Existing IP- Autonagar Gajuwaka

New / Upcoming IP- Gudipalli

Baseline Documentation for Selected Industrial Parks in Andhra Pradesh – A Pilot Study

November, 2016

List of Contents

List of Figures

List of Tables

List of Abbreviations

APIIC	Andhra Pradesh Industrial Infrastructure Corporation Limited
CCA	Climate Change Adaptation
DRM	Disaster Risk Management
IALA	Industrial Area Local Authority
IMD	Indian Meteorological Department
IPs	Industrial Parks
IT	Information Technology
ITeS	Information technology enabled services
PCB	Pollution Control Board
SEZs	Special Economic Zones
SC	Scheduled Castes
ST	Scheduled Tribes
TSIIC	Telangana State Industrial Infrastructure Corporation Limited

Summary

Despite knowing that climate change is a risk which cannot be ignored for tomorrow, the action towards addressing the risk does not provide desired results. Some of the key factors of failure of a climate change adaptation are actions without holistic assessment of the risk, the nuances of the existing infrastructure, and piecemeal approach to adaptation. The present project “Climate Change Adaptation in Industrial Areas of Andhra Pradesh” has assessed the climate risks in shortlisted climate sensitive IPs. This baseline report explains existing conditions of selected pilot IPs i.e., IP-Gajuwaka as existing IP & IP-Gudipalli as upcoming IP so as to implement Adaptation planning measures to achieve the key objectives of the project

The findings of this report are summarised as:

- Describing a method for baseline documentation
- Applying baseline documentation to the project

The climate related profile of the IP would provide information about the past climatic trends, frequency of extreme events, and observed variability. This report provides findings and observations of the baseline study conducted at IP Gajuwaka. This includes observation during the site visit and inputs during the consultation with the Zonal & IALA officials. Most of the climatic observation are applicable to all part of industrial park.

This chapter also provides the findings of New / Upcoming IP Gudipalli which includes general observation of the current status of the IP and measures that need to be considered while planning measures in future process.

1.Introduction and Background of the Study

1.1 Background of the report

Climatic conditions are never static. Historically, the climate has been changing at natural pace. However, human activities have resulted in increasing the pace of these changes due to emission of greenhouse gases. The scientific community has predicted that if human intervention were to continue in the same shape and form the impacts will become harsher and more unbearable with time; magnitude of loss of infrastructure, human life, business could be several times larger and more unpredictable. In the wake of these changes, communities need to assess the risk, and their current ability to cope with climatic changes, small and large, and not just address disasters post-fact-to. Such a pro-active and structured approach will lead to more resilience and sustained growth.

To provide any solution to climate change, it is important to understand precisely the current infrastructure status, management procedures, maintenance systems, and manpower capabilities to understand the climate change impacts and address them. The baseline information collection will also result in identification of infrastructure gaps, documentation gaps etc.

INTEGRATION has been entrusted by GIZ the task of developing demonstration projects or pilot cases on climate change adaptation in the industrial parks in the state of Andhra Pradesh. The first step in this process was to select IPs to be further analysed, the second step was to establish the baseline documentation for subsequent elaboration of climate change adaptation plans and identification and implementation of climate change adaptation measures in the identified industrial parks.

INTEGRATION has commissioned Core CarbonX Solutions Pvt Ltd to identify one existing and one upcoming industrial park in the State of Andhra Pradesh and to undertake the baseline study for climate change adaptation planning.

The study involves below mentioned tasks:

- Main Task 1: Preliminary screening of climate risks in existing and upcoming industrial parks / SEZs in the States of Andhra Pradesh.
- Main Task 2: Rapid Climate Risk Analysis of selected and existing and upcoming industrial areas of Andhra Pradesh
- Main Task 3: Baseline study for two selected (1-existing & 1-upcoming) pilot industrial parks in both industrial parks in both states.

CoreCarbonX has already submitted the report under the Task1 and Task 2 Results of Task1are available in the report titled ‘Preliminary Risk Assessment of the Industrial Parks in Andhra Pradesh. Task 1 has resulted in selection of six existing and four upcoming parks based on the preliminary findings on climate exposure and impact data on the adaptive capacity status of the industrial park. Results of Task 2 are available in the report titled ‘Rapid Climate Risk Analysis of Industrial Parks - Experiences Made in Andhra Pradesh’. The completion of task 2 has resulted in selection of one existing IP-Autonagar Gajuwaka under APIIC – Visakhapatnam zone and one New IP-Gudipalli under Ananthapuram Zone for baseline documentation. The details of the selection process is mentioned in Annex I.

This report provides as-is-status of the above industrial parks with respect to the key vulnerabilities identified in Task 2.

This step 3 will provide detailed baseline status of the identified IP. The baseline report provides elaboration on the key baseline parameters needed for development of Climate Change Adaptation interventions. The objective of baseline documentation is to further understand and document the infrastructure and institutional framework in the IP that is already stressed and are likely to get further stressed on account of climatic changes. Adaptation measures, in the next step, will be identified for the infrastructure and institutional parameters identified as stressed.

The report is divided into three chapters:

- **Chapter 1: Introduction and background**
  This chapter provides a background of the climate change adaptation project, objectives and the key aspects of this report
  This chapter provides in brief an overview of the earlier steps in the project i.e. Preliminary screening and RCRA reports, current industrial park set up in Andhra Pradesh, climatic trends as found during the study are also briefed here.
- **Chapter 2: Baseline documentation methodology**
  This chapter explains in detail the procedure followed for collecting baseline information from the IP.
- **Chapter 3: Baseline observations and findings**
  This chapter describes baseline status of all the key parameters. The information presented in this section is based on survey and other secondary source of information and through any sample collection and primary data.

2.Baseline Documentation Methodology

2.1 Development of baseline

Creation of a baseline of existing assets and services becomes the starting point for climate risk analysis where multiple components are taken together and their interactions are studied. Therefore, to document the baseline, as the first step, an inventory of critical infrastructure in the industrial park was developed. Subsequently identification of hot spots of these assets and services to climate change impacts for climate resilient interventions was conducted. The figure below figure shows the broad approach that will be followed for this study.

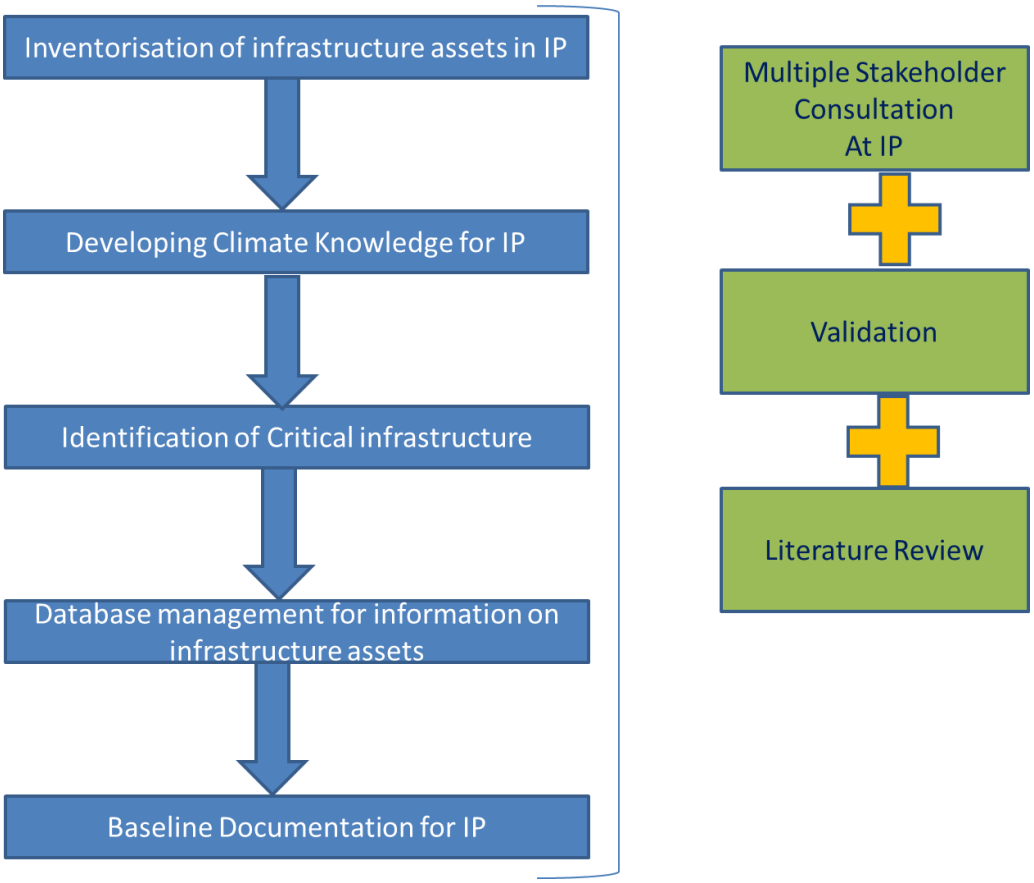

Figure 1: Methodology for baseline documentation

Inventorisation of infrastructure assets in IP

In Andhra Pradesh climate change does not yet figure as one of the primary considerations while planning of Industrial Park. Besides, even if the IP has an environmental goal outlined, it is often observed that it is not translated into the design elements of infrastructure and services for climate resilience. Thus, infrastructure inventories of IP are a starting point and the very basis for preparation of risk inventories for climate change. Infrastructure inventory provides the basis for understanding interdependencies of various sectors. The focus of the infrastructure inventory was collecting baseline information on infrastructure assets and

services at the IP level. The approach that will be followed has been illustrated in the below paragraph:

