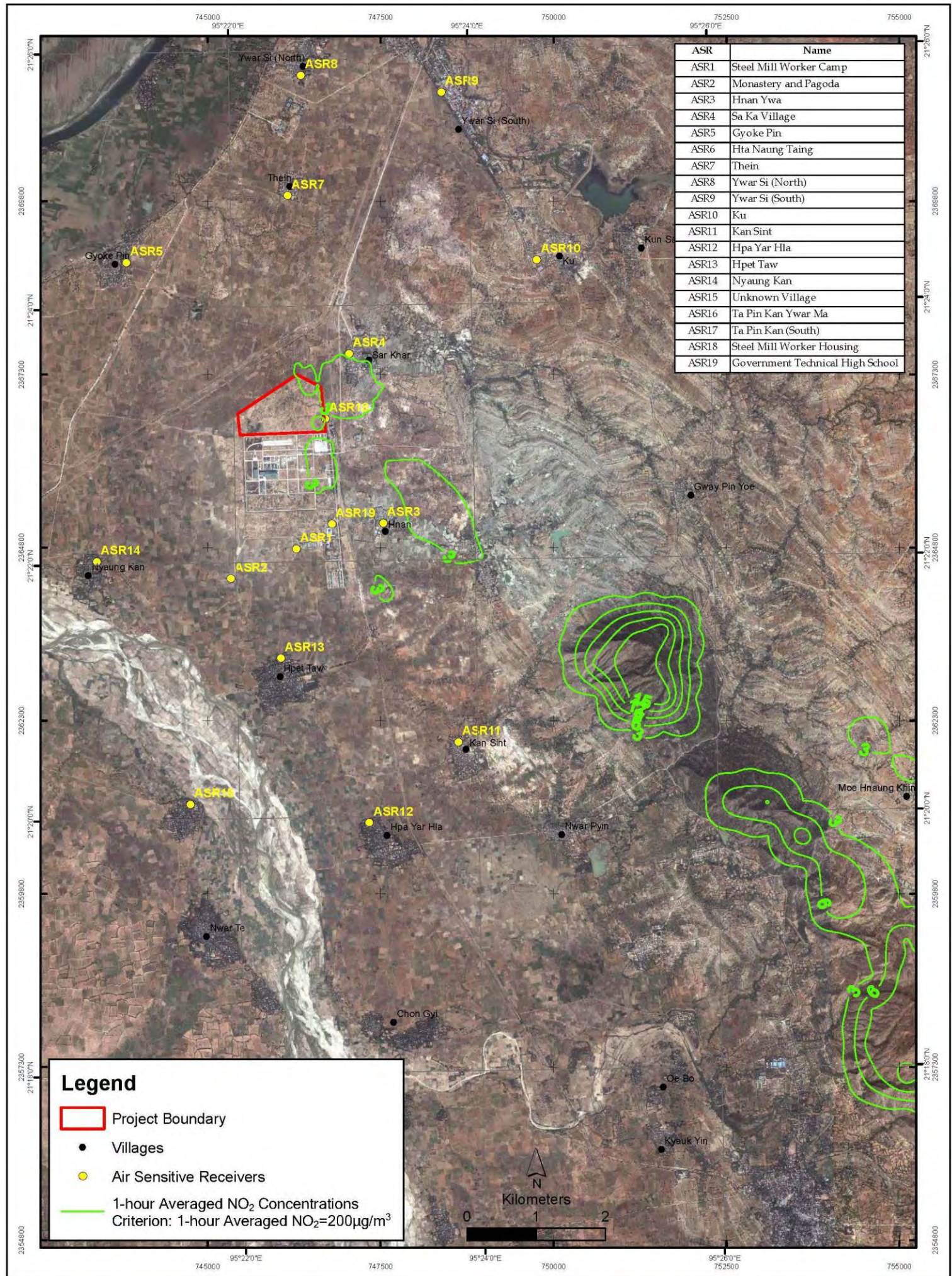


Figure 7.15 Predicted Maximum Ground Level 1-hour Average NO<sub>2</sub> Concentrations during Simple Cycle Operation (Project Only) in 2011