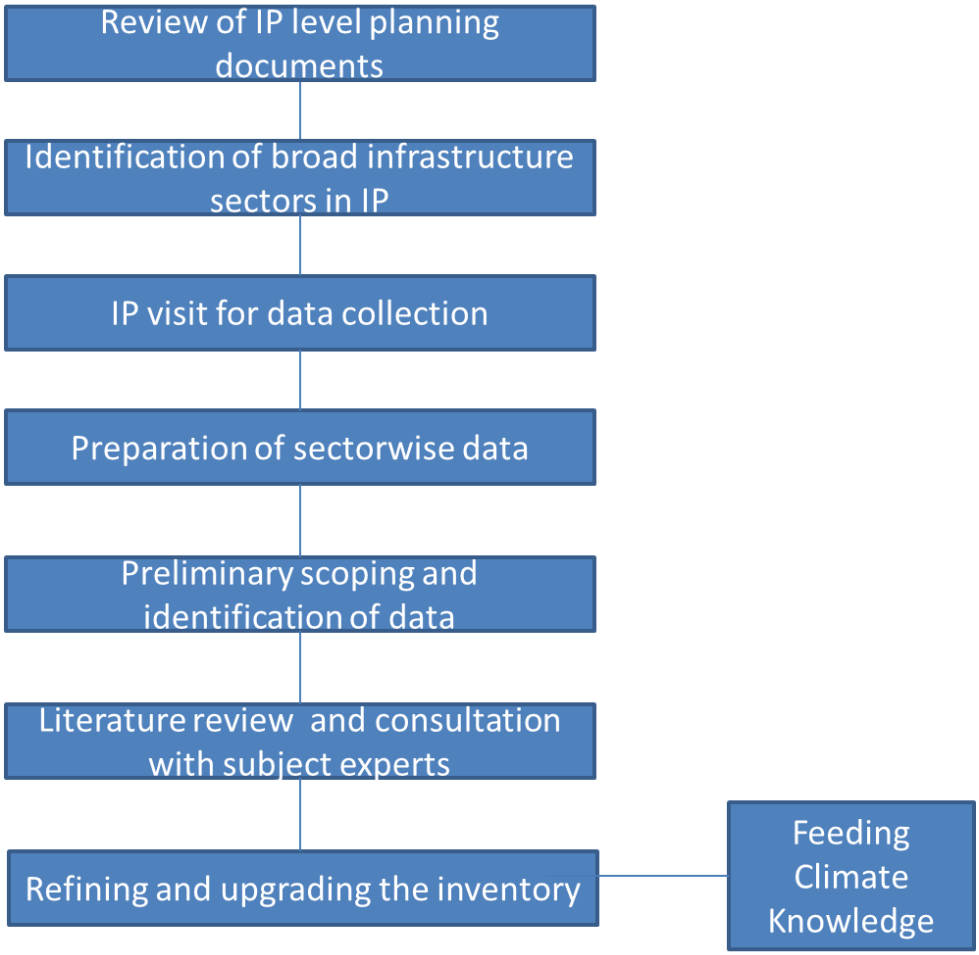

Figure 2: Approach for the Inventorisation

Developing Climate Knowledge of IP

The knowledge of climate, particularly in the context of IP like rainfall, storm surges, availability of water, flood etc., is an essential component of this study. This has already been evaluated for the selected IP at the earlier stage. The same information has been consolidated to make an assessment of impact of this climate hazard on IP.

Identification of Critical infrastructure

In the next step, the climate hotspots were spatially identified for the IP to identify areas that are likely to be affected. These include storm water drains, road networks, open areas/public spaces/parks, emergency response stations, etc.

2.2 Baseline Documentation of IP

This stage involves evaluation of the IP profile. The IP profile may be categorized as non-climatic and climatic.

The non-climatic profiling involves collecting information and understanding the following:

1. Socio–economic profiling—Industries and economic parameters.
2. Environmental profiling— Natural assets of the IP like nearby rivers, water bodies, green cover, waste treatment and disposal, etc.
3. Institutional profiling— this would involve an institutional analysis of IALAs and their functions.
4. Major functions/sectors— an assessment of the major function of the IP in terms of type of industries and size of industries.
5. Growth trends (Physical and demographic)—Growth trends of the IPs in terms of increase in number of industries. A detailed study of the land-use / master plan would be necessary to understand the growth trend.
6. Future projections for growth—Account the future expansion, demands and industry growth of the IP.

The climate related profile of the IP would provide information about the past climatic trends, frequency of extreme events, and observed variability. Some of the indicators with respect to key sectors and their respective guiding questions for baseline documentation are given in the below table1. The guiding question will also result in identification of areas under each indicator for documentation.

Table 1: Guiding questions for Baseline documentation

Indicators	Guiding Question
Socio Economic Profile	In which part of the IP the density of SMEs is more? What has been the extent of casualties/ impacts on Industries and workforce because of past climate-related events or hazards? The key sector within the IPs?
Eco system	Are there fragile stretches of land sensitive to any of the identified climate hazards? What are the key issues which have made the land sensitive? Has the expansion of built-up areas affected the ecosystem in terms of increasing its sensitivity? Has there been impact on the ecosystem of the IP due to extreme events or hazards?
Infrastructure and Basic services	Which part of the IP is critically affected by water availability? Whether energy systems (power and other infrastructure) are prone to climate change? Whether precipitation projections likely to surpass drainage capacity? Is the drainage of the IP efficient to handle extreme climate events such as heavy rainfall? Would hazards like floods hamper the basic services like drinking water supply/supply lines?

3.Baseline Oobservations and Findings

3.1 Baseline Status of Existing Industrial Park Gajuwaka

The selected existing pilot IP – Autonagar Gajuwaka is associated to the port city of Visakhapatnam lying on the east coast of India in the state of Andhra Pradesh. Easy access to Highway, seaways and railway paved way for development of major public sector industries around this IP like Vishakhapatnam Steel Plant(VSP), Hindustan Petroleum Corporation Ltd(HPCL)., Bharat Heavy Plates and Vessels, Hindustan Zinc Ltd., NTPC, 20 Coramandel Fertilizers etc. There are various sectors of industries like pharmaceuticals, sugar, cement industries including medium to small scale industries are existed in this area and more are to come up soon in the new planned blocks within IP especially in the pharmaceutical sector.

The information collected during earlier phases of the study also contributed towards development of baseline documentation.

IP visit was carried out by project team to IP Gajuwaka on 8th and 9st of June 2016. A focused group consultation was conducted at the IALA office of the IP on 8th of June 2016. The relevant stakeholders who consulted during the visit were:

- IALA Chairman, Gajuwaka IP
- Secretary, IALA, Gajuwaka IP
- Commissioner, IALA, Gajuwaka IP
- Members, IALA, Gajuwaka IP
- Zonal Manager, Gajuwaka, APIIC
- Zonal Environmental Engineer, Gajuwaka, APIIC
- Environmental Engineer, Corporate APIIC
- DE(Electrical) from APTRANSO-Gajuwaka

Table 2: The key findings of the baseline documentation are as follows:

Aspect	Observations
General profile	Gajuwaka is an area lying approximately 15 km to the south of Visakhapatnam City in the state of Andhra Pradesh, India. Since most of the heavy industries established in Visakhapatnam, like HPCL and Vizag Steel, lie in close proximity of Gajuwaka, its growth has mirrored that of Visakhapatnam. On November 21, 2005, the Gajuwaka Municipal Corporation was merged into the Greater Visakhapatnam Municipal Corporation (GVMC)
Climatic profile	The climate of the Gajuwaka is characterized by high humidity throughout the year with aggressive summer and pleasant winter. Gajuwaka has a temperate climate and owing to its proximity to the sea, the humidity is usually high in the atmosphere. The temperature is observed to fluctuate. The rise in temperature is higher during dry season than in the monsoon season. The temperature rises progressively from

	February to May and during the winter season it is less. The significant observation in the mean temperatures is the gradual increase in the temperature with the effect of industrialization and denudation of vegetation cover in many parts of city and surrounding areas.
Ground Water	The mode of ground water abstraction is mostly by means of dug wells or shallow bore wells and is used mostly for domestic purposes. The dug wells range in depth from 2 to 21 m, while the general depth being 8 to 10 m. The depth of bore wells 82 varies from 15 to 60m. The depth to water level ranges from 0.7 to 19.20 m. observed the records that the average seasonal water level fluctuation is of the order of 1.33 to 6.39 m. The long term water levels do not show any significant trend.
Open space	Overall open space in the IP is about 10%.
Water logging and storm water system	No major water logging areas were identified. However, due to open drainage system and disposal of garbage around the drains they get clogged with heavy silt, leaves, and other items and cause flooding during heavy rains. The cleaning of drainage channels takes place before monsoon and when the drainage gets clogged
Energy system	Almost all the companies depend on state electricity grid for supply of power. They do not generate on site power. Some of the companies have diesel generator sets as source of backup power. **Observed that Energy and telecommunication are the sensitive sectors of IP during heavy rains, cyclones and storm surges.**
Governance and management system	APIIC zonal office and IALA are responsible for management of the IP. The IALA and APIIC provide maintenance of roads, common lights and other infrastructure.
Water and waste water system	With the increased industrialization and urbanization during the last three decades there has been a lot of thrust on water resources in the urban area. Consequently there is a big gap between water supply and demand. During summer the situation becomes worse. The demand for water may further increase in future since the limits of city are expanding along with the increase in population. IALA has also requested to GVMC to provide 1.2 lakh litres of drinking water through pipeline to supply for Block-B & D of IP as a 1st phase No common waste water treatment system is present in IP.

The consultation was followed by reconnaissance survey on 8th and 9th of June 2016. Reconnaissance survey was carried out by team of experts from INTEGRATION and CoreCarbonX along with the assistance of IALA/APIIC field staff. During the survey team visited all phases of IP Gajuwaka i.e. Block-A, Block-B, Block-C, Block-D, and Expansion of Block-D, Block E-Apparel Export Park, and upcoming / proposed Block F and Block G within IP. Team visited and interacted with few industries, all the major water logging locations in the IP, interviewed few industries, visited and interviewed the relevant stakeholders.

Figure 3: IALA & Industry Consultations at IP Gajuwaka

3.1.2 Water Logging and floods

Hydrology of Gajuwaka is dominated by its topography and climate. The city receives on an average 1,260 mm of rainfall in a year. Out of which about 80% falls in monsoon period (June to October). Nearby areas to the city of Visakhapatnam show high rainfall variability (32% coefficient of variation and 380 mm of standard deviation).

Recently in last couple of years, some areas have experienced the localized water logging during rain due to drainage clogging. **Storm water drains are available in pockets in the blocks. However, these are mostly being used as sewage drain. These drains run along the length of the road and are open. Drains are present on both sides of the road but in some cases they run only along one side of the road. Rain water from the industrial premise flows into storm water drains, which discharge it into the Municipal sewers, and open nallahs. Some of the storm water flows into natural drains and existing ponds, open spaces outside the IP. The storm water drains are discontinuous at certain places.**

Due to rapid industrialization and urbanization the current infrastructure and housing is inadequate to meet the needs of ever-increasing population attracted by the ever-increasing industries. Apart from industrial toxins polluting the waters there is a huge inflow of untreated domestic waste and sewage

Figure 4 (a): existing open drains of IPs
Figure 4(b): Industrial & administrative waste dumped on road side

Rain water finds its way into the storm water drains. Whenever the design and maintenance of drainage system is inappropriate coupled with solid waste dumping into the drains have altered the drainage of the industrial park, causing water logging during monsoons.

Figure 5: Garbage Disposal impacts on Drainage System

Some of the common observations are as below:

- Municipal waste is found lying along the drain- as a part of the cleaning process or as a practice to dispose waste
- Though site visit was conducted during a dry weather several drains had blackish water flowing through them
- Shoulders of the road at several places are neither paved, nor covered with a green patch providing opportunity to the loose top soil to enter the drains. This increase the possibility of silt accumulation in the drains.
-

3.1.3 Non- Climatic Profile of Gajuwaka Industrial Park

The small town of Gajuwaka, 15 km away from Vizag city **located at a distance of ~ 7.5 km from Bay of Bengal coast** has emerged as the industrial growth engine of the state, topping the list of other such areas with the same potential across Andhra Pradesh. It falls within Visakhapatnam was one of the earliest municipalities in the State of Andhra Pradesh and was formed as early as in 1858. It was converted in to Municipal Corporation in 1979 and Greater Visakhapatnam Municipal Corporation (GVMC) came into existence on November 21, 2005 after the release of G.O by Govt of Andhra Pradesh. Greater Visakhapatnam Municipal Corporation is Urban Local Body which providing public services like Roads, Drains, Water Supply, UGD, Street Lighting, Sanitation Community developments etc.,

There are around 1,100 micro-, small- and medium-scale industrial units being run in various industrial clusters in Gajuwaka, which, put together, do a turnover of Rs 200 crore per annum. Around 20,000 workers directly and indirectly depend on these units in the district for their livelihood. Most of them are ancillary units of VSP and BHEL, plywood industries and freight and container yards[1].

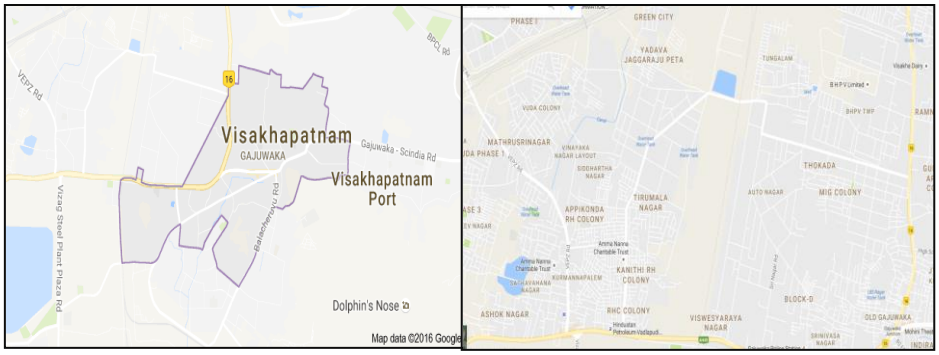

Figure 6: Location Map of Gajuwaka

3.2. Observed Climate Change impacts

IP Gajuwaka is divided into eight (8) blocks namely, **Block A, Block B, Block C, Block D, Block D(Expansion), Block E, Block F and Block G.** Block- F& G are the newly proposed blocks.

3.2.1 Storm water drains

3.2.1.1 Block-A: total extent is 122.07 and occupied with 20 no. of plots, facilitated with open drainage system. As these open Drains are not contiguous during rainy seasons this leading to floods within block and disturbing other blocks.

3.2.1.2 Block B: The total extent of Block-B is 156.43 acres and divided into 4-phases i.e., I, II, III & IV. 80% of the block area is facilitated with internal roads, storm water drains and proposed to construct more drains including widening of internal roads, shifting of Power poles/lines location as the tress that grow near power lines causing power outages and during storm

[1] http://www.deccanchronicle.com/business/in-other-news/270516/gajuwaka-s-gdp-highest-in-andhra-pradesh.html

Observed that all the drains in IP are open and several storm water drains were clogged with plastics and solid waste and **all these existing drains outlet connected into existing ponds in the IP located within IPs boundary, those got severely polluted,** during rains the overflow of drains and ponds causing inconvenience.