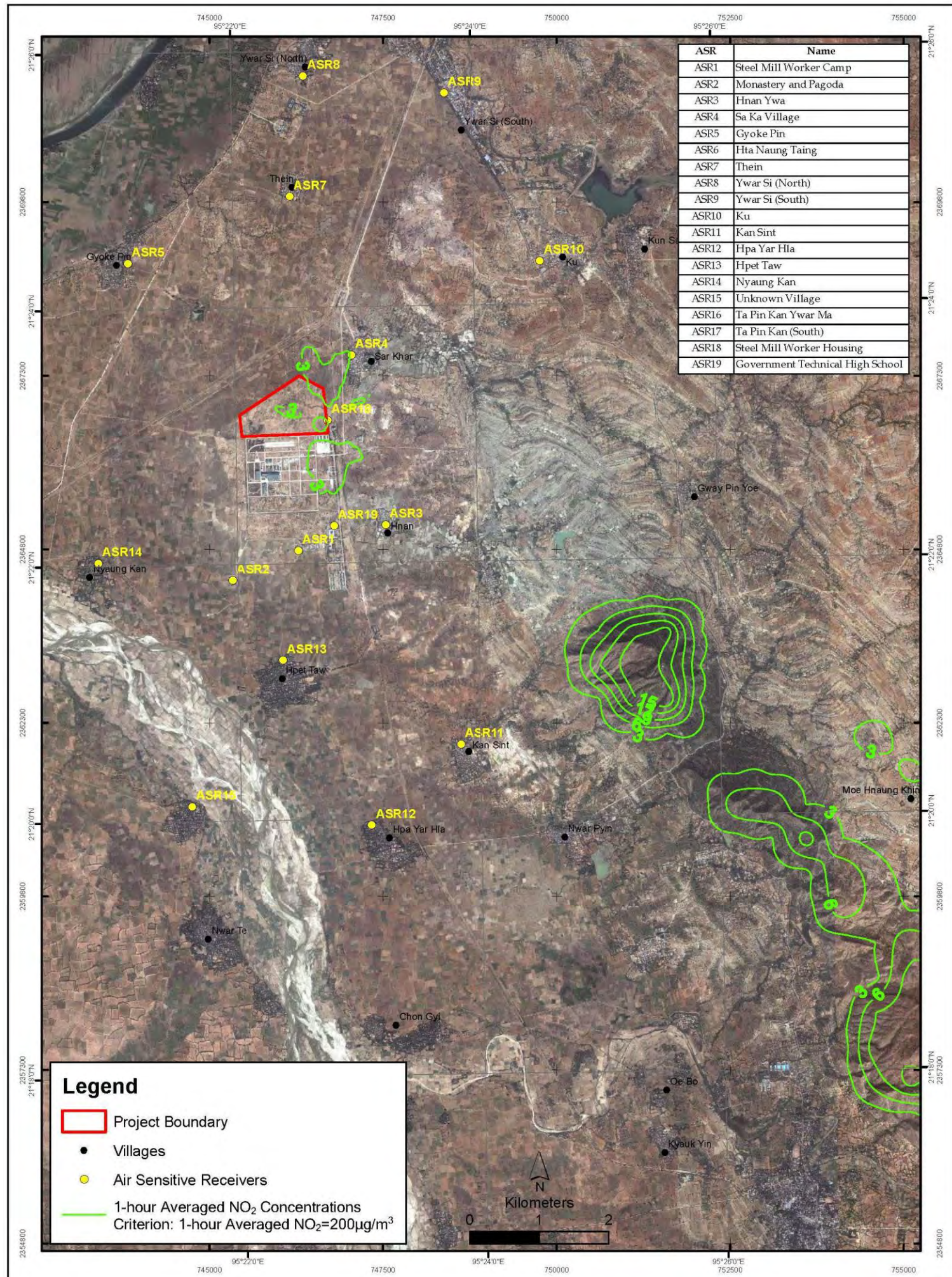


Figure 7.16 Predicted Maximum Ground Level 1-hour Average NO<sub>2</sub> Concentrations during Simple Cycle Operation (Project Only) in 2012

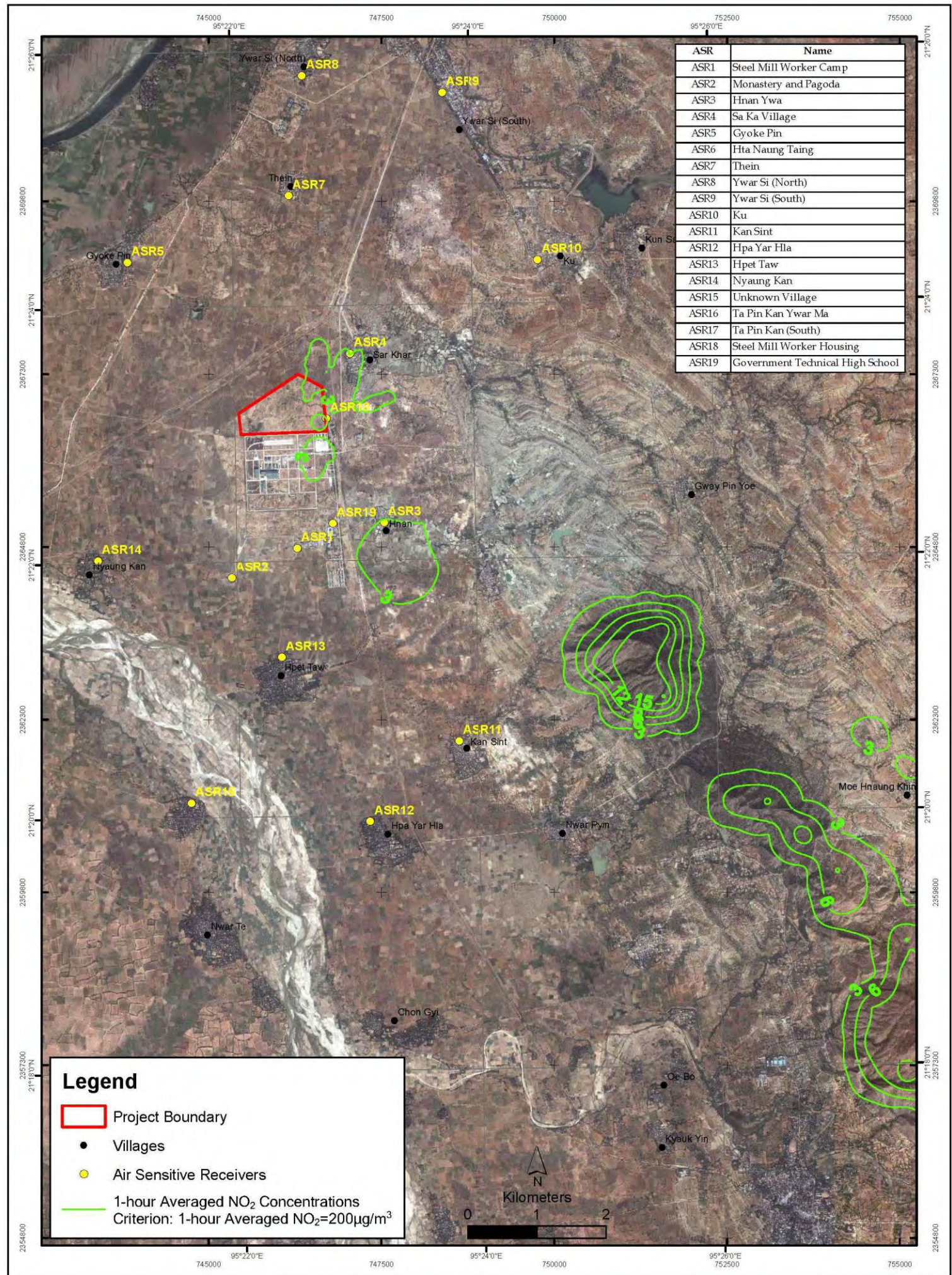


Figure 7.17 Predicted Maximum Ground Level 1-hour Average NO<sub>2</sub> Concentrations during Simple Cycle Operation (Project Only) in 2013