Figure 7: Images of existing open drains

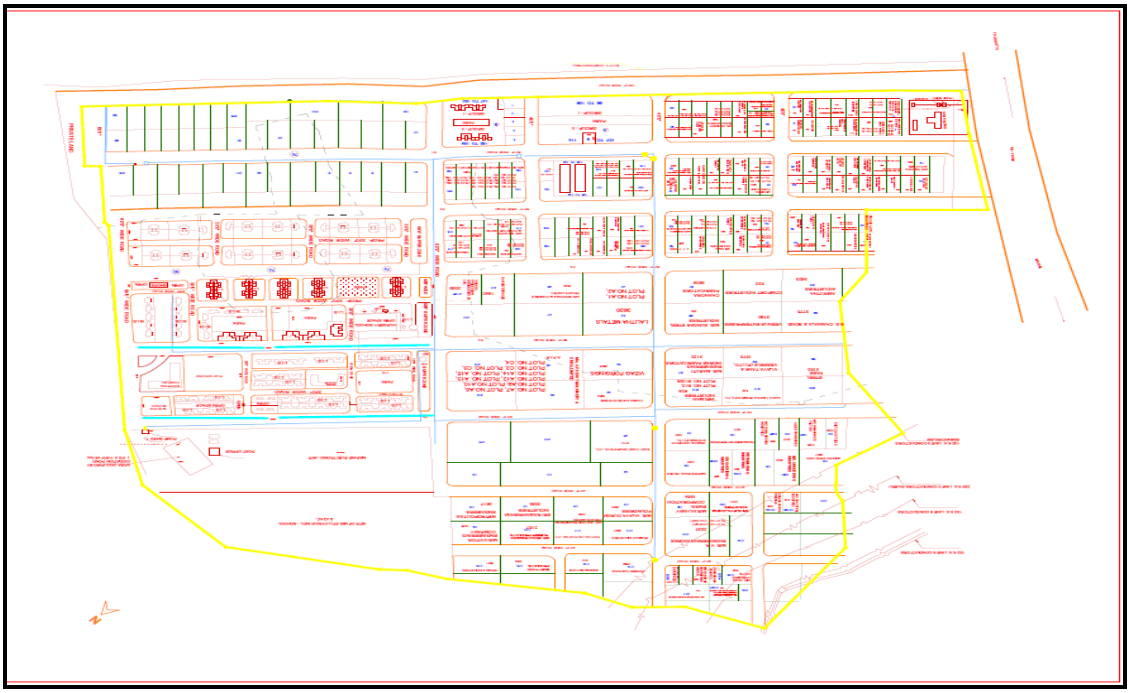

Figure 8: Layout of Block – B of IP-Gajuwaka

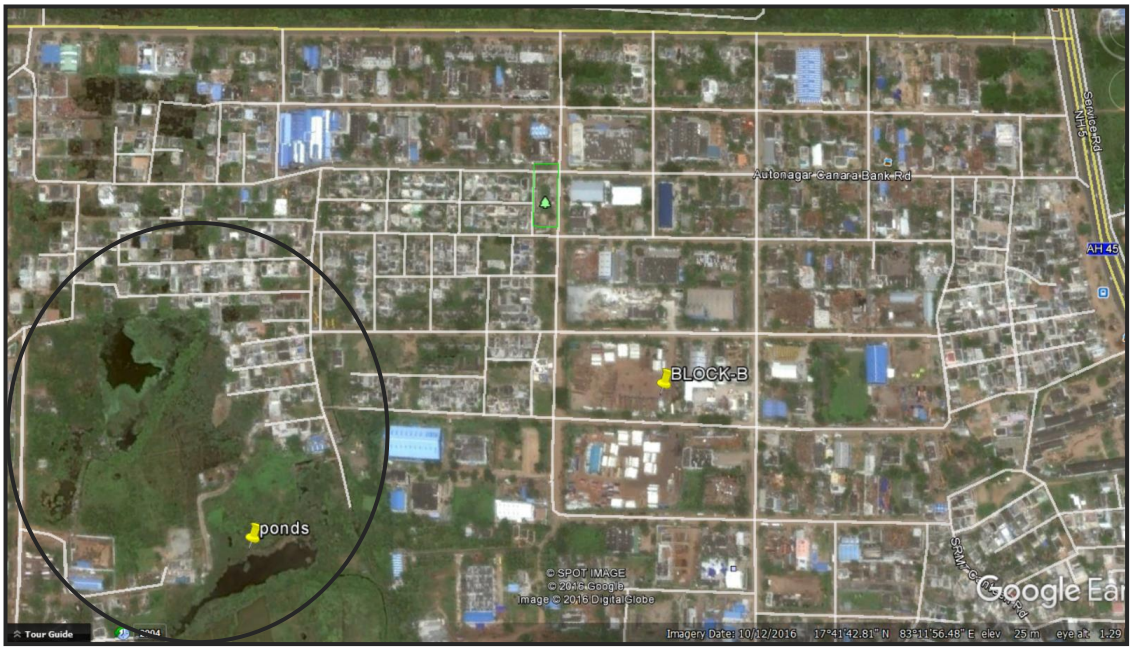

Figure 9: Google image of Block – B

3.2.1.3 Block-C: Total extend of block-C is 211.16 acres and out of which 17.86 acres to be acquired and at present occupied with 70 no.s of industries. Storm water drains are yet to be constructed in this block.

3.2.1.4 Block D: As showed above, two ponds are located in Block D and got polluted due to waste water/ drainage water coming from other blocks and residential areas of IP. APIIIC expanded Block-D in the area extent of 91.64 acres including open space area of 5 acres.

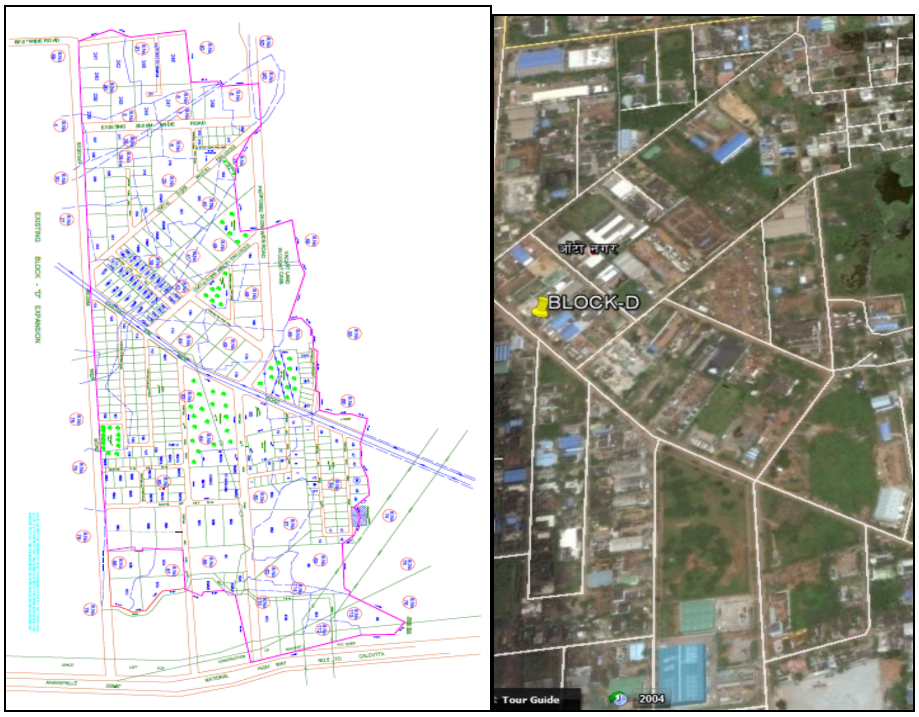

Figure 10: Layout and Google image of Blok-D

3.2.1.5 Block E: The total extent of are is about 140 acres out of which 24 acres of open space (17.5 %) is allocated to green belt / plantation as marked in the below map. This block is also facilitated with storm water drains but due to lack of waste management, many illegal dumps of industrial waste (packaging and administrative waste not process waste) is observed.

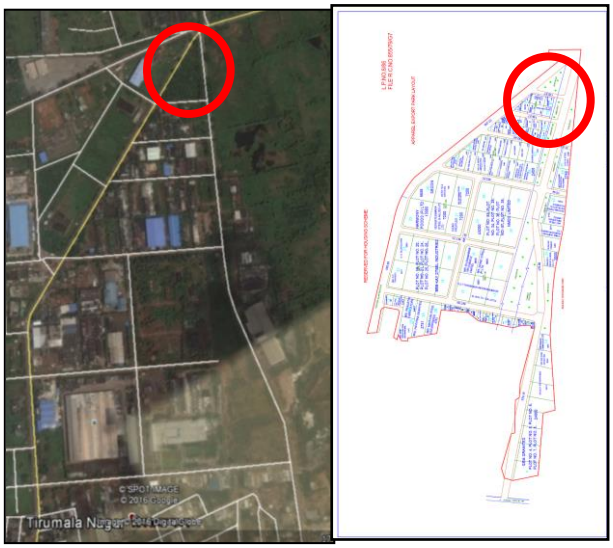

Figure 11: Google image and layout of Block-E

3.2.1.6 Block F

This is the proposed block by APIIC in area of 50.79 acres with the plotted area of 27.82, open space area of 3.25 acres. During visit observed that there is a solid waste dump yard located adjacent to open space. IP-Gajuwaka comes under municipal ZONE-V of GVMC, all the waste (heterogeneous and residential waste) generated within IP now collecting by GVMC.

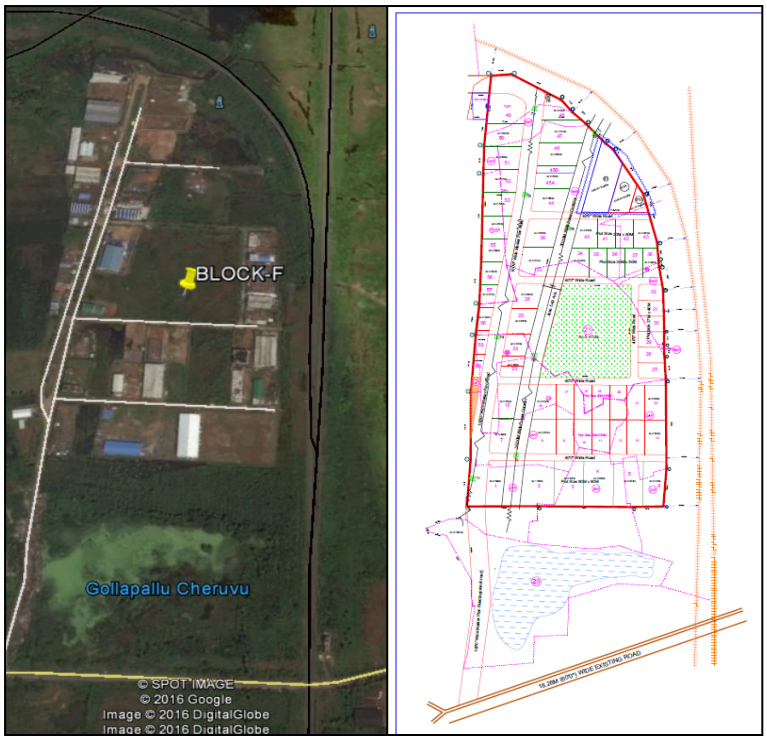

Figure 12: Google image and layout of Block-F

3.2.1.7 Block G:

APIIC proposed this Block G at Fakirtakya village, Gajuwaka Mandal with a plotted area of 57.48 acres and opened space / plantation area of 8.94 acres. The major Raiwada River canal is passing through the proposed block. Phase wise construction of open drains are proposed in this block and this proposal also may lead to clogging in future and canal also may pollute.