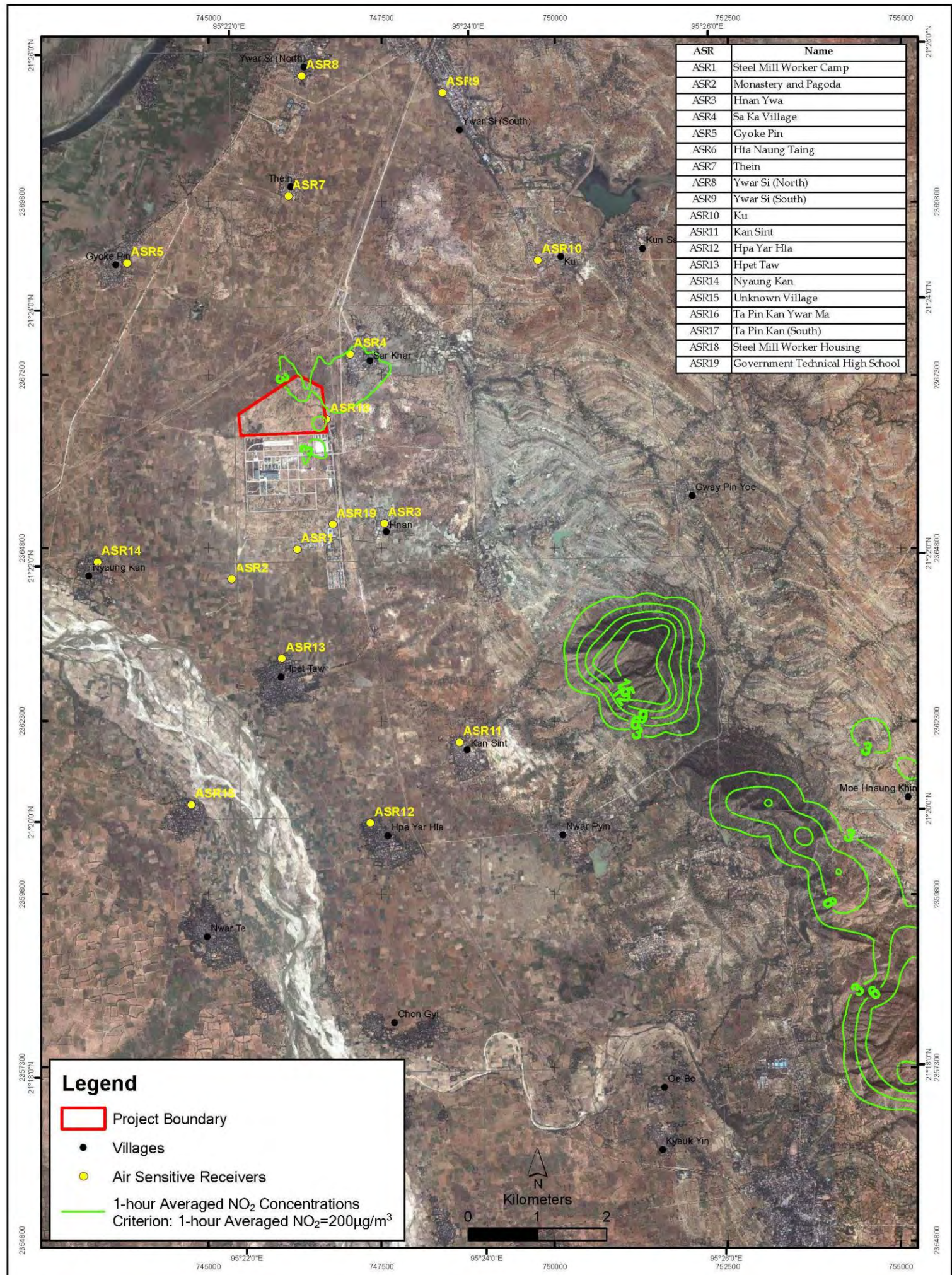
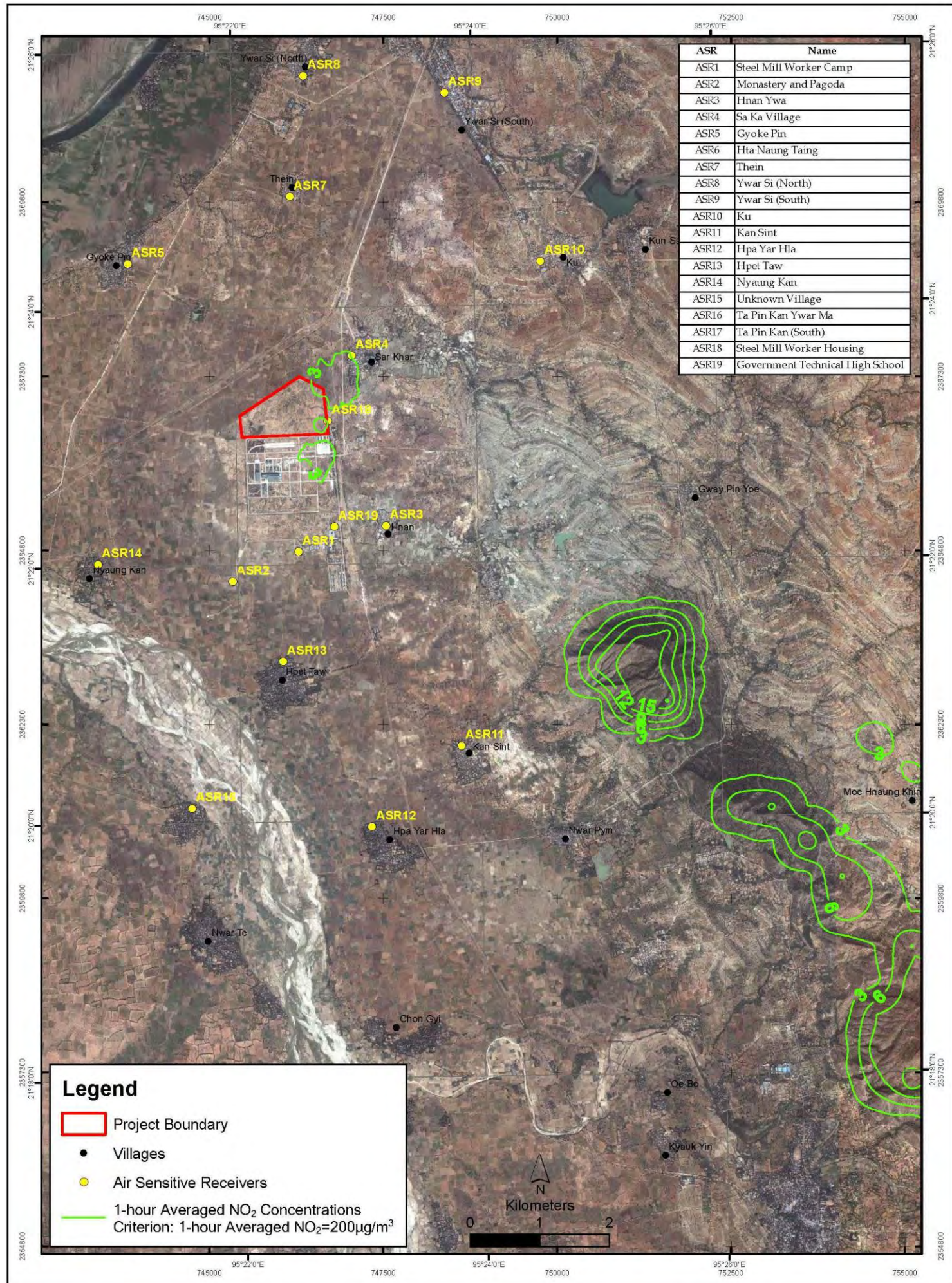