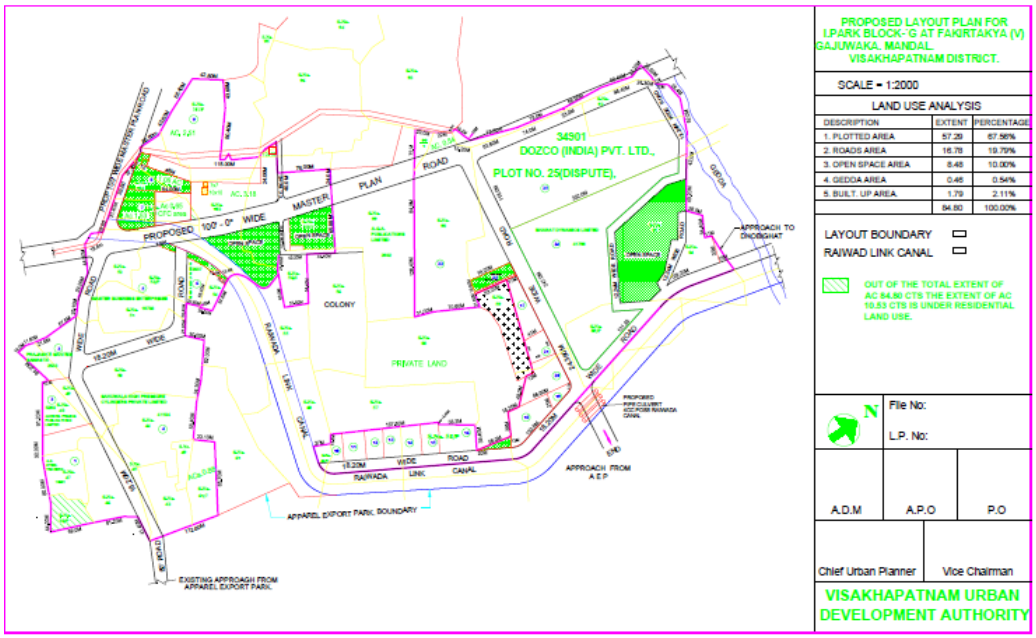

Figure13: Layout of proposed G-Block

3.2.2 Cyclones and storm surges

The Gajuwaka IP is particularly vulnerable to climate change induced extreme events like cyclones and storm surges. The year 2013 alone witnessed the two cyclones Phailin and Helen, causing damage to property and infrastructure assets besides damaging the coastal structures and morphology and in the year 2014 very severe cyclones Hudhud caused huge damage to city including industrial infrastructure, solar, and network/ communication sectors of IP.

The computation of cyclonic wind speeds, surge heights along the coast and associated inundation extent as well as flood depth with various extreme events is being defined in the report “Hazard Risk and Vulnerability Analysis for the City of Visakhapatnam, Andhra Pradesh”, July 2014. The wind speed of various categories of cyclonic disturbances, provided by India Meteorological Department (IMD), is given in table 3.

The tropical cyclones affect the IP region in two seasons during a year: Pre-monsoon (April-May) and post-monsoon (October-December). The peak frequency is found to be in the months of June and November. Between the years 1877 and 2015, 47 tropical disturbances passed within 150 km of Visakhapatnam City, an average of 1 cyclone in 10 years

Based on the historical data, the Visakhapatnam City including IP has witnessed several storms ranging from Tropical Depression (31 – 61 km/hr) to very strong storm (Very Severe Cyclonic Storm. Historical data reveals that seven VSCS struck the coast within the 100 km radius surrounding the Visakhapatnam city.

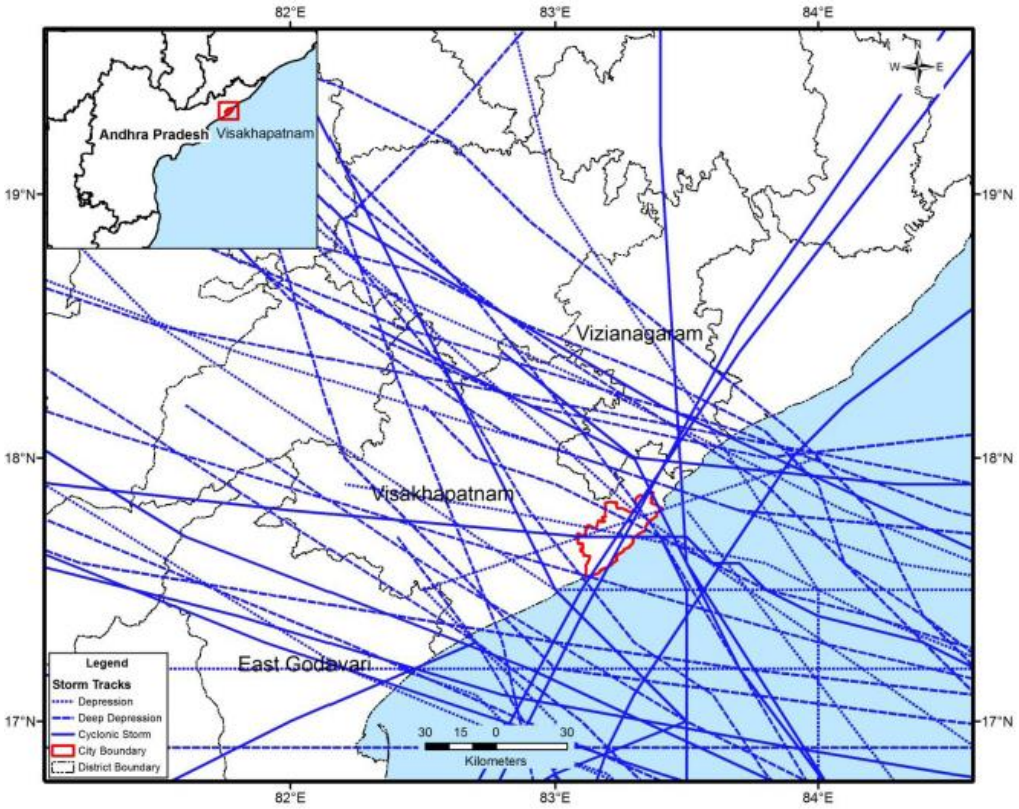

Figure.14: Historical storm tracks on the coast of Visakhapatnam city (1877 – 2013)
(Source: Hazard Risk and Vulnerability Analysis (HRVA) City of Visakhapatnam, Andhra Pradesh, July 2014, UNDP Publication)

3.2.3 Wind

As per IMD Guidelines, wind speed associated with tropical cyclones of 50-61 kmph may cause minor damage to loose and unsecured structures. Whereas, wind speeds associated with cyclonic storm (62- 87 kmph) or storms of higher categories, one can expect an extensive damage to thatched roofs and huts, minor damage to power and communication lines due to uprooting of large avenue trees, etc. Hence, in the higher return period (> 5 Years) under most severe scenario, wind magnitude and extent start increasing and cover many areas of the city. The below wind hazard maps show the wind extent and wind magnitude for various return periods. These return periods are 5, 10, 25, 50 and 100 years. The highest return period indicates the worst case of wind hazard. The criteria followed by the Indian Meteorological Department to classify the low pressure systems in the Bay of Bengal and Arabian Sea as adopted from the World Meteorological Organization as given in below table no 3.

Table 3. Wind speed categories

S.No.	Category	Wind speed in Km/h
1	Super Cyclonic Strom	≥ 222
2	Very Severe Cyclonic Storm	119 to 221
3	Severe Cyclonic Storm	89 to 118
4	Cyclonic Storm	62 to 88
5	Deep Depression	50 to 61
6	Depression	31 to 49
	Low Pressure Area	< 31

Figure 15: industries damged due to severe cyclone –Hudhud

During the Hudhud cyclone, most of the industry roofs of various industries has been blown away under the impact of gusty winds lashed the coast at a speed reaching up to 210 km per hour and damaged electrical and communication system. The major losses for sectors like pharmaceutical industries, MSMEs, IT industries and other major industries like power, drugs, steel, etc

Figure 16: Interacting with industry workers who experienaced recent Hudhud

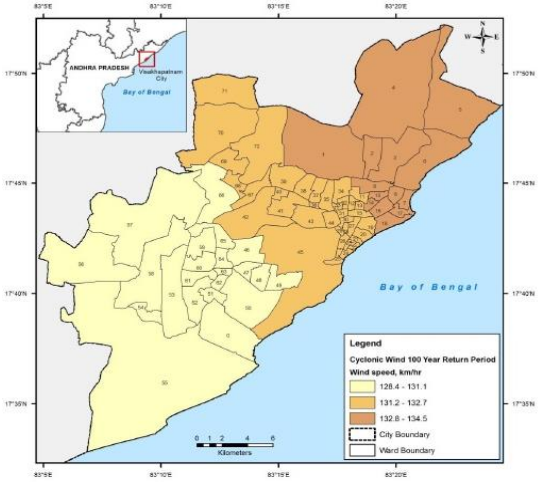

Figure 17 (a): Cyclone hazard map for 100-year return period for Gajuwaka
Figure 17 (b): Damaged electric pole after Hudhud Cyclone on NH-16(5)at Gajuwaka.

3.2.4 Storm Surge Flood

Damage from tropical cyclones is caused not only by their strong winds but also by accompanying storm surges and torrential rains. The severity of the storm surge at any location of interest is a consequence not only of the strength of the storm but also of the complex interaction of the storm's track, pressure and wind fields with the bathymetry (water depth offshore) near the coast. As the surge heights are generated above the mean sea level, the flood depths associated are deduced by subtracting local topographic heights from the surge heights. The storm surge hazard maps figure 9 and 10 show the inundation extent and flood water depth for key return periods. In descriptive terms, highest probable storm surge heights indicate the worst case of surge heights. Each of the storm surge hazard maps contains ward boundaries, district boundary, river, surge flooding extent and depths. Ward boundaries have been labelled with ward numbers.