Figure 7.18 Predicted Maximum Ground Level 1-hour Average NO<sub>2</sub> Concentrations during Simple Cycle Operation (Project Only) in 2014



As the sensitivity for human health within the general population is “medium”, the overall significance of impact from the operation of the Project at identified ASRs is considered **minor**. The impact assessment is summarised in **Table 7.14** below.

**Table 7.14 Assessment of Air Quality Impacts from Stack Emission at Identified Air Sensitive Receptors**

Impact	Stack emissions potentially affecting the identified Air Sensitive Receptors				
Impact Nature	Negative	Positive	Neutral		
	Impact on human health within the general population is negative.				
Impact Type	Direct	Indirect	Induced		
	Impact on health within the general population is direct.				
Impact Duration	Temporary	Short-term	Long-term	Permanent	
	Impacts are considered long-term, as the impacts will occur throughout the operation of the power plant.				
Impact Extent	Local	Regional	International		
	Impacts on human health are mostly expected to be local within 10 km.				
Impact Scale	The scale of the impact is estimated to be the area within 10 km area from the power plant boundary.				
Frequency	Throughout the operation period of power plant.				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
	Impact magnitude is considered small as the project contribution within the degraded airshed is between 10% and 15% of the relevant air quality standards at the identified ASRs.				
Receptor Sensitivity	Low	Medium	High		
	The receptor sensitivity is considered as medium as the ASRs identified in the surrounding are generally population.				
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered to be <b>Minor</b> .				

### 7.9.3 Cumulative Impacts

#### Potential Impact

As noted in **Section 7.8.2**, the assessment of cumulative impact includes air quality impacts attributed to the operation of the Project and the general background air quality in the Project site area. Therefore, the cumulative NO<sub>2</sub>, SO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub> impacts are assessed based on the following equation:

$$\text{Cumulative results (NO}_2 \text{ or SO}_2 \text{ or PM}_{10} \text{ or PM}_{2.5}) = \text{Average background air pollutant concentrations (as presented in Table 7.4) + predicted maximum GLCs (as presented in Table 7.13 and Table 7.14 for combined cycle operation and simple cycle operation, respectively).}$$

The highest cumulative results at the ASRs during combined cycle operation and simple cycle operation are presented in **Table 7.15** and **Table 7.16**, respectively. Detailed results for each assessment year are presented in **Annex E2**. For combined cycle operation, the cumulative maximum NO<sub>2</sub>, SO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub> concentrations under different time averaging at the ASRs comply with the respective air quality standards,

except for annual averaged NO<sub>2</sub>, which has exceeded the criterion of 40µgm<sup>-3</sup>. For simple cycle operation, the cumulative maximum NO<sub>2</sub>, SO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub> concentrations under different time averaging at the ASRs comply with the relevant air quality standards.

**Table 7.15 Cumulative Maximum Ground Level Concentrations at Representative Air Sensitive Receivers during Combined Cycle Operation**