Storm surge flood depths are shown in blue color ramp with dark blue indicating higher flood depth and light blue indicating lower flood depths. From the below maps, it can be seen that inland inundation extents are limited to areas near coast. It is observed that during both the events surge penetrate into the river inside up to distance of about 1.7 km and 2 km for 5 return period event and 100 year return period respectively.

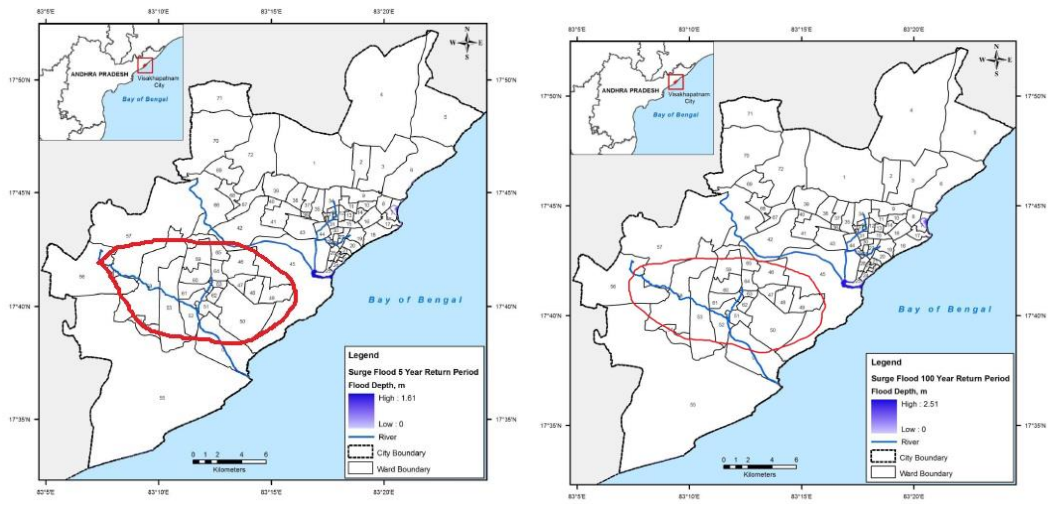

Figure 18(a): Storm surge flood hazard map for 5-year & 100 year return period for Gajuwaka

Figure 18(b) : Storm surge flood hazard map for 100-year return period for Gajuwaka (Source: Hazard Risk and Vulnerability Analysis (HRVA) City of Visakhapatnam, Andhra Pradesh, July 2014, UNDP Publication)

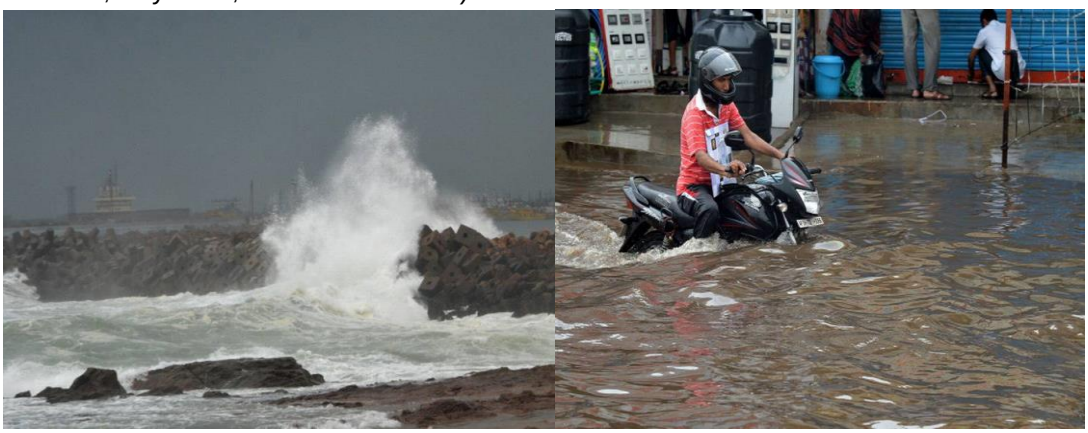

Figure 18(b): High tides & flooded water on the highways of Gajuwaka IP, during cyclonic"Roanu March 19, 20, 2016

3.2.5 High Temperature / heat waves

In the region, the annual mean surface air temperature has risen during the past two centuries. However, the rate of increasing trend has sharply increased in the last few decades of the 20th century, which could be attributed to global climate change due to anthropogenic forcing. Further analysis of data also suggests that the rate of increase in temperature is found to peak in May and June months of the year. It has been observed that severe heat stress condition has continued to prevail in the region since the beginning of this century.

This heat wave /stress condition with humidity in the region have a wider impact on number of sun stroke during the summer. Many of the industries located in the industrial park does not have boilers. Thus, hotspots associated with boiler usage during summer are negligible and

Figure 19: Avenue & Block Plantation at IP-Gajuwaka

3.2.6 Energy System

It is a general practice in the IP to procure power through state electricity board instead of generating power onsite. APIIC or IALA does not operate any common power or steam generating facility for common offices in IP, lighting or any other purpose. During power interruptions by the supplier, most of the medium and large scale industries operate on diesel generators located in their premise. Amongst all types of renewable sources of power, roof top solar based power generating systems and small wind power based power generation cab be one of the option for industries.

The cyclone Hudhud, which made the study area plunge into darkness for almost a week due to heavy downpour accompanied by winds gushing at a speed of 200-220kmph on October 12, 2014 severely pounded the power distribution mechanism in the coastal areas which ripped out 4800 transformers and uprooted about 56,000 poles including the study area.

During interaction meeting with IALA & DE (Electrical) from Gajuwaka IP area, suggested IALA officials to go for underground electrical and network cabling within IP / upgrade the transmission and distribution system by replacing the existing iron/ cement concrete poles with fibreglass poles which are virtually maintenance free, because they are resistant to salt-water corrosion, acids, acids, rotting, fire, temperature changes, insects & birds and its life expectancy of 80 to 100 years but the cost of the pillar is 1/3rd more on existed one..

3.2.7 Governance and Management System

IALA has the responsibility of managing the IP along with APIIC. The IALA allocates about 20% of it's funds for environment related activity. However, no separate funds are allocated towards climate change and disaster management activities. Although the industries in the IPS are facing natural disaster the mechanism of early warning system, capacity development of industries professional to understand and dress climate change is missing

3.2.8 Water supply and wastewater management

Water Supply

The industries in the IP are mostly dependent on ground water. IALA has also requested to GVMC to provide 1.2 lakh litres of drinking water through pipeline to supply for Block-B & D of IP as a 1st phase. (Relevant construction works like, Tank, laying pipeline to industries etc., are completed)

Wastewater

Many of the industries located in the IP does not produce waste water from their operations. Thus, data on the same is not available.

3.2.9 Snap Shop of Climatic Profile of Gajuwaka Industrial Park

IP Gajuwaka's climatic profile is similar to that of Vishakhapatnam. It is experiencing changes in climatic pattern. The rainfall and temperature pattern have been altered. The minimum and maximum temperature during the seasons has changed. The temperature during summers has increased and the duration of summers has increased. The number of days with heat waves has risen in the last decade.

Cyclone is another climatic phenomenon which is an indicator of increasing frequency of natural disasters. Thus, industries and its resources are exposed to cyclone.

Heavy rainfall is a climatic event which has impacted and is likely to have even more severe impacts on the IP. **The IP has experienced shorter but more intense rainfall in last decade. It is predicted that such variations will only increase. These incidents have increased incidents of localized water logging in the IP.**

Thunderstorm and flash of lightening incidents appears to have increased in the region but there is no documentation on significant negative impact of these events either within the IP. Hence, thunderstorm and stroke of lightening are considered to be inconsequential. A snapshot of the climatic profile of IP Gajuwaka is provided below:

Table 4: Snap Shop of Climatic Profile of Gajuwaka Industrial Park

Heat waves		Cyclone		Heavy rainfall including flood, landslide and other events	
Whether there are instances of heat waves in the region	Yes	Whether there are instances of cyclones in the region during the past years	Yes	Whether there are instances of flood, landslide and other events during the past years in and around the IP?	Yes
If yes how do you rate the instances of heat wave?	High	If yes, how do you rate the intensity of cyclone?	High	If yes what type of event was observed?	Localised flood due to heavy rain
Whether the duration of experienced heat waves has increased during the past years?	Yes	Whether the duration of cyclone has increased during the past years?	Yes	If yes, how do you rate the strength/intensity of these events?	low
If yes, how do you rate the increase in duration of heat wave?	high	If yes, how do you rate the increase in frequency of cyclone?	high	Have you experienced increase in duration of these events in the past years? If yes, how do you rate it?	low
Whether the frequency of heat waves has increased during the past years?	Yes	Whether the frequency of cyclone has increased during the past years?	Yes	Whether there are increase instances/frequency of flood and rainfall related events?	No
How do you rate the increase in frequency of heat wave?	high	If yes, how do you rate the increase in frequency of cyclone?	High	If yes, how do you rate the increase in frequency?	No

3.3 Baseline Status of New Industrial Park – Gudipalli

The selected pilot new IP-Gudipalli is an upcoming IP located in Ananthpur Zone /district. IP terrain is mostly undulated and hilly and adjacent to NH-7 on Bangalore – Hyderabad Express way. IP is spread across 1111 Acres, under which 570 Acres will be with APIIC and 25 Acres is un-developed land. Rest of the area has been allotted to private developers (e.g. Eureka Forbes) and its management will be done by them. Around 300 Acres will be going to develop as electronic manufacturing cluster, where small to medium electronic manufacturing unit will be established.