ASR	Combined Cycle Mode (Main stacks S1 and S3 in operation)							
	Maximum Ground Level Concentration (µg m <sup>-3</sup> )							
	1-hr NO <sub>2</sub> <sup>(a)</sup>	Annual NO <sub>2</sub> <sup>(a)(e)</sup>	10-min SO <sub>2</sub> <sup>(b)</sup>	24-hr SO <sub>2</sub>	24-hr PM <sub>10</sub> <sup>(c)</sup>	Annual PM <sub>10</sub> <sup>(c)</sup>	24-hr PM <sub>2.5</sub> <sup>(c)</sup>	Annual PM <sub>2.5</sub> <sup>(c)</sup>
ASR1	62.8	54.5	7.0	6.2	43.4	43.3	26.8	26.7
ASR2	61.9	54.2	6.9	6.2	43.4	43.3	26.7	26.7
ASR3	64.6	54.5	7.2	6.2	43.4	43.3	26.8	26.7
ASR4	64.1	55.0	7.1	6.3	43.5	43.3	26.9	26.7
ASR5	60.7	54.2	6.8	6.2	43.3	43.3	26.7	26.7
ASR6	61.1	54.1	6.8	6.2	43.3	43.3	26.7	26.7
ASR7	61.8	54.3	6.9	6.2	43.4	43.3	26.7	26.7
ASR8	62.3	54.2	7.0	6.2	43.4	43.3	26.7	26.7
ASR9	61.7	54.3	6.9	6.2	43.4	43.3	26.7	26.7
ASR10	61.1	54.2	6.8	6.2	43.3	43.3	26.7	26.7
ASR11	61.2	54.2	6.9	6.2	43.4	43.3	26.7	26.7
ASR12	60.2	54.2	6.8	6.2	43.4	43.3	26.7	26.7
ASR13	60.9	54.3	6.8	6.2	43.4	43.3	26.7	26.7
ASR14	61.5	54.1	6.9	6.2	43.4	43.3	26.7	26.7
ASR15	61.7	54.1	6.9	6.2	43.3	43.3	26.7	26.7
ASR16	60.8	54.1	6.8	6.2	43.4	43.3	26.7	26.7
ASR17	60.4	54.1	6.8	6.2	43.4	43.3	26.7	26.7
ASR18	76.1	55.7	8.3	6.5	43.7	43.4	27.0	26.7
ASR19	64.5	54.8	7.2	6.3	43.4	43.3	26.8	26.7
<b>Background Concentration<sup>(d)</sup></b>	<b>54.0</b>	<b>54.0</b>	<b>6.2</b>	<b>6.2</b>	<b>43.3</b>	<b>43.3</b>	<b>26.7</b>	<b>26.7</b>
<b>Assessment Criteria</b>	<b>200</b>	<b>40</b>	<b>500</b>	<b>125</b>	<b>150</b>	<b>70</b>	<b>75</b>	<b>35</b>
<b>Max % of Cumulative Impact to criteria</b>	<b>38%</b>	<b>139%</b>	<b>2%</b>	<b>5%</b>	<b>29%</b>	<b>62%</b>	<b>36%</b>	<b>76%</b>

**Notes:**

- (a) Reference to UK Air Quality Assessment Guidelines – short-term (1-hour) NO<sub>2</sub> = 50% of NO<sub>x</sub>; long-term (annual) NO<sub>2</sub> = 100% of NO<sub>x</sub>
- (b) A general factor of 1.43 is used to convert hourly SO<sub>2</sub> results to 10-min results
- (c) For conservative approach, emissions of PM<sub>10</sub> and PM<sub>2.5</sub> are assumed to be the same. Therefore, modelling results of PM<sub>10</sub> and PM<sub>2.5</sub> are identical.
- (d) Average background pollutant concentrations presented in Table 7.4 have been included to assess cumulative impact.
- (e) Exceedance of air quality standard for cumulative annual NO<sub>2</sub> at ASRs due to high background NO<sub>2</sub> concentrations in the Project site area.

**Table 7.16 Cumulative Maximum Ground Level Concentrations at Representative Air Sensitive Receivers during Simple Cycle Operation**

ASR	Simple Cycle Mode (Main stacks S2 and S4 in operation)							
	Maximum Ground Level Concentration (µg m <sup>-3</sup> )							
	1-hr NO <sub>2</sub> <sup>(a)</sup>	Annual NO <sub>2</sub> <sup>(d)</sup>	10-min SO <sub>2</sub> <sup>(b)</sup>	24-hr SO <sub>2</sub>	24-hr PM <sub>10</sub> <sup>(c)</sup>	Annual PM <sub>10</sub> <sup>(c)(d)</sup>	24-hr PM <sub>2.5</sub> <sup>(c)</sup>	Annual PM <sub>2.5</sub> <sup>(c)(d)</sup>
ASR1	56.3	-	6.4	6.2	43.3	-	26.7	-
ASR2	56.3	-	6.4	6.2	43.3	-	26.7	-
ASR3	57.0	-	6.4	6.2	43.3	-	26.7	-