IP Gudipali is at severely drought affected area. Ground water table is around 300-400 feet and only source of water. Nearest river is around 30km away from the IP. APIIC has planned to set up a power sub-station inside the IP for industries power requirement.

Figure 20: Layout and images of IP Gudipalli

Table 5: Profile of new IP-Gudipalli

Extent in Acreage	1111.09 Acres (Gudipalli lands)
Dimensions – Frontage	3428.00 Mtrs
Hi-Tension Electricity Towers at Site	No Hi-Tension Electricity Towers in site
Soil Test Report – Suitability for Construction	Soil test not conducted
Ground Water Estimation – Water Report	300-400 Feets Depth
Additional Acquisition of Land to ensure the ideal site shape – extent possible / not possible / if possible – time line	737 Acres opposite to this site acquisition is under process, 6 months to one(1) year
Nature of Land – Government / Agriculture - Dry Land - Waste Land	Dry Land (Patta)
Adjoining Additional Land Acquisition - extent possible /not possible / if possible – time line	800 Acres in Sy.No.64 of Gudipalli, towards West side, Hill/Konda
Land Contour - Rough Estimate of elevation / undulation - site levelling timelines & expenses	
Utilities to Site Information	
Water Pipeline Routing & Details	No water pipe line near by the Site
Water Reservoir & Water Pump-House Storage etc,. - Details	Gollapalli Reservoir is under construction at a distance of 20 KMs nearer to Highway
Substation Location & Connecting Grid Details – for 2 Sub-Stations - Timelines & Details	220 KV substation at Sevamandir near Hindupur connecting from Chennai Southren Grid. 1.Penukonda, 2.Somandepalli, 3. Gorantla (Gummaiahgaripalli)
Temporary Electricity Supply Details / Time Line – Construction Requirements	33/11 KV Sub Stations, Penukonda, Somandepalli & Gorantla
Temporary Water Supply Details / Time Line – Construction Requirements	Ground Water
Telecommunication Details	Penukonda Telephone exchange
Gas Supply to Site	--
Nearest Rail Head – Materials Logistics Inward & Outward	Penukonda
Truck Parking Terminal – Temporary & Permanent	--
Fire Protection Services	Penukonda fire Station

Public Transport Services – From Site to Nearest Town / State Border	Bus & Auto's
Temporary Training Facility	ITI's (Three Nos.) at Hindupur
Solid-Waste Dump Site	Proposed land
Temporary Project Office	Somandepalli
Railway Siding connectivity to site possibility	Rangepalli Railway Station near Somandepalli
Generic Information Required	
Distance from Site to	
Bangalore Airport	106 KMs
AP Border	25 KMs
Rail Head / Station	Penukonda 14.5 KMs & Hindupur 33 KMS
Sea Port	330KMs (Krishnapatnam Port,Nellore,AP)
International / Domestic Airports & Helipad	106 KMs (Bangalore)
Nearest Substation	Somandepalli
Pipeline Pump Head	--
Water Source Reservoir	Palasamudramu Tank
Dump Site	proposed site
RTO Office	Hindupur
District Collector Office	82 KMs
Temporary Project Office	Somandepalli
Police Station	Somandepalli
To Delhi – NCR Region	2011 KMs
To Hyderabad	440 KMs
To Punjab - Chandigarh	2321 KMs
To Tamil Nadu – Chennai	379 KMs
To Kerala	882 KMs

Weather Report – Annual – 50 years Return	Temperature: 26°C to 45°C Wind : 30 to 60 Km/hr Avg.Rainfall : 46.9mm (2015-16)
Site Photographs – Aerial / Ground Level	
Adjoining Industries in 15kms radius - No Pollute Zone (Compatible Industries)	Land allotted to BEL, NACEN & Air Bus
Socio-Administrative Information + Unskilled & Skilled Labour in vicinity	Sufficient technical and non-technical labour is available in surrounding villages and towns
Political Information - Site Area - 5yr return	The proposed land situated within the jurisdiction of Penukonda Assembly constancy and Hindupur Parliamentary constancy.

A five people team from Integration and CCX has visited IP on 16th June 2016. A consultation with APIIC official were also conducted on 16th June 2016 at APIIC Zonal office. The meeting was attended by several representatives of APIIC i.e. CEO and other APIIC officials.

The stakeholders explained the process of development of new industrial parks. An overview of the processes is presented below:

3.3.1 Based on industrial demand land is identified and finalized by APIIC

If the land available in existing land bank of APIIC is not sufficient or not suitable, new or additional land is identified for this purpose. Following this, a site analysis report may or may not be taken up at this stage which is based on reconnaissance survey and secondary information. Objective of the report is to analyse the availability of important infrastructure like road and rail connectivity, water availability, power line etc.

3.3.2 Land pricing

Asset management division has the primary responsibility of ascertaining the right market price of land. It undertakes this task parallel to the process of technical DPR preparation. Land pricing report is taken up either internally or through external consultants.

3.3.3 Development of Master plan

Detailed project report (DPR) is required to be prepared to assess the technical viability of the project. It also provides a layout for the project. This is usually done by engaging a third party consultant. Civil Engineering departments lead the DPR development process.

3.3.4 Project clearances

Apart from internal approval by managing director of APIIC, several other clearances are required for the project. The above documents are required for the approval process. Environmental clearance may be needed for some of the IPs. Environmental impact assessment (EIA) report is prepared wherever an EC is required. This report is usually developed through EIA consultants.

3.3.5 Implementation of new IP

After completion of all approvals including approval of master plan for the IP, the sale of plots is initiated. Simultaneously, infrastructure development process gets initiated.

The roles and responsibilities of different departments of APIIC and the government departments responsible for approval of new industrial parks are provided in Annexure II.

3.3.6 Conclusion

Based on the stakeholder consultation process, it is concluded that climate change is not one of the criterions explicitly mentioned in the current process of planning and development of IPs. However, the planning of new IP's does take into consideration some of the measures like storm water management, early warning system, cyclone resilient infrastructure and wastewater treatment, which are a part of CCA. It appears that CCA activities are not being undertaken explicitly and in a structured manner.

It is concluded that new industrial parks need a two-level approach to climate change adaptation:

1. Baseline study for one of the identified industrial parks
2. Framework document to assess the challenges, possibility and opportunities by introducing these options in the planning and implementation stage of all industrial parks in a structured manner to have measurable results

All the new industrial parks identified for the study are exposed to similar climatic hazards. IP Gudipalli is expected to be a world class industrial park. It is currently in the initial planning stage which is the ideal time for development of baseline documentation on CCA, identification of adaptation measures and also implementation of the same.

Based on the information so far, CCA aspects can be introduced during site analysis, DPR preparation and master layout planning, environmental clearance, and construction of the IP. This would be studied further in the next step of the study to provide interventions and intervention plan.

Annexure A

1.1 Results and overview of Preliminary Screening of IPs

The state of Andhra Pradesh has over 40 Industrial Parks (IPs) established throughout the State. Several new industrial parks are also under different stages of planning. Andhra Pradesh State Industrial Infrastructure Corporation Limited (APIIC), an undertaking of Government of Andhra Pradesh State, is a premier organization in the state, vested with the objective of providing Industrial infrastructure through the development of Industrial Parks and Special Economic Zones. To develop and manage the industrial parks APIIC has divided these IPs into Ten industrial zones namely Anantapur, Kurnool, Kadapa, Tirupati, Nellore, Prakasam, Vijayawada, Visakhapatnam(R), Visakhapatnam(TS). Most of these industrial zones are in the periphery of Hyderabad. Details of industrial sectors present and proposed in each of the industrial zone are presented in the table below:

Table 6: Zone-wise distribution of industrial sectors

Industrial Zones	Existing industrial sectors	Proposed industrial sectors[2]
Kurnool/ Ananthpur	Automotive based Industries, General Engineering, Steel Re rolling, Aerospace, Solar Equipment, Electronic Hardware	Pharma, food processing, Solar power
Kakinada	General, Port based, Edible Oils, Petroleum storage	Pharma, power, cement, textiles, Port based
Vijayawada	Automotive based industries, Textile, Cargo, Edible Oils	Chemicals, engineering, and automobiles
Kadapa	Automotive, Stone crushing, Electronic Hardware	food processing, textiles, consumer products
Visakhapatnam & Visakhapatnam (Spl Project)	IT & ITeS, Pharmaceuticals, Vaccines	Pharma, Bulk drugs, power, Cement, Paint and Fabrication
Tirupati	Automotive, Stone crushing, Electronic Hardware	Automotive
Nellore	Automotive, Edible oil, General Engineering	General Engineering, Fabrication

The Task 1 and Task 2, has resulted in a two-step preliminary screening methodological tool for screening of IP based on their climatic exposure, climatic impact and capability to adapt. The field-based preliminary screening methodology was tested and applied to 100 upcoming IPs in the state, spread across all zones. To reduce the effort for the field-based preliminary screening before preliminary screening, a desk based first screening (first step) was performed to arrive at IPs which are significant for the CCA project in size and the allotment of industrial plots to industries. The field step of the preliminary screening methodology was conducted through one to one interview process with the stakeholders by means of a structured preliminary questionnaire. Zonal manager and officers at zonal office were the key stakeholders identified for this survey. Information of Climatic changes and weather pattern data were also recorded from the revenue department and IMD. The field level information was corroborated with secondary data available with these departments. For the upcoming

[2] Conceptual plan for district development, Pg 117, Socio Economic Outlook 2015

IPs/new IPs, no climatic impact history and capability information were available through the one to one interview. Hence, the new IPs were assessed based on data from secondary sources on climatic exposure, accompanied with the inputs from corporate office of APIIC on planning process of IPs. Existing IPs were scored under each section i.e. climatic exposure, climatic impact and capability. Finally, geometric mean of each IP was arrived at and used for ranking the IPs. The IPs finally chosen for climate rapid risk analysis are presented in the table below.