ASR	Simple Cycle Mode (Main stacks S2 and S4 in operation)							
	Maximum Ground Level Concentration ( $\mu\text{g m}^{-3}$ )							
	1-hr NO <sub>2</sub> <sup>(a)</sup>	Annual NO <sub>2</sub> <sup>(d)</sup>	10-min SO <sub>2</sub> <sup>(b)</sup>	24-hr SO <sub>2</sub>	24-hr PM <sub>10</sub> <sup>(c)</sup>	Annual PM <sub>10</sub> <sup>(c)(d)</sup>	24-hr PM <sub>2.5</sub> <sup>(c)</sup>	Annual PM <sub>2.5</sub> <sup>(c)(d)</sup>
ASR4	57.1	-	6.5	6.2	43.4	-	26.7	-
ASR5	56.0	-	6.3	6.2	43.3	-	26.7	-
ASR6	55.6	-	6.3	6.2	43.3	-	26.7	-
ASR7	56.2	-	6.4	6.2	43.3	-	26.7	-
ASR8	55.7	-	6.3	6.2	43.3	-	26.7	-
ASR9	56.0	-	6.3	6.2	43.3	-	26.7	-
ASR10	56.1	-	6.4	6.2	43.3	-	26.7	-
ASR11	56.6	-	6.4	6.2	43.3	-	26.7	-
ASR12	56.2	-	6.4	6.2	43.3	-	26.7	-
ASR13	56.8	-	6.4	6.2	43.3	-	26.7	-
ASR14	56.0	-	6.3	6.2	43.3	-	26.7	-
ASR15	56.0	-	6.3	6.2	43.3	-	26.7	-
ASR16	55.8	-	6.3	6.2	43.3	-	26.7	-
ASR17	55.7	-	6.3	6.2	43.3	-	26.7	-
ASR18	57.0	-	6.4	6.2	43.4	-	26.7	-
ASR19	56.8	-	6.4	6.2	43.4	-	26.7	-
<b>Background Concentration<sup>(e)</sup></b>	<b>54.0</b>	<b>-</b>	<b>6.2</b>	<b>6.2</b>	<b>43.3</b>	<b>-</b>	<b>26.7</b>	<b>-</b>
<b>Assessment Criteria</b>	<b>200</b>	<b>40</b>	<b>500</b>	<b>125</b>	<b>150</b>	<b>70</b>	<b>75</b>	<b>35</b>
<b>Max % of Cumulative Impact to criteria</b>	<b>29%</b>	<b>-</b>	<b>1%</b>	<b>5%</b>	<b>29%</b>	<b>-</b>	<b>36%</b>	<b>-</b>
<b>Notes:</b>								
<sup>(a)</sup> Reference to UK Air Quality Assessment Guidelines – short-term (1-hour) NO <sub>2</sub> = 50% of NO <sub>x</sub>								
<sup>(b)</sup> A general factor of 1.43 is used to convert hourly SO <sub>2</sub> results to 10-min results								
<sup>(c)</sup> For conservative approach, emissions of PM <sub>10</sub> and PM <sub>2.5</sub> are assumed to be the same. Therefore, modelling results of PM <sub>10</sub> and PM <sub>2.5</sub> are identical.								
<sup>(d)</sup> Annual averaged results are not presented since simple cycle mode will only be operating intermittently throughout the year.								
<sup>(e)</sup> Average background pollutant concentrations have been included to assess cumulative impact.								

### Potential Consequence

For combined cycle operation, the cumulative short-term and long-term impacts have been assessed. From **Table 7.15**, the cumulative NO<sub>2</sub>, SO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub> concentrations at the ASRs comply with the respective air quality standards, except for annual averaged NO<sub>2</sub> which has exceeded the annual criterion. However, it should be noted that, due to high NO<sub>2</sub> background concentration in the Project site area (54.0 $\mu\text{g m}^{-3}$ ), the annual NO<sub>2</sub> criterion has already been exceeded even without the presence of the Project. The maximum project contribution of annual averaged NO<sub>2</sub> concentration at ASRs is only about 4.4% of the annual criterion as presented in **Table 7.12**.

For simple cycle operation, only the cumulative short-term impacts (1-hour and 24-hour averaging time) have been assessed since simple cycle mode will only be operating intermittently throughout the year. From **Table 7.16**, the cumulative short-term impacts of NO<sub>2</sub>, SO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub> at the ASRs comply with the respective air quality standards.

Since the background NO<sub>2</sub> levels at the Project site area are relatively high and exceed the relevant annual NO<sub>2</sub> criterion, the Project site area should be considered as degraded airshed. As discussed in **Section 7.9.2** and following the criteria for defining magnitude of impact in **Table 7.9**, the magnitude of cumulative air quality impact is

considered small since the maximum project contribution at the ASRs is between 10% and 15% of the air quality standards for degraded airshed.

### Existing and / or In-place Controls

The embedded controls of the power plant have been described in **Section 7.9.2**.

### Significance of Impact

The magnitude of impacts from the operation of the Project and general background is considered small as the maximum project contribution at the ASRs is between 10% and 15% of the air quality standards for degraded airshed, following the criteria for defining magnitude of impact in **Table 7.9**.