Table 7: List of IPs selected for rapid climate risk analysis study

Sr. No.	Name of IP	Industrial Zone	Preliminary Screening Score	Name of IP	Industrial Zone
	Existing IP			**New IP**	
1	IP Kurnool	Kurnool	0.894	APSEZ Atchuthapuram	Visakhapatnam
2	Vakalpudi (Phase III)Kakinada	Kakinada	0.872	Naidupeta IP & MPSEZ	Nellore
3	Growth Centre Bobilli	Vishakhapatnam	0.716	MIP Kopparthy	kadapa
4	Growth Centre Ongole	Ongole	0.709	IP Gollapuram	Ananthapuram
5	Autonagar, Gajuwaka	Visakhapatnam		OMIH Kurnool	Kurnool
6	IP Gajulamandyam	Tirupati	0.612		
7	Ramnepeta, (Phase II) Kakinada	Kakinada			

1.2 Results and overview of Rapid Risk Analysis of IPs

The step of rapid risk analysis in this projects aims at:

- Describing a replicable approach for a rapid climate risk assessment methodology for industrial parks in India;
- Applying the approach to the state of Andhra Pradesh

Rapid climate risk assessment approach

The climate risk assessment approach depicted in this study is based on a 7-step process as shown in the figure on the right:

Step 1: Identify relevant *climatic hazards* in the area
Step 2: Determine temporal and spatial *exposure* of the IP to these hazards
Step 3: Determine *susceptibility and fragility* of the IPs
Step 4: Combine exposure and susceptibility to expected *impact*
Step 5: Determine *resilience* of the IP
Step 6: Combine impact and resilience to derive *vulnerability* of the IP
Step 7: *Risk* analysis

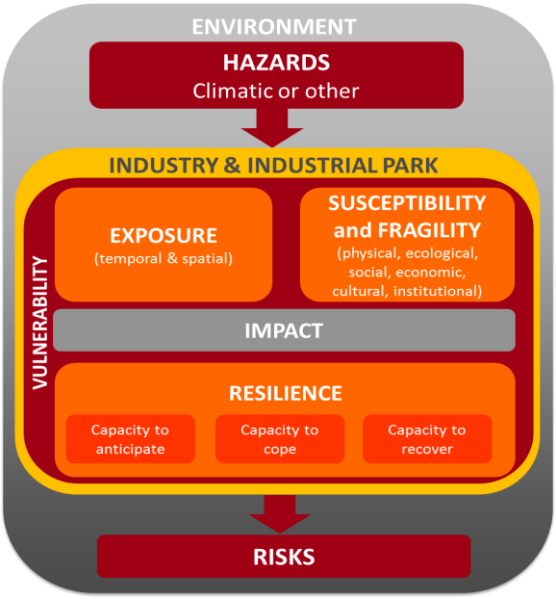

Figure 21: Process of Climate Risk Analysis

Andhra Pradesh case study

Chapter 3 of this report provides findings of the application of the rapid risk assessment approach in industrial parks in Andhra Pradesh. Seven IPs were selected through a preliminary screening process (as described in–please refer to the report) and have been analysed in more detail through the Rapid Climate Risk Analysis Methodology described in (please refer to the respective report).

IP Gajuwaka spans in an area of about 894 acres. It is divided into eight Blocks namely, Block A, Block B, Block C, Block D, Extension Of Block D, Block E, Block F, Block G and Apparel Block. and separated from other Blocks by the National Highway main road that passes between them.

The information collected during earlier blocks of the study has also contributed towards development of baseline documentation.

Table 8: The IPs for which a rapid climate risk analysis was carried out in Andhra Pradesh

Sr No	Existing IPs	Zone	New IP	Zone
1	Growth Centre Bobbili	Vishakhapatnam	APSEZ Atchuthapuram	Visakhapatnam
2	Autonagar Gajuwaka	Vishakhapatnam	Naidupeta IP & MPSEZ	Nellore
3	IP Gajulamandyam	Chittoor	MIP Kopparthy	Kadapa
4	IP Kurnool	Kurnool	IP Gollapuram	Ananthapuram
5	Vakalpudi (Phase III) kakinada	Kakinada	OMIH Kurnool	Kurnool
6	Growth Centre Ongole	Ongole		
7	Ramnepeta, (Phase II) Kakinada	Kakinada		

Focus Group stakeholder consultations with industrialists, IALAs, APIIC zonal officers were conducted between 20th of January 2016 and 1st of February, 2016. The stakeholder consultations were guided by a climate risk adaptation questionnaire designed for the study.

Key findings related to each element of the risk assessment approach for existing IPs in Andhra Pradesh are summarised in below table:

Table 9: key findings of each climate element

Element	Key findings
Exposure	Cyclone: The coast line of AP is impacted by cyclone. The intensity and frequency of cyclones has increased in last few decades. The IPs at coast are directly impacted by cyclone and those at a distance are indirectly impacted due to cyclone exposure. Autonagar Gajuwaka and Growth Centre Bobbili are the worst impacted. Droughts: the frequency of drought incidents has increased; drought causes reduction in ground water level and several other water quality and availability issues. Drought issues impact IP Gajulamandyam, Growth centre Bobbili and IP Kurnool to a high degree. Heat waves: heat wave situations have become worse in last decade; IP Kurnool is facing severe heat conditions. Heat waves can potentially worsen drought conditions and may result in fatigue and heat stroke of employees. Salinization, lighting and thunderstorms not perceived as relevant or no changes experienced by the IPs. Growth Centre Bobilli has the highest exposure to climatic hazards followed by IP Gajulamandyam.
Susceptibility	Waste water management system was found to be the most susceptible parameter consistently across all IPs except IP Kurnool. IPs road infrastructure, storm water management system, and production were found to be next climatically most susceptible areas among the main 9 climatic susceptibility measures studied. Autongar Gajuwaka has highest susceptibility (High plus medium) i.e. 9 out of nine parameters are under high and medium susceptibility. Age, design and type of industries are influencing this ranking.
Resilience	Growth centre Ongole has lowest resilience and Growth Centre Bobbili has highest resilience. In general the resilience of governance system and supply structure was found to be low.

The scoring and subsequent ranking of IPs has resulted in prioritising IP Autonagar **as the most vulnerable existing IP**. It is proposed that the baseline documentation will be conducted for IP Autonagar, Gajuwaka.

Table 10: Climatic Vulnerability Ranking of IPs based on the risk assessment tool

Order Based on exposure	Susceptibility Score			Impact ranking	Resilience Score			Vulnerability Ranking
Growth Centre Bobbili	**1**	4	4	**2**	**1**	3	2	**2**
Autonagar Gajuwaka	**0**	4	5	**1**	**1**	3	2	**1**
IP Gajulamandyam	**1**	4	4	**3**	**0**	3	3	**6**
IP Kurnool	**6**	2	1	**7**	**1**	1	4	**7**
Vakalpudi (Phase III) Kakinada	**5**	2	2	**4**	**1**	0	5	**3**
Growth Centre Ongole	**4**	4	1	**6**	**0**	1	5	**4**
Ramnepeta, (Phase II) Kakinada	**5**	3	1	**5**	**1**	1	4	**5**

In case of upcoming IPs, the methodology focuses on three reinforcing pillars that collectively contribute to the understanding of IPs risk: a hazard impact assessment, an institutional assessment, and a socioeconomic assessment. All the new industrial parks identified for the study are exposed to similar climatic hazards.

A participatory stakeholder consultation was conducted with the APIIC team and concluded that all the new industrial parks are exposed to similar climatic hazards. It was also concluded that **IP-Gudipalli, Ananthapuram zone will be considered for the next level of baseline assessment**. It is also currently in the layout preparation stage which is the ideal time for development of baseline documentation on CCA, identification of adaptation measures and also implementation of the same.

This project, assisted by the German Government, is being carried out by a consortium consisting of 'INTEGRATION Environment & Energy GmbH, adelphi consult GmbH and ifanos concept & planning' on behalf of the Deutsche Gesellschaftfür Internationale Zusammenarbeit (GIZ) GmbH.

Published by

INTEGRATION Environment & Energy
Climate Change Adaptation Project (CCA),
1st Floor, Parisrama Bhavan
Fateh Maidan Rd, Basheerabagh, Hyderabad – 04, Telangana, India
www.integration.org
Tel. +91 (0)40 66184019, Fax. +91 (0)40 23233677
Responsible
Dieter Brulez, Director, CCA
Prepared by

Core CarbonX Sols Pvt Ltd
Hyderabad-500082, Telangana, India
Tel:+91-4023410367
www.corecarbonx.com
Authors:
Shaily Maloo
Niroj Mohanty

The Report was developed by the Core CarbonX Solutions Private Limited on behalf of INTEGRATION CCA-Project team has participated in the researching, compiling, editing and reviewing of this report. The accuracy of the data included cannot be guaranteed.