As the sensitivity for human health within the general population is “medium”, the overall significance of impact arising from the operation of the Project and general background is considered **minor**. The impact assessment is summarised in **Table 7.17** below.

**Table 7.17 Assessment of Cumulative Air Quality Impacts from the Operation of the Project and General Background Air Quality**

Impact	Operation of the Project and general background air quality				
Impact Nature	Negative	Positive		Neutral	
	Impact on human health within the general population is negative.				
Impact Type	Direct	Indirect		Induced	
	Impact on health within the general population is direct.				
Impact Duration	Temporary	Short-term	Long-term	Permanent	
	Impacts are considered long-term, as the impacts will occur throughout the operation of the power plant.				
Impact Extent	Local	Regional		International	
	Impacts on human health are mostly expected to be within 10 km.				
Impact Scale	The scale of the impact is estimated to be the area within 10 km area from the power plant boundary.				
Frequency	Throughout the operation period of power plant.				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
	Impact magnitude is considered small as the project contribution is between 10% and 15% of the relevant air quality standards at the identified ASRs within degraded airshed.				
Receptor Sensitivity	Low		Medium	High	
	The receptor sensitivity is considered as medium as the ASRs identified in the surrounding are generally population.				
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered to be <b>Minor</b> .				

### Mitigation and / or Management Measures

As discussed in **Section 7.9.2**, the predicted maximum contribution of air pollutants at the ASRs arising from the operation of the Project is low, about 11% of the relevant air quality standards. Referring to **Table 7.9**, since the Project is located in degraded airshed and the maximum Project contribution is predicted to be between 10% and 15%

of the relevant air quality standards, the cumulative impact significance is also considered minor during the operation of the Project. No additional mitigation measure associated with the operation of the Project is therefore required.

It is recommended to include the stack design parameters and emission limits adopted in this assessment in the future EPC's contract as one of the contractual requirement.

### **Residual Impacts**

As the cumulative impact significance is considered minor and no additional mitigation measure is required, no residual impact arising from the operation of the Project is anticipated.

### **Environmental Monitoring and Audit during the Operational Phase**

It is proposed to carry out an environmental monitoring and audit programme, which includes the monitoring of the emission concentrations at the main stacks and bypass stacks, as well as ambient air quality monitoring at nearby air sensitive receptor. The proposed environmental monitoring programme is presented in **Table 7.18**.

**Table 7.18** *Environmental Monitoring Program for Stack Emissions and Ambient Air Quality at Air Sensitive Receptors during the Operation of the Project*

Aspect	Frequency	Sampling location	Parameters	Recommended Method
Stack emission	Continuous	Main stacks Bypass stacks	<ul style="list-style-type: none"> <li>NO<sub>x</sub> as NO<sub>2</sub>, PM, SO<sub>2</sub>, O<sub>2</sub>, moisture content</li> <li>Frequency: continuous and annually</li> </ul>	<ul style="list-style-type: none"> <li>Continuous Emission Monitoring System (CEMS)</li> <li>Annual stack emission test : following USEPA method or equivalent</li> </ul>
Ambient air quality	Monthly (year 1 – first 3 months of operation) Quarterly (year 1 – after first 3 months of operation) <sup>1</sup>	<ul style="list-style-type: none"> <li>One village house at Hnan Ywa village (ASR3)</li> <li>One village house at Sa Ka village (ASR4)</li> <li>One village house at Gyoke Pin village (ASR5)</li> <li>One village house at Nyaung Kan village (ASR14)</li> </ul>	<ul style="list-style-type: none"> <li>1-hour and 24-hour averaged NO<sub>2</sub> and SO<sub>2</sub></li> <li>24-hour averaged PM, PM<sub>10</sub> and PM<sub>2.5</sub></li> </ul>	<ul style="list-style-type: none"> <li>Method published by International Organization for Standardization, or USEPA or European Committee for Standardization or equivalent</li> </ul>

## **7.10** *RESIDUAL IMPACT ASSESSMENT CONCLUSIONS*

The assessments indicate that the air quality associated with the construction will be controlled to minor; no adverse air quality impact during construction phase will be anticipated provided all recommended air mitigation measures will be implemented.

<sup>1</sup> As outlined in the IFC EHS Guidelines for Thermal Power Plants (2008), the effectiveness of the ambient air quality monitoring program should be reviewed regularly. If compliance is shown from the monitoring in year 1 monitoring may be stopped in year 2.

The potential air quality impacts arising from the Project during the operational phase have been predicted to be small relative to the relevant WHO Ambient Air Quality Guidelines as recommended in the IFC Guidelines. The significance of impact during the operation phase of the Project is considered minor and the Project contribution is low. Therefore, no significant air quality impact during operational phase of the Project will be anticipated at the ASRs and in the vicinity of the Project site provided all embedded air mitigation measures will be implemented